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Frank Muller

J. Andrew Hoerner

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FRANK MULLER*
J. ANDREW HOERNER**

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* Mr. Muller is Director of Policy Research at the Center for Global Change (CGC), University of Maryland. He has a Master of Public Administration from Harvard University.

** Mr. Hoerner is Senior Policy Analyst at the CGC. He has a J.D. from Case Western Reserve University and is currently a doctoral candidate in the economics program at the University of Maryland.

I. Introduction[1]

Excise taxes on fossil fuels have long been an important source of revenues for both state and federal governments. States and localities annually receive more than $20 billion from motor fuels taxes and more than $3 billion in electricity taxes, in addition to a wide range of other energy related revenues including severance taxes, pipeline taxes, and natural gas taxes. Various rationales have been advanced to support the imposition of these taxes, including compensating the public for expropriating the natural bounty of the land,[2] acting as a proxy for user fees or toll charges on the nation's roads and highways,[3] and paying for adverse environmental[4]

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1. An earlier version of this paper was published as Frank Muller and J. Andrew Hoerner, *The Promise of State Carbon Taxes: Opportunities and Policy Issues*, 4 STATE TAX NOTES 530 (1993). The paper was prepared as a result of work supported by the W. Alton Jones Foundation. The opinions, findings, conclusions, and recommendations are those of the authors and do not necessarily represent the views of the Foundation.

2. Severance taxes have their root in the idea that sub-surface mineral resources belong to the sovereign and that the mining company is required to compensate the sovereign when those resources are appropriated for private use. Commonwealth Edison Co. v. Montana, 453 U.S. 609 (1981).

3. Thirty-six states and the federal government dedicate some or all of their motor fuel taxes to transportation through the use of highway trust funds. THE ROAD INFORMATION PROGRAM (TRIP), STATE HIGHWAY FUNDING METHODS (1992).

4. *See, e.g.*, 26 U.S.C. §§ 4041(d), 4042, 4081, 9508 (1988 & Supp. V 1993) (taxes on gasoline to pay for remediation of leaking underground storage

or health[5] consequences associated with the mining, transportation, storage, and consumption of fossil fuels.

The United States has both ratified the United Nations Framework Convention on Climate Change and committed to the convention's goal of "stabilizing greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."[6] On Earth Day 1993, President Clinton furthered this goal by committing the United States to return greenhouse gas emissions to 1990 levels by the year 2000 and to make further reductions in subsequent years. The President's Climate Change Action Plan for reducing greenhouse gas emissions was largely based on voluntary measures, which he called a first step "in the face of perhaps the biggest environmental threat to this planet."[7]

These expressions of national commitment imply that the entire range of policies to reduce greenhouse gases, including the imposition of energy taxes, will be part of the national agenda for many years to come. Individual states, however, had begun implementing measures to reduce emissions of greenhouse gases, most notably carbon dioxide (CO_2), through executive and legislative measures years prior to recent federal pronouncements. Vermont has developed a comprehensive plan to reduce greenhouse gas emissions and nonrenewable energy consumption per capita as a result of a 1989 gubernatorial directive. In 1992, the Connecticut legislature directed that the state energy plan include a CO_2 emissions reduction goal. Several states, including California and Minnesota, have developed inventories of their greenhouse gas emissions. New York, Massachusetts, California, and Nevada have all assigned explicit monetary costs to CO_2

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tanks); 26 U.S.C. § 4611 (1988 & Supp. V 1993) (Superfund Trust Fund and Oil Spill Liability Trust Fund taxes).

5. *See, e.g.*, 26 U.S.C. §§ 4121, 9501 (1988 & Supp. V 1993) (excise on coal for the Black Lung Disability Trust Fund).

6. *Report of the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change*, U.N. Conference on Environment and Development, 5th Sess., Agenda Item 2, at Annex I, U.N. Doc. A/AC.237/18 (Part II)/Add. 1 (1992).

7. President William J. Clinton, Earth Day Address (Apr. 22, 1993).

emissions for purposes of doing least-cost electricity planning. A host of other initiatives are also in place in other states.[8]

It is important to note that the state initiatives are not insignificant with respect to the global effort to control anthropogenic greenhouse gas emissions. Only six foreign nations release more CO_2 than Texas. Texas greenhouse emissions exceed those of countries such as Canada, Poland, and Mexico. California contributes more to global warming than Spain, South Korea, or South Africa. Even a relatively small state like Maryland, with a population of less than five million, contributes approximately the same level of emissions as Pakistan, whose population in excess of 125 million makes it the seventh most populous nation on earth.[9]

The combination of state concern over global climate change and a tradition of state-level energy taxation has focussed attention on a tax approach to combatting greenhouse emissions. Carbon dioxide is currently unregulated and not readily amenable to traditional tailpipe and chimney-stack controls or other point source strategies. Carbon dioxide is an inherent result of fossil fuel combustion, not a by-product, and is emitted by a myriad of sources from automobiles to lawnmowers to utility plants. A carbon tax is commonly proposed as a cost-effective way of achieving some degree of emission reductions across all these sources.

A carbon tax is a levy on fossil fuels at rates proportional to the carbon content of each fuel. Per unit of energy, coal has the highest carbon content of the fossil fuels and natural gas the lowest, with petroleum products in between. The tax is therefore proportional to the carbon dioxide emissions associated with each fuel, but also broadly correlates with emissions of the major pollutants regulated by the federal Clean Air Act.[10] A carbon tax is not imposed on energy sources such

8. For a review of state initiatives on global warming, see CENTER FOR GLOBAL CHANGE, Cool Tools: State and Local Policy Options to Confront a Changing Climate (P. Wexler, ed. 1992), and A. SILBIRGER AND R. GRAVIS, SELECTED SUMMARY OF CURRENT STATE RESPONSES TO CLIMATE CHANGE (1992).

9. See Appendix 1 for a comparison of state and national CO_2 emissions.

10. 42 U.S.C. §§ 7401-7671q (1988 & Supp. V 1993).

as hydroelectric, nuclear,[11] solar, wind, or sustainably harvested wood.

A carbon tax reduces carbon dioxide emissions in two ways. First, by increasing fossil fuel prices, it encourages more efficient use of energy and stimulates development of zero-emission technologies. Second, by changing relative prices, it encourages a shift in consumption from coal and oil to cleaner-burning natural gas. By the same logic, a carbon tax reduces emissions of sulfur dioxide, nitrogen oxides, and hydrocarbons.

Relative to traditional state energy taxes like motor fuels taxes, a carbon tax has a number of advantages:

- The broader base of a carbon tax implies that a required level of revenue can be raised at a lower tax rate.[12]
- A carbon tax promotes global and local environmental quality while raising revenue. This "two-for-one" aspect adds to both the policy and the political appeal of the tax.[13]
- The burden of the tax is broadly distributed over residential, commercial, and industrial taxpayers. An appropriate share is born by interstate commerce and tourism.
- The tax is less regressive than motor fuels taxes.
- A carbon tax causes less economic distortion than traditional excise taxes. Indeed, by "internalizing" the social cost of pollution, the tax may actually improve economic efficiency.

It is difficult to identify another state tax vehicle that shares the combined advantages of increased economic effi-

11. Because of concern that this strategy may promote new nuclear development, many carbon tax advocates argue for an additional tax and the removal of existing subsidies to account for the risks associated with nuclear power.

12. Moving from single-fuel energy taxes toward a carbon tax is broadly consistent with the bipartisan tax reform ideology which motivated the Tax Reform Act of 1986, Pub. L. No. 99-514, 100 Stat. 2085 (codified as amended in scattered sections of 26 U.S.C.).

13. A carbon tax was found to be the most favored energy tax by a Business Week/Harris poll taken in January 1993. Christopher Power, *The Public Braces for a Hit*, BUSINESS WEEK, Feb. 8, 1993, at 29.

ciency, environmental benefits, improved fairness and substantial revenue potential. This article will examine the evolving interest in carbon taxes and provide an analysis of related fiscal and environmental policy issues. It will also consider a range of administrative and design issues in light of concerns over the competitiveness of state industries and constitutional constraints on state taxation of interstate commerce. It will conclude with case studies of carbon tax proposals from Maryland, Minnesota, and California.

II. Evolving Interest in Carbon Taxes

Many nations are considering proposals to restructure energy taxes to reflect differences in environmental impact. Interest has been strongest in Europe, where energy taxes are increasingly seen as an attractive option for reducing combustion-related emissions that contribute to global and regional environmental problems. In 1992, the European Community (EC) agreed to a community-wide hybrid carbon/energy tax conditioned upon other Organization for Economic Cooperation and Development (OECD) countries adopting a similar tax or other measures having an equivalent financial impact.[14] The tax is a key element of a broader strategy to achieve the EC's ambitious carbon dioxide emission reduction target. The tax would be collected by member countries on a revenue-neutral basis, i.e., other national taxes would be reduced to offset the revenue gain. It would be phased in over seven years to reach the equivalent of $75 per ton of carbon[15] by the end of the decade.[16]

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14. For a detailed description of the tax, see COMMISSION OF THE EUROPEAN COMMUNITIES, PROPOSAL FOR A COUNCIL DIRECTIVE INTRODUCING A TAX ON CARBON DIOXIDE EMISSIONS AND ENERGY 1 (1992).

15. Throughout this paper carbon tax rates are expressed in dollars per ton of carbon contained in a fuel. To convert to dollars per ton of carbon dioxide emitted, divide by 3.67.

16. There are two components to the tax. One component applies a charge uniformly to all energy sources, except non-hydro renewables, according to their energy content. Such a tax is known as a Btu tax in the United States. The other component is a standard carbon tax, which is levied on fossil fuels according to their carbon content. When both components are fully phased-in, the tax as applied to oil would equal $10 per barrel, which is equivalent to $75 per ton of carbon. COMMISSION OF THE EUROPEAN COMMUNITIES, *supra* note 14.

Some European industries strongly oppose the tax, arguing that it will damage their competitiveness, especially because European energy prices are already considerably higher than United States prices. For this reason, the EC Council agreed to the tax on a conditional basis, instead of moving unilaterally as originally proposed. Implementation of the tax has also been delayed by divisions between wealthier and poorer nations concerning burden sharing and by British concerns over the powers of the EC.

New energy taxes have also been under consideration at the national level. As of early 1992, carbon-related energy taxes had been introduced in Finland, Norway, Sweden, the Netherlands, and Denmark. Sweden had also introduced sulfur- and nitrogen-based energy taxes.[17] In Japan, the Ministry of Finance and the Environment Agency have proposed a carbon tax, although this is opposed by the Ministry of International Trade and Industry.[18]

America's political debate over energy taxes has lagged behind the consensus of other industrialized countries. There is nonetheless an increasing recognition that energy taxes have an important role to play in any comprehensive long-term national strategy to combat global warming. This recognition was a factor in President Clinton's decision to propose the first broad-based national energy tax as part of his deficit reduction plan of February 1993. The Clinton proposal was adopted by the House, but subsequently replaced with a smaller motor fuels tax following a Senate amendment.[19]

17. For a review of recent energy tax developments in industrialized countries, see INTERNATIONAL ENERGY AGENCY, ENERGY POLICIES OF IEA COUNTRIES: 1991 REVIEW (1992). See also INTERNATIONAL ENERGY AGENCY, TAXING ENERGY: WHY AND HOW (1993), for a discussion of the fiscal and non-fiscal rationales for energy taxes.

18. Telephone Interview with Hirohiko Nishikubo, Environmental Attaché, Japanese Embassy (July 1992).

19. For a summary of the Administration's original Btu tax proposal, see OFFICE OF MANAGEMENT AND BUDGET, U.S. CONGRESS, A VISION OF CHANGE FOR AMERICA (1993). This proposal was subsequently modified by the Administration in response to objections by various industries and released by the Treasury Department as legislative language on April 30, 1993. The House added a few minor additional changes and introduced the bill in May 1993. H.R. 2141, 103rd Cong., 1st Sess. (1993). The bill was passed by the House on May 27,

The proposed tax applied to all fuels at a basic rate proportional to their energy content as measured in British thermal units (Btus).[20] Oil-derived fuels were subject to an additional surcharge. According to the Administration, the tax was designed to serve four separate policy goals: deficit reduction, environmental protection, national security, and energy conservation.

The proposed Btu tax was considerably smaller than the EC carbon/energy tax. The EC tax starts at a rate that is roughly equivalent to the full Clinton tax and then increases to more than three times this rate over seven years. Nevertheless, statements by EC spokesmen implied that the Clinton tax would have gone a long way towards satisfying the EC's conditionality requirement.[21] It is likely, therefore, that the Btu tax could have been introduced without United States industry suffering any erosion in the energy price advantage that it enjoys over European competitors. Unfortunately, the Administration failed to grasp this opportunity to address industry competitiveness concerns and thereby answer critics of its tax proposal.

In formulating the budget plan, the Administration considered a carbon tax but judged it inconsistent with the President's theme of deficit reduction through shared sacrifice. Compared to the Btu tax, a carbon tax would have imposed a higher burden on coal-producing and -consuming regions and

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1993 as the Omnibus Budget Reconciliation Act. H.R. 2264, 103rd Cong., 1st Sess. (1993). The Senate then passed its version of the bill deleting the Btu tax and replacing it with a 4.3 cent per gallon motor fuels tax on June 25, 1993. S. 1134, 103rd Cong., 1st Sess. (1993). The conference version of the bill adopted the Senate amendment and passed the House on August 5 by a 218-216 vote and the Senate on August 6, 1993, by a 50-50 vote, with Vice President Al Gore casting the deciding vote. H.R. 2264, 103rd Cong., 1st Sess. (1993).

20. In the case of electricity produced by nuclear fission or hydropower, the average Btu rate per kilowatt-hour for fossil-fired power plants was applied to calculate the tax rate.

21. *See, e.g., March Events Mark Beginning of Critical Period for EC Tax,* ENERGY ECONOMICS & CLIMATE CHANGE, Mar. 1993 (discussing talks between president of the EC energy ministers and United States Secretary of Energy).

a lower burden on regions with abundant hydropower.[22] The proposed Btu tax, however, did incorporate a key feature of a carbon tax: a zero tax rate for non-hydro renewable energy production. It also favored natural gas over coal for new electricity generation, because of the relatively higher efficiency of advanced gas-fired units.

Prior to the Btu tax debate, carbon tax proposals were beginning to emerge as serious contenders for consideration at the national level. The Congressional Budget Office (CBO) released a major carbon tax study in 1990[23] and subsequently included a carbon tax option in its annual report to Congress on options for reducing the deficit.[24] In February 1991, Representative Pete Stark (D-CA), a senior member of the House Ways and Means Committee, introduced legislation for a $18 per ton tax to be phased in over five years.[25]

Ideally, a national carbon tax whose primary purpose is to combat global warming would be set at a rate that can achieve society's emission reduction goals. Scientists have concluded that a 60% reduction in carbon dioxide emissions is required to stabilize atmospheric concentrations at present day levels.[26] To date governments have adopted more modest short-term goals. President Clinton's commitment is to return total United States greenhouse gas emissions to 1990 levels by the end of the century.[27] Many OECD countries

22. Nevertheless, regional factors, including the opposition of Democratic senators from oil-producing states, played a major role in the demise of the Btu tax proposal.

23. CONGRESSIONAL BUDGET OFFICE, U.S. CONGRESS, CARBON CHANGES AS A RESPONSE TO GLOBAL WARMING: THE EFFECTS OF TAXING FOSSIL FUELS (1990).

24. CONGRESSIONAL BUDGET OFFICE, U.S. CONGRESS, REDUCING THE DEFICIT: SPENDING AND REVENUE OPTIONS 343 (1992).

25. H.R. 1086, 102nd Cong., 1st Sess. (1991).

26. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE: THE IPCC SCIENTIFIC ASSESSMENT (1990).

27. Under the Clinton Administration's Climate Change Action Plan, United States carbon dioxide emissions, not including sinks, are expected to increase by 3% between 1990 and 2000. This increase is to be offset by reductions in emissions of other greenhouse gases, especially methane, and by tree planting. The total greenhouse gas emission level is calculated by multiplying emissions levels for individual gases by a weighting factor, known as the "global warming potential," which reflects the relative potency of each gas. Clinton, *supra* note 7.

have adopted more ambitious targets for the year 2000 that apply specifically to carbon dioxide.[28]

Numerous econometric modelling studies which consider the relationships between aggregate consumption of fossil fuels and other economic variables have examined the link between tax rates and emission levels. The studies generally suggest that a tax of around $100 per ton of carbon is needed to reduce United States emissions early next century by 30 to 40% from the levels expected under a business-as-usual scenario.[29] However, engineering technology assessments which examine available efficiency improvements in particular technical applications have found that technologies are available to achieve significant emission reductions at a low and even negative cost.[30] This implies that if markets worked perfectly, a lower or even zero tax rate would be sufficient to stabilize emissions.

Economic models alone cannot determine the correct tax rate for a given emission reduction goal for at least two reasons. First, energy markets are highly imperfect. Numerous barriers inhibit the adoption of cost-effective energy efficiency and renewable technologies that would reduce carbon dioxide emissions. A carbon tax should be part of a broader array of policies that address the market failures as well as the policy

28. The Framework Convention on Climate Change includes ambiguous language on the emission reductions required of developed countries by the year 2000. Many OECD countries sought a firm commitment to stabilize CO_2 emissions at 1990 levels by 2000, but this was opposed by the Bush Administration. Nevertheless, the language eventually adopted can be read to require developed countries to return emissions of CO_2 (not including sinks), and separately those of other greenhouse gases, to 1990 levels by 2000. The Convention does not include specific commitments for post-2000 emission reductions. However, for the ultimate objective of the Convention in relation to atmospheric concentrations to be achieved, substantial reductions in developed country emissions post-2000 will be required. See D. Bodansky, *The United Nations Framework Convention on Climate Change: A Commentary*, 18 YALE J. INT'L L. 451 (1993) for a detailed discussion of the provisions of the convention.

29. William D. Nordhaus, *The Cost of Slowing Climate Change: A Survey*, 12 ENERGY J. 37 (1991).

30. NATIONAL ACADEMY OF SCIENCES, GREENHOUSE WARMING (1992).

and institutional biases underlying these barriers.[31] The effectiveness of a tax will depend on the overall combination of policies. For example, the price impact of the tax could be amplified by using revenues to fund alternative technologies and energy-efficient infrastructure. Indeed, one study found that a significantly lower tax rate is required to achieve emissions reductions if the revenues are dedicated to carbon abatement measures as opposed to general revenues.[32]

Second, economic models are by nature backward looking, relying on data describing how the economy functioned in the past. They make little allowance for technological innovation that affects the cost of carbon abatement technologies, or for shifts in consumer preferences due to changing lifestyles or values. Environmental policies commonly stimulate innovation that reduces the cost of achieving their stated goals. Reductions in ozone depleting emissions, for example, have proven to be far less expensive than was predicted only a few years ago. A carbon tax enacted as part of a suite of policies aimed at improving national energy efficiency, fuel switching, and renewable energy technologies is likely to be far more effective in meeting environmental and energy security goals and less burdensome to industry and consumers than a tax enacted as a stand-alone policy.

In practice, any serious discussion of carbon tax proposals will involve multiple policy goals, as was the case with the proposed Btu tax. Since a carbon tax can raise sufficient revenues to affect the overall shape of government budgets, fiscal considerations are likely to be a dominant factor. The Congressional Budget Office estimates that a national carbon tax of $70 per ton would raise net revenues of $72.5 billion per annum.[33] Carbon tax rates are, therefore, likely to reflect fis-

31. UNION OF CONCERNED SCIENTISTS ET AL., AMERICA'S ENERGY CHOICES: INVESTING IN A STRONG ECONOMY AND A CLEAN ENVIRONMENT - EXECUTIVE SUMMARY (1991).

32. NEW YORK STATE ENERGY OFFICE ET AL., DRAFT NEW YORK STATE ENERGY PLAN: 1991 BIENNIAL UPDATE — ISSUE 9 ENERGY/ENVIRONMENTAL TAXES (1991).

33. CONGRESSIONAL BUDGET OFFICE, U.S. CONGRESS, REDUCING THE DEFICIT: SPENDING AND REVENUE OPTIONS 343 (1992). The Congressional Budget Office estimates that a $120 per ton carbon tax (1993 dollars) phased in over ten

cal priorities as well as the judgments of decision makers about environmental and other goals. Indeed, as both the European and American experience suggests, the basic carbon tax design is likely to be modified to serve goals other than combatting global warming, such as applying the tax to nuclear energy or imposing a higher rate on oil.

Analysts have had little to say about how to design carbon taxes or how to set their rates to serve multiple policy goals. Recent discussions have focussed on the potential uses for carbon tax revenues. Several analysts have proposed a "tax shifting" strategy, whereby such revenues are used to reduce existing taxes on capital and labor that retard investment and employment growth.[34] Ex-Federal Reserve Chairman Paul Volcker and former Council of Economic Advisors Chairman Martin Feldstein suggest using a carbon tax to reduce the federal deficit.[35] This was also the main purpose of the Btu tax. A third possible use for carbon tax revenues is to finance public investment in energy efficient transportation infrastructure and environmental technologies. Such investment has been proposed by some economists to help revive growth and address longer term structural problems in the United States economy,[36] a position also embraced by President Clinton during the 1992 election campaign.

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years from 1993 would raise nearly $207 billion in revenues from 1993 through 1997, when the tax would be $70 per ton (1993 dollars). *Id.* Revenue estimates are net of reduced income and payroll tax revenues.

34. *See, e.g.*, ROBERT SHACKLETON ET AL., U.S. ENVIRONMENTAL PROTECTION AGENCY, THE EFFICIENCY VALUE OF CARBON TAX REVENUES (1992); ROGER C. DOWER & MARY BETH ZIMMERMAN, WORLD RESOURCES INSTITUTE, THE RIGHT CLIMATE FOR CARBON TAXES: CREATING THE ECONOMIC INCENTIVES TO PROTECT THE ATMOSPHERE (Aug. 1992).

35. Interview with Paul Volcker, *Charlie Rose Show* (PBS television broadcast, June 22, 1992); Martin Feldstein, *The Case for a World Carbon Tax*, WALL ST. J., June 4, 1992, at A8.

36. *See, e.g.*, ROBERT KUTTNER, ECONOMIC POLICY INSTITUTE, THE SLOW GROWTH TRAP AND THE PUBLIC INVESTMENT CURE (1992).

III. Carbon Taxes at the State Level

Regardless of federal action, there are many good reasons for states to consider levying modest carbon taxes. Such taxes could serve state fiscal and environmental goals. Moreover, their introduction would help build momentum for a national shift towards carbon and other pollution taxes by providing policy makers with practical experience and familiarizing the body politic with the concept. State initiatives would also avoid the difficult inter-regional politics of the Btu tax debate.

State and local governments already impose various taxes on energy consumption including motor fuel, utility, sales, and other energy taxes. Increases in such taxes have been on many states' agendas in recent years due to budgetary problems. However, unlike a carbon tax, none of these taxes discriminate between clean and dirty fuels.

State carbon taxes are not precluded by the possible future introduction of a federal carbon tax. Gasoline taxes provide a model of an energy excise base split between state and federal use. State severance taxes on coal have also been paralleled by federal excises to support the Black Lung Trust Fund.[37] Finally, federal energy taxes of a similar magnitude to the Clinton Btu tax would not suffice to achieve needed reductions in carbon emissions in the near future. In this context, state carbon taxes retain a critical role in environmental management. Indeed, in some ways a national carbon tax improves the desirability of a state carbon tax. Assuring compliance is a constant problem with all excise taxes, and recent years have shown the value of state-federal cooperation in assuring compliance with gasoline taxes. State-federal agreements are likely to bear similar fruits in the context of the system of energy excises which constitute a carbon tax.

The case for state carbon taxes would also be strong if the Administration and Congress decided to revisit the idea

37. The Black Lung Trust Fund was created by the Black Lung Benefits Act of 1972 to benefit coal miners and surviving dependents of coal miners disabled due to pneumoconiosis. 30 U.S.C. §§ 901-945 (1988 & Supp. V 1993).

of a relatively low Btu or ad valorem tax instead of a carbon tax. These taxes are less effective at stimulating reductions in emissions of carbon dioxide and other air pollutants. By adopting carbon taxes, states could keep the energy tax debate focused on environmental objectives and perhaps lay the groundwork for a federal carbon tax.

A carbon tax as high as some of those being proposed at the national level could cause significant interstate price differences and damaging economic impacts unless a state adopts compensating reductions in other taxes or a strong system of border adjustments.[38] But even without such adjustments, more modest carbon taxes — perhaps as high as $15 per ton — will be an attractive environmental and fiscal option in some states. Twenty-five states tax the gross receipts of electric utilities at rates ranging from less than 1% to nearly 10%. Of these states, fourteen also impose a sales tax on at least some categories of electricity sales.[39] A $10 per ton carbon tax on a utility with national average fuel mix and electricity prices would mean a price increase of 2.4% for residential customers and 4.0% for industrial customers. These increases are within the range of existing taxes. The $10 per ton carbon tax translates into 2.7 cents per gallon on gasoline, which would represent only a small addition to existing state motor fuels taxes.[40]

IV. Fiscal Policy Issues

As is true at the federal level, fiscal considerations will influence whether states adopt carbon taxes. There are three broad strategies for using state carbon tax revenues:

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38. *See infra* sections VI.B. - VI.D.

39. JOE W. LOPER, ALLIANCE TO SAVE ENERGY, STATE AND LOCAL TAXATION: ENERGY POLICY BY ACCIDENT (June 1994). Of these twenty-five states, several levy a gross receipts tax in lieu of corporation or property taxes. Some states have local gross receipts (e.g., Illinois) or energy taxes (e.g., Maryland) in addition to a state tax. Of the states with no gross receipts tax, twenty-two impose a sales tax on some or all electricity sales. *Id.*

40. *Id.* Motor fuels taxes are levied by every state. According to data compiled by the Federation of Tax Administrators, as of January 1, 1993 the median state gasoline tax was eighteen cents. The high was twenty-eight cents and the low five cents. *Id.*

- Providing revenues for state general funds and transportation trust funds;
- Providing dedicated revenues for carbon abatement initiatives and air quality programs;
- Replacing existing state energy taxes with a tax that sends a stronger environmental signal.

In recent years state finances have been under considerable pressure. States were forced by a combination of factors to enact record revenue increases for fiscal years 1991 and 1992.[41] Faced with severe budget crises and the unpopularity of conventional revenue sources, like income and sales taxes, many states searched for new revenue sources. This led Maryland, for example, to consider a state carbon tax during the 1992 legislative session.[42]

State finances have improved somewhat in the past year, partly because of the revenue increases and expenditure cuts enacted in 1990 and 1991, and partly due to the slow improvement in the economy. New taxes and fees enacted for fiscal year 1994 in the fifty states totalled $3 billion, compared to a high of $15 billion for 1992.[43] The economic recovery, however, has been highly uneven, with slow growth continuing to affect state finances in the northeast and far west. Moreover, other pressures on state budgets have not receded, including rapid growth in Medicaid expenditures, increasing demand for state services such as corrections, and cutbacks in federal spending. The finances of many states remain fragile. Fourteen states project end-of-year balances for

41. These increases were enacted in the 1990 and 1991 legislative sessions. The net revenue increase for the fifty states totalled $10.3 billion in fiscal year (FY) 1991 and $15.0 billion in FY 1992. NATIONAL GOVERNORS' ASS'N AND NATIONAL ASS'N OF STATE BUDGET OFFICERS, THE FISCAL SURVEY OF STATES (1993) [hereinafter 1993 FISCAL SURVEY].

42. *See infra* section VII.A.

43. 1993 FISCAL SURVEY, *supra* note 41. Twenty-nine states enacted net revenue increases and nine states enacted net revenue decreases for fiscal year 1994. Of the twenty-nine states that enacted net revenue increases, nine increased sales tax revenues, nine increased personal income taxes, and twelve increased corporate income taxes. Seven states increased motor fuels taxes by amounts varying from one to six cents per gallon. Louisiana extended its sales tax to utilities, and New Mexico and West Virginia increased fuel severance taxes. *Id.*

fiscal year 1994 of less than 1% of expenditures, leaving them vulnerable to continued recession and other contingencies.[44]

Despite the turnaround in the economy, some states will be forced to consider new revenue measures in the next few years. First, some states may have to increase revenues to overcome immediate budget shortfalls. Second, many states are conducting strategic reviews of government functions and revenues to address the long-term imbalance between revenue and expenditure growth. There may be an openness to new ideas in states where additional revenues are needed and resistance is high to increases in conventional taxes. A carbon tax will be an attractive option in states where energy is lightly taxed and where energy taxes have not been recently increased. A carbon tax is more broadly based, and raises more revenue at a given tax rate, than most existing state energy taxes.[45] A carbon tax should be especially attractive in states that depend on out-of-state fossil fuel supplies and could benefit from redirecting private spending to in-state efficiency measures.

There are two other trends in state fiscal policy that could affect the prospects for state carbon taxes. First, states are increasingly turning to environmental taxes and fees for the specific purpose of funding environmental programs.[46] The largest increase in state taxes for fiscal 1993 was in miscellaneous taxes and fees ($1.3 billion), including environmental charges.[47] Although the total increase in this category for 1994 was lower ($361 million), eight states introduced additional environmental charges.[48]

At the very time that state budgets are under pressure, federal monies are not increasing with the growth of state and local responsibilities under federal environmental man-

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44. *Id.*

45. *See infra* section VII.A.

46. EVELYN SHIELDS, NATIONAL GOVERNORS' ASS'N, FUNDING ENVIRONMENTAL PROGRAMS: AN EXAMINATION OF ALTERNATIVES (1989).

47. NATIONAL GOVERNORS' ASS'N & NATIONAL ASS'N OF STATE BUDGET OFFICERS, THE FISCAL SURVEY OF STATES (1992) [hereinafter 1992 FISCAL SURVEY].

48. 1993 FISCAL SURVEY, *supra* note 41.

dates.[49] A 1990 United States Environmental Protection Agency report estimates that the costs incurred by local governments nationwide in complying with the agency's various environmental mandates will increase from $19.19 billion in 1987 to $32.54 billion in 2000, while state government costs are estimated to increase from $2.99 billion to $4.44 billion.[50] The 1990 amendments to the federal Clean Air Act, for example, present states and localities not only with increased administrative responsibilities, but also with the need to make new investments in areas such as mass transit to achieve compliance with air quality standards and avoid losing federal highway funds.[51] A National Association of Counties study estimates that the cost to counties of implementing the Clean Air Act over the next five years (1994-98) will be $2.7 billion.[52] The Clean Air Act specifically authorizes states to include pollution taxes and other economic incentives in the state implementation plans mandated by the Act.[53] A carbon tax can raise sufficient revenues to fund both clean air programs and investments in infrastructure and technologies that reduce emissions of criteria pollutants and carbon dioxide.

The second trend is the use of health-related taxes to finance health-related expenditures. For example, fifteen states enacted cigarette and tobacco tax increases for fiscal 1994 with a total revenue gain of $634 million.[54] President Clinton is also proposing higher tobacco taxes to help finance his health care reforms. States might consider taxing pollutants that are linked to health damages as a way of financing

49. MARYLAND DEP'T OF FISCAL SERVICES, JOINT STUDY GROUP ON REVENUES: FINAL REPORT (1991).

50. This covers all of EPA's mandates including air, radiation, water, land, and chemical pollution control. Estimates are in 1986 dollars. U.S. ENVIRONMENTAL PROTECTION AGENCY, ENVIRONMENTAL INVESTMENTS - THE COST OF A CLEAN ENVIRONMENT: A SUMMARY 2-5 (1990).

51. 42 U.S.C. §§ 7401-7671q (1988 & Supp. V 1993).

52. NATIONAL ASS'N OF COUNTIES, THE BURDEN OF UNFUNDED MANDATES: A SURVEY OF THE IMPACT OF UNFUNDED MANDATES ON AMERICA'S COUNTIES 4 (1993).

53. J. Andrew Hoerner, *New Clean Air Bill Directs States to Collect Environmental Taxes?*, 49 TAX NOTES 944 (1990).

54. 1993 FISCAL SURVEY, *supra* note 41.

growing health expenditures. As discussed below, a carbon tax could serve as a proxy for a general air pollution tax.

States will need to consider the stability of carbon tax revenues in the context of their medium- to long-range fiscal planning. At the low rates discussed here, the immediate impact of state carbon taxes on fuel consumption and expected revenues is likely to be modest. If carbon taxes and other federal and state policies achieve their emission reduction goals, revenue will not grow proportionally to the economy. However, for a phased-in tax, future increases in the tax rate would more than counteract reduction. Inflation will erode carbon tax revenues unless the tax rate is indexed to the consumer price index or another relevant price index. Carbon tax revenues will also be affected by business downturns; whether they are impacted more or less than other state taxes should be evident from historical fuel consumption data.

V. Environmental and Energy Policy Issues

In most states, regional air quality looms larger as a policy concern than does global warming. Measures to reduce emissions of carbon dioxide, however, also reduce emissions of conventional pollutants like sulfur dioxide, nitrogen oxides and hydrocarbons. As Table I below illustrates, a carbon tax is a reasonable proxy for a general air pollution tax on fuel combustion, because emissions of carbon dioxide associated with burning coal, oil and natural gas broadly correlate with emissions of the other major pollutants.

Even so, carbon taxes at the rates likely to be adopted by states will only send a modest price signal. For an electric utility with a fuel mix of 90% coal and 10% natural gas, a $10 carbon tax means a price increase of 2.9 mills per kilowatt-hour. By acquiring renewable resources to shift its fuel mix to 80% coal, 10% gas, and 10% renewables, the utility would reduce its tax to 2.6 mills per kilowatt-hour. A diversified utility with a fuel mix of 50% renewables, hydro and nuclear, 30% natural gas, and 20% coal, which is today's average fuel

mix in California, would pay just 1.2 mills per kilowatt-hour.[55]

TABLE I. RELATIVE UTILITY EMISSION FACTORS FOR COAL, RESIDUAL OIL AND NATURAL GAS STEAM PLANTS, NORTH CENTRAL UNITED STATES[56]

	CO_2	SO_2	NO_x	CO	VOC
Coal	100%	100%	100%	100%	100%
Residual Oil	81%	31%	35%	89%	180%
Natural Gas	56%	1%	25%	196%	46%

However, the effectiveness of using state carbon taxes as environmental and energy policy tools will not hinge just on the strength of the price signals they send. First, to the extent that revenues are used to fund clean air or carbon abatement programs such as energy efficiency or tree planting, such taxes will provide a direct environmental benefit. The New York State Energy Office, for example, estimates that an $8 carbon tax, with revenues dedicated to carbon abatement measures, could reduce New York's emissions of carbon dioxide to 5% below 1988 levels by the year 2008.[57]

Second, perceptions could matter more than actual tax rates. The medium- to long-term price effect of a modest state carbon tax will be magnified if it is perceived to be part of a national and international trend to address regional and global environmental problems through taxes and related policies. Investors will consider the possibility of future in-

55. This assumes average heat rates of 10,000 BTU/kwh for coal and 12,000 BTU/kwh for gas, and transmission and distribution losses of 5%. For the diversified utility, an average heat rate of 11,000 BTU/kwh is assumed for gas units.

56. Except for CO emission factors, which vary somewhat, the relative rankings are the same for the northeastern, southern, and western regions. The ranking for VOC emissions in the south (100%, 80%, 82% for coal, oil, and gas respectively) differs from other regions. Emission factors for residual oil and natural gas plants are expressed as a percentage of the equivalent emission factor for a coal plant. Current average utility emission factors (lb/MBtu) are used. UNION OF CONCERNED SCIENTISTS ET AL., *supra* note 31.

57. NEW YORK STATE ENERGY OFFICE, DRAFT NEW YORK STATE ENERGY PLAN: 1991 BIENNIAL UPDATE - ISSUE 9: ENERGY/ENVIRONMENTAL TAXES (1991).

creases in the tax rate and the introduction of similar taxes in other jurisdictions.

Third, introducing carbon taxes at the state level will help build political momentum for a national carbon tax. The political process inherently resists new ideas, especially in a controversial area like taxation. Legislators understand the politics of conventional taxes on income and consumption and are reluctant to move into uncharted waters. Agencies know how to administer existing taxes and to estimate the revenues they will generate. Interest groups know where they stand with familiar proposals. Breakthroughs in states where the political environment is receptive to a carbon tax will help overcome this political inertia at a national level. It will also provide policy makers with practical experience in designing and implementing a carbon tax.

States may choose to combine introduction of a small carbon tax with a policy on the regulatory risk associated with global warming, including the possibility of a future national carbon tax or emissions trading scheme. The California Public Utilities Commission recently ordered that the state's investor-owned utilities should only undertake long-term purchases of electric power or generation capacity with significant carbon emissions if the supplier provides assurance that it alone will bear the costs resulting from a carbon tax or other carbon emission control strategy.[58] In the absence of such a policy these costs are likely to be passed on to ratepayers.[59]

State carbon taxes should not substitute for current efforts of state regulatory commissions to account for air emissions in electric utility planning. Such taxes are likely to be lower than the externality values already ascribed just to carbon emissions by regulators in several states. State carbon taxes should instead be regarded as an initial step towards taxing pollution which has important advantages over the regulatory approach. A carbon tax can be applied to all fuels

58. CALIFORNIA PUBLIC UTILITIES COMM'N, No. 92-04-045 (Apr. 22, 1992).

59. For a discussion of allocation of risks associated with future regulation of CO_2 emissions, see R. Cavanagh et al., *Utilities and CO_2 Emissions: Who Bears the Risks of Future Regulation?*, 1993 ELECTRICITY J. 64.

and end use sectors, whereas the regulatory approach singles out the utility sector. Taxes are therefore a better instrument for achieving a given environmental outcome at the least cost to society. Indeed, within the utility sector, the regulatory decisions based on environmental externalities often only apply to marginal investments, missing other cost-effective emission reduction opportunities.[60] By changing fuel prices, a carbon tax influences the operation of existing generating units as well as resource acquisition decisions.

VI. Tax Design and Administration

A. Defining the Tax Base

An ideal carbon tax would be a tax on the actual release of carbon dioxide into the atmosphere. Although a carbon tax is usually referred to as a tax on fossil fuels, when defining the tax base it is important to think of the tax as ultimately targeted at emissions of carbon dioxide from fuel combustion.

There are two natural candidates for the base of a broad-based carbon tax at the state level. The first is emissions caused by energy which is consumed in the state, regardless of whether goods produced with that energy are consumed in-state or out-of-state. This will be referred to as a "carbon emissions tax." Such a tax would include both fuels directly consumed and used to produce electricity consumed in the state. The second is emissions from energy sold to households in the state or used to produce goods consumed in the state. This will be referred to as a "carbon consumption tax." The two bases differ only with respect to the proper tax treatment of goods other than fossil fuels and electricity which cross state lines. If the tax base is energy used to produce goods consumed in a state, then manufacturers of exported goods should receive a credit for carbon taxes paid on energy used to produce those goods, while importers of goods into the state should pay a tax based on the energy used to produce the imports. If the base is emissions from energy consumed

60. Clinton J. Andrews, *The Marginality of Regulating Marginal Investments: Why We Need A Systemic Perspective on Environmental Externality Adders*, 20 ENERGY POLICY 450 (1992).

in the state, neither imports nor exports would receive any special treatment.

This article does not discuss a third possible base: fossil fuels produced in the state. This base is more appropriate for a federal tax than a state-level tax because it would unnecessarily parallel the existing severance tax system and inappropriately dissociate the burdens of the carbon tax from the benefits of energy consumption. It would also impose more severe distortions on interstate trade in fuels and electricity than either of the other bases.

These two preferred bases pose quite different problems in tax design. In broad outline, the carbon emissions tax is easier to administer, but at higher tax rates it may create burdens on energy-intensive industries which compete in national and international markets. However, as shown in section VI.B, the burden on even the most energy intensive industries is quite modest at tax rates in the range likely to be considered by states. Even these modest burdens can be offset, but the offsets may reduce the fairness of the tax or the incentives it provides for fuel switching and energy efficiency. In section VI.C, this paper discusses how to design offsets to minimize the reduction in environmental incentives from the tax while providing any desired level of protection from competitive burdens. A carbon consumption tax would not reduce the competitiveness of a state's energy-intensive industries, even if the tax were at much higher levels than have usually been considered possible for a carbon tax at the state level. Taxing the carbon emissions associated with imports, however, is administratively far more difficult and may create a constitutional question related to interstate commerce. Again, these problems can be ameliorated, but only if the United States is willing to accept "rough-justice" solutions. In section VI.D, the problems associated with administering a carbon consumption tax are discussed. Section VI.E shows that such a tax, if properly designed, would probably be found constitutional. Finally, section VI.F considers administrative issues in setting the point of taxation for various fuels.

A carbon consumption tax will raise more revenue if a state's nonenergy imports are produced using more fossil fuels than its nonenergy exports. If the state's nonenergy exports are produced using more fossil fuel than its nonenergy imports, a carbon emission tax will raise more revenue.

It is not clear which base is preferable in terms of the underlying justification for a carbon tax. A carbon emissions tax is more effective in reducing the local consumption of energy from fossil fuels, but high rates could drive more highly energy-intensive industries out of the state without inducing any net reduction in carbon emissions from those industries. To the extent that the tax is motivated by the state's desire to do its part in combatting global warming, a carbon consumption tax would probably be preferable. On the other hand, to the extent that a carbon tax is enacted as a proxy for a general tax on air pollution from the combustion of fossil fuels, a carbon emissions tax is preferable, because it would be more effective in protecting environmental quality and health within the state.

The carbon tax bill introduced in Maryland, discussed in section VII.A below, was a carbon emissions tax. It is instructive to examine the treatment of electricity under the Maryland tax. Under the proposed bill, electricity sold by each Maryland utility would be taxed at a fixed rate per kilowatt-hour (Kwh) that depended on the implicit carbon content of the electricity as measured by an annual determination of that utility's fuel mix. The fuel used to generate power purchased by the utility was treated as part of the utility's fuel consumption, even if purchased out-of-state, while electricity sold out-of-state was not taxed. This mechanism is consistent with a carbon emissions tax if electricity is regarded as a form of fossil fuel transport. If, on the other hand, electricity is regarded as a good in its own right, then electricity is treated as it should be under a carbon consumption tax, and the Maryland bill would embody a hybrid emissions/consumption tax. However, because of the close competition between electricity and other fuels in a variety of end-use applications, it is more appropriate to regard electric-

ity as a form of energy transmission rather than as an independent good.

It is probable that regulations will be required to settle further questions about accounting for interstate flows of electricity to prevent utilities from gaming the system to reduce the carbon tax burden without reducing net carbon emissions. Suppose an in-state utility subject to the carbon tax buys power from an out-of-state utility not subject to the tax. Assume the out-of-state utility has 50% coal-fired electricity and 50% nuclear power. The out-of-state utility enters into a contract to sell power from its nuclear plant. Because electricity is fungible, this may have no impact on the generation mix. The out-of-state utility is simply calling the power it sells to the in-state utility nuclear power, while it labels the electricity it sells to its own customers coal-generated power. To avoid such gaming, purchases should be tied to the average fuel mix of the entire selling utility, or perhaps even to the mix in some larger unit, such as the power pool to which the utility belongs.

Another tax base question is whether the state wants to include greenhouse gases other than carbon dioxide or carbon dioxide emissions from sources other than fossil fuels. Other greenhouse gases include methane, nitrous oxide, and certain organic compounds. The primary nonfuel sources of carbon dioxide are the manufacture of lime and portland cement and the destruction of natural carbon sinks, particularly the clearing of forest land. Although it may ultimately be desirable to include a broader spectrum of greenhouse contributors in a tax designed to discourage global warming, extensions of the tax beyond fossil fuels raise complex issues of both science and tax policy which have not yet been adequately studied. These extensions should therefore probably be delayed until they are better understood.

B. Effects on State Competitiveness

A carbon tax could have a negative impact on the competitiveness of fossil fuel-intensive industries. The extent of this impact would depend on a variety of factors, the most

important of which are the tax rate and the extent to which the industry's market is national or international. Some energy-intensive industries, such as portland cement and brick making, could bear substantial tax burdens without altering their competitive position because shipping costs are so high that the market is essentially local.

A modest carbon tax would not seriously reduce the competitiveness of any industry. For instance, among manufacturing industries defined at the level of the two digit standard industrial classification (SIC) code, none would see cost increases from a $7.50 tax per ton of carbon that would exceed half a percent of their total sales.[61] A $7.50/ton carbon tax is lower than the Clinton tax proposal for all industries.[62]

Consideration of industries at the four digit SIC code level would place the heaviest burden on the manufacture of portland cement. The cement industry is not internationally competitive and is only slightly competitive on the state level because cement, relative to its value, is expensive to transport. Aside from cement, only nitrogenous fertilizers and a few primary metal industries such as aluminum and steel would see price increases in excess of half a percent, and even these would see increases of no more than 2%. Overall, the competitive impact of a modest state-level carbon tax would appear to be limited to only a handful of industries and would be small even for those industries most affected.[63]

It should be noted, however, that these carbon consumption estimates are based on average efficiencies for the listed industries and that the imputed carbon consumption from electricity use is based on national averages for the generation mix. Low-efficiency plants within an industry might bear significantly higher burdens, as might highly electricity-intensive industries in areas of the country where most electricity is generated from coal. From an environmental perspective this is precisely what is desired — low-efficiency

61. See Appendix 2, column 6.

62. See Appendix 2, column 4 for estimates of the Clinton Btu/oil tax for comparison.

63. See Appendix 2, column 6.

plants will pay a higher tax in order to provide a suitable efficiency incentive. The least efficient plants, however, would also suffer a larger disadvantage in terms of interstate and international competitiveness under a carbon tax.

Because competitive burdens of a modest tax are limited to a few industries or products, border adjustments or other policies to offset competitive impacts could likewise be limited to those same industries and products. This greatly reduces the administrative complexity and compliance burden of those adjustments.

C. Offsetting Competitive Burdens: A Carbon Emissions Tax

The draft carbon tax legislation considered by the Maryland House of Delegates in 1992 included a provision setting a cap on carbon tax at $250,000 per enterprise in an effort to limit the impact of the tax on the competitiveness of Maryland industries.[64] This form of competitiveness offset has the merit of administrative simplicity and precedent, having already been used to limit the burden of the state's small environmental surcharge on electricity. However, this offset is only one strength against a number of weaknesses.

First, a simple per-firm cap is poorly designed to assist firms that need relief. It may help a company for which the carbon tax is a very small fraction of total cost simply because that company is very large. Conversely, it will provide no assistance to a small but extremely energy-intensive firm for which the tax might have a real impact on the price at which the firm can sell its goods. Second, the cap eliminates all incentive to invest in energy efficiency or fuel switching for those firms which anticipate a tax liability that substantially exceeds the cap. These large polluters may be the very firms that are most able to achieve reductions with a real impact on overall environmental quality.

64. MARYLAND HOUSE OF DELEGATES, BRIEFING ON PROPOSED AIR POLLUTION TAX BEFORE THE HOUSE COMMITTEE ON WAYS AND MEANS (Mar. 12, 1992)(on file with the PACE ENVIRONMENTAL LAW REVIEW).

A better way of structuring the cap would be to offset the tax burden for the highest-energy industries with a separate tax credit. The credit would be equal to a small percentage of sales or to a fixed rate per ton of output. In either case, the rate would vary by industry in a systematic way to assure that no industry bears an average burden in excess of some specified small percentage of price, e.g., one percent. Companies would be fully taxed on the energy they consume, but the credit would assure that the impact on output prices, and hence on competitiveness, would be small. Such a credit would reduce the average energy tax burden on a company while retaining the marginal tax rate on energy at the same level. This would have the advantage of controlling the impact of an energy tax on the sale price of goods produced in the state, thus eliminating the impact of energy taxes on the competitiveness of in-state firms, while retaining the incentive to pursue energy efficiency. The magnitude of the credit would be based on the energy consumption of the industry during some base period, for example, the three years prior to enactment.[65]

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65. As an example of how such a credit would be calculated for "Big Steel Company," assume that the maximum tax rate set by a state is equal to 1% of gross sales. Assume that the carbon tax rate equals $10 per ton of carbon, or $6.05 per ton of coal.

In the base period Big Steel Co. has sales of $1,000,000 and purchases 3305.8 tons of coal. Big Steel would have paid $20,000 in carbon tax had the tax been in place, or two percent of gross sales. The Excess Burden Percentage is defined as the percentage of gross sales in the base year less the Maximum Tax Rate. Here that is: 2% - 1% = 1%.

In year two, the first year after the new tax is enacted, Big Steel Co. doubles its output to $2,000,000 without changing its efficiency, and so purchases 6611.6 tons of coal, paying $40,000 in carbon taxes. Big Steel receives a credit equal to its gross sales times the Excess Burden Percentage, here $2,000,000 x 1%, or $20,000. This results in a tax net of credit of $20,000, which is one percent of gross sales, the Maximum Tax Rate.

In year three Big Steel installs a new high-efficiency furnace. It continues to produce $2,000,000 in steel, but consumes only 4958.7 tons of coal, a 25 percent reduction. Thus it pays only $30,000 in carbon tax. However, the firm is still entitled to the same credit, $2,000,000 x 1%, or $20,000. Thus the net tax falls to $10,000, reducing the effective rate by 50 percent to one-half of one percent. Under an incremental carbon tax efficiency gains pay big tax dividends.

Note that if Big Steel cuts its production, say to $500,000, without improving efficiency, its credit is cut proportionally, to $500,000 x 1% = $5,000. The

The impact of carbon taxes on output prices can be set to a very low level without losing a great deal of revenue. For instance, if the maximum increase in an industry's output price were set at one-half of one percent, the credit would cost only about one-tenth of the revenue from the tax. Only a few industries — cement, aluminum, steel, nitrogenous fertilizer, and perhaps chlorine — would require credits. The tax burden on each industry with and without a credit is shown in Appendix 2. Column 6 shows the burden of a $7.50 carbon tax as a percentage of the value of shipments. This is how much the price of an industry's product would increase if all of the tax burden were passed on in the price of output. Columns 7 through 13 show the total tax burden under caps set at various percentages of value of sales. These revenue numbers should be compared to the numbers in column 3, which shows the carbon tax revenue without a credit. Finally, the credit rate for each industry can be calculated by subtracting the maximum percentage of sales at the top of columns 7 through 13 from the actual percentage of sales shown in column 6. For example, the $7.50/ton carbon tax would be 1.11% of the value of shipments for the aluminum industry. Thus a credit intended to cap the price increase from the tax at half a percent of sales would be 1.11 - 0.5 = 0.61% of sales. An equivalent tax based on tonnage of aluminum instead of sales could easily be calculated.

Such a credit would be easy for firms to comply with and the state to administer. All states already require firms to calculate and report their sales for purposes of sales, income, gross receipts, and other state business taxes, so the additional compliance burden would be minimal. Moreover, the auditing burden would also be minimal because firms would have no incentive to cheat. A firm could only receive a larger credit by reporting more sales. Additional sales, however, would also result in increases in other business taxes which would likely exceed the tax decrease from the credit. Thus, the only way a firm can increase its tax savings from the

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effective tax rate remains the same as if production were not cut. Efficiency gains lower the firm's effective rate, but production cuts do not.

credit is to improve its energy efficiency. Efficiency improvements can yield substantial tax advantages under a percentage of sales capping credit.[66] The carbon tax/capping credit combination can therefore be an effective device for encouraging energy conservation.

The credit mechanism is also an efficient device for offsetting competitive burdens. It provides each industry with the tax relief that is strictly proportional to the burden on that industry. It focusses relief on those firms that need it, regardless of size and other irrelevant distinctions. It also sets a cap on the price increase caused by the tax which is the same for all industries and so should be regarded as fair. The credit discriminates only on the basis of variations in fossil fuel intensity within each industry, rewarding firms which consume fossil fuels efficiently or move to non-fossil energy sources, and punishing firms with above-average levels of fossil fuel use and emissions. It should be noted, however, that fossil fuel-reliant firms which achieve substantial efficiency gains can end up with very low effective energy tax rates when the credit and the tax are considered together. This may create a perception of unfairness if the environmental purpose of the tax is not sufficiently well understood.[67]

D. Offsetting Competitive Burdens: A Carbon Consumption Tax

Under an ideal carbon consumption tax, all imports would be taxed on the carbon content of the fuel used to produce them, and all exports would receive a rebate of carbon taxes associated with fuels used to produce those exports. Practically speaking, such a comprehensive system of border adjustments is neither necessary nor desirable. Only a small

66. *See supra* note 65.

67. All incremental taxes face certain problems, first and foremost of which is the definition of the tax liability in the base period. Special rules are needed for mergers, spin-offs and new firms. For a discussion of these rules, see Steven R. Corrick & Martin A. Sullivan, *An Incremental Investment Tax Credit: Can It Deliver on Its Promise?*, 58 TAX NOTES 209 (1993), and J. Andrew Hoerner, *Cheap, Effective, or Fair — Pick Any Two to Design an ITC*, 58 TAX NOTES 221 (1993).

proportion of all goods that move in interstate commerce have an energy content high enough to justify the administrative cost of a system of special compensating taxes on imports or of export credits. The affected goods would be those produced by the same industries which might suffer a competitive burden under a carbon emissions tax as discussed above: cement, aluminum, steel, nitrogenous fertilizer and perhaps chlorine.

Adjustments would take place on both exports and imports. A rebate or credit on exports would be easy to administer and would not create troublesome constitutional issues. Most states already require companies which are engaged in interstate commerce to distinguish in-state and out-of-state sales as part of the process of allocating the firm's total income between the states. A firm could be given a credit in an amount equal to the carbon tax paid multiplied by the percentage of all sales which are out-of-state sales. For diversified firms, the credit would have to be calculated by product line to avoid a situation where, for example, the tax liability from in-state production of cement was not reduced as a result of out-of-state sale of software.

The more troubling issues arise on imports. When a wholesaler of copper pipe or aluminum siding sells to an in-state contractor, it is probable that neither party has any idea of the nature or quantity of fuel used to produce the goods sold. Moreover, many thousands of firms may be involved in selling such goods over a state's borders. To be enforceable, a tax on carbon emissions embodied in imports would have to be based on simple observable qualities of the goods, or be easily calculable from those observable qualities.

The easiest way to construct such a tax would probably be a per-pound or per-ton tax on the import of the most energy-intensive goods, such as cement, aluminum, steel, and nitrogenous fertilizers, based on national or regional data on carbon fuels used to create those goods. This would provide a working solution to the problem of taxing imports that would probably be adequate to offset the major economic distortions of the tax and preserve the competitiveness of the state market. However, it might raise constitutional interstate com-

merce issues, because the tax on imports would not be defined in the same way as the tax on in-state production.

E. Constitutional Issues

Under the Commerce Clause of the Constitution,[68] a state may place taxes on interstate commerce which complement the taxes that it places on its own commerce. These taxes have the purpose and effect of equalizing the tax burden on interstate and intra-state transactions. When examining this issue a court will consider a state's tax system as a whole, and will not reject a tax which on its face applies only to interstate commerce where the tax system, "taken in its totality, is within the state's constitutional power."[69] In *Henneford v. Silas Mason*, the Supreme Court approved a Washington state use tax set at the same rate as the state's sales tax, which included a credit against sales taxes previously paid on goods in another state. The Court found that the purpose and effect of the tax was to equalize the tax burden on state and interstate commerce and not to discriminate against interstate commerce.[70]

A carbon emissions tax, which has no special treatment of interstate trade except to tax imports of fuels and electricity and to rebate the carbon tax paid on exported fuels, treats fuels in the same way as existing sales and motor fuel excise taxes do and is clearly allowed under *Silas Mason*. It is less obvious, however, whether the equalizing tax which a carbon consumption tax would impose on the carbon content embodied in imported goods would survive a challenge under the Commerce Clause. This is because the tax on imported goods is calculated on a different base — embodied carbon — than the tax on in-state production, which is imposed directly on fossil fuels. However, it will be shown below that such a tax,

68. "The Congress shall have Power . . . [t]o regulate Commerce . . . among the several States." U.S. CONST., art. I, § 8.

69. Henneford v. Silas Mason, 300 U.S. 577, 584 (1937) (quoting Gregg Dyeing Co. v. Query, 286 U.S. 472, 480 (1932)).

70. *Id.* at 581. *See also*, W. Hellerstein, *Complementary Taxes as a Defense to Unconstitutional State Tax Discrimination*, 39 TAX LAWYER 405 (1986).

properly designed, meets the constitutional standard under the Commerce Clause.

Prior to 1977, case law suggested that a state could not place a tax on an out-of-state entity for the privilege of doing business in the state.[71] The Supreme Court rejected this view in *Complete Auto Transit, Inc. v. Brady*,[72] in which it announced a four-prong test for the validity of a tax under the Commerce Clause. Under the *Complete Auto* test, a tax is valid where the transaction (1) has sufficient nexus to the state, (2) is fairly apportioned, (3) does not discriminate against interstate commerce, and (4) is reasonably related to services provided by the state.[73] Each of these factors will be considered in turn.

1. Nexus

An activity is required to have a sufficiently close relationship with a state in order to bring it properly within the reach of the state's sovereignty. There is clearly no nexus problem with respect to taxing in-state sales or imposing compensating use taxes on in-state use. Thus, there would appear to be no nexus issue with taxing fuel-intensive goods on import. Indeed, many states now impose their taxes on gasoline and other fuels on the shipper or the first recipient on import.

The issue would become somewhat more problematic if the state attempted to impose its tax on out-of-state entities shipping goods into the state. The Supreme Court has been gradually relaxing the nexus requirements, and now recognizes that a state has the authority to tax a firm as long as the firm has at least one employee,[74] or a representative independent contractor within the state.[75] However, this nexus

71. *See, e.g.*, Boston Stock Exchange v. State Tax Comm'n, 429 U.S. 318 (1977); General Motors Corp. v. Washington, 377 U.S. 436 (1964); Illinois Cent. R. Co. v. Minnesota, 309 U.S. 157 (1940).

72. 430 U.S. 274 (1977).

73. *Id.* at 279.

74. Standard Pressed Steel Co. v. Dep't of Revenue, 419 U.S. 560 (1975).

75. Scripto, Inc. v. Carson, 362 U.S. 207 (1960).

requirement is not satisfied if the firm's only contact with the state is by mail.[76]

2. Apportionment

Income attributable to multistate operations must be fairly apportioned in order to prevent multiple taxation. *Moorman Manufacturing Co. v. Blair*[77] held that Iowa could allocate corporate income by a single-factor, the corporation's in-state sales as a fraction of total sales, even though this allocated more income to Iowa than the three-factor test (sales, payroll and property) used by most states. The Supreme Court found that:

> states have wide latitude in the selection of apportionment formulas and that a formula-produced assessment will only be disturbed when the taxpayer has proved by "clear and cogent evidence" that the income attributed to the state is in fact "out of all appropriate proportion to the business transacted . . . in that state" or has "led to a grossly distorted result."[78]

Under a carbon emissions tax, the tax burden on fuel and electricity consumption by a multi-state firm is apportioned according to the proportion of energy from fossil fuels, including carbon consumption embodied in electricity consumption consumed in-state. Under a carbon consumption tax, the tax burden on fuel consumption of a multi-state firm is apportioned according to the proportion of sales of final goods in the state. Given the wide latitude that the Supreme Court has accorded states in their apportionment, it seems clear that either of these systems would pass constitutional muster.

3. Discrimination

A state is not permitted to impose taxes which are intended to discriminate against interstate commerce or which have the effect of discriminating against interstate com-

76. Quill Corp. v. North Dakota, 112 S. Ct. 1904 (1992).
77. 437 U.S. 267 (1978).
78. *Id.* at 274.

merce. The Commerce Clause's ban on discrimination is obviously violated where there is direct evidence that a tax is intended to discriminate, such as a tax imposed on out-of-state entities which is not a complement to a tax of the same magnitude on in-state entities,[79] or a tax on both in-state and out-of-state entities which includes credits or exclusions that substantially exempt in-state entities from the tax.[80] In these cases, intent to discriminate can be inferred from the nature and structure of the tax.

Although some scholars have argued that the dormant Commerce Clause requires the invalidation of state legislation only when the discrimination against interstate commerce is intentional,[81] it is clear that in the arena of taxation the Supreme Court has gone further and has barred a class of taxes which have the effect of placing additional burdens on interstate commerce regardless of intent. Where the tax does not discriminate against interstate commerce on its face or where it is intended to complement a tax on intra-state commerce, the Court will examine the totality of the burdens imposed by the tax system and will conclude that the tax is discriminatory only if the burden that the tax places on interstate commerce is so disproportionate to the burden on local commerce as to bear unfairly on the former.[82]

Since 1983, the Supreme Court has adopted a second test under the rubric of non-discrimination, that of "internal consistency," which is also applied in apportionment cases.[83] The Court defines a tax as internally consistent if two or more states with an identical tax system would subject the taxed interstate activity to multiple tax burdens. A state is constitutionally permitted to use a tax system which in practice — given the actual tax systems of other states — places additional burden on interstate commerce, provided that the

79. Armco Inc. v. Hardesty, 457 U.S. 638, 643-44 (1984).

80. Maryland v. Louisiana, 451 U.S. 725 (1981).

81. *See, e.g.*, Donald H. Regan, *The Supreme Court and State Protectionism: Making Sense of the Dormant Commerce Clause*, 84 MICH. L. REV. 1091 (1986).

82. Dunbar-Stanley Studios, Inc. v. Alabama, 393 U.S. 537, 542 (1969); Alaska v. Arctic Maid, 366 U.S. 199 (1961).

83. Container Corp. of America v. Franchise Tax Bd., 463 U.S. 159, 169 (1983).

formula is "internally consistent" such that there would be no multiple taxation if every state used that formula. The Court appears to believe that the evaluation of the internal consistency of a tax, unlike the evaluation of the precise level of burden that a tax imposes, is within its scope of review. As a result, it has been willing to invalidate taxes which are not internally consistent even where the additional burden placed on interstate commerce by the tax is quite modest.[84]

A carbon consumption tax will most likely run afoul of the discrimination prong of the *Complete Auto* test. The tax facially discriminates against energy-intensive imports, but is arguably a complementary tax to the in-state tax on fossil fuels. Because the intent of the tax is to achieve equality, and because a tax on the actual implicit carbon content of imports would be difficult if not impossible to administer, the Supreme Court is likely to accept the tax so long as in practice it does not place a substantial additional burden on out-of-state companies relative to similarly situated in-state companies.

So long as the tax rates on imported high-energy products are correctly set, out-of-state companies should, on the average, bear the same tax burden as in-state companies. However, a highly energy-efficient out-of-state company or an electricity-intensive company from a state with more non-fossil electricity production may bear an excessive burden compared to an equally energy-efficient in-state company. In order to assure that the tax is constitutionally valid with respect to such companies, the state should create a mechanism which allows an out-of-state company to calculate the actual implicit carbon content of its product and the carbon tax that would apply to the portion of its product shipped to the state. In addition, the company would receive a rebate of any excess of the tax collected on import and the tax due based on actual fuel consumption.

84. Armco Inc. v. Hardesty, 467 U.S. 638, 644 (1984) (holding West Virginia's wholesale gross receipts tax unconstitutional); Tyler Pipe Indus., Inc. v. Washington Dep't of Revenue, 483 U.S. 232, 240 (1987) (holding Washington's manufacturing tax unconstitutional).

Similarly, to avoid problems with the internal consistency test, it would probably be wise to include a credit against carbon taxes — taxes on fossil fuels set proportional to their carbon content — paid in other states. No credit should be granted for taxes on fossil fuels which are not carbon taxes, because such taxes would not necessarily produce the environmental benefits of carbon taxes.

It is worth noting that for unit taxes such as carbon taxes, unlike ad valorem taxes, the tax does not vary depending on the point in the chain of production at which it is imposed. A tax on coal levied per ton of carbon is of the same dollar amount whether levied at the mine mouth, on combustion, or at any intermediate point.[85] Moreover, for unit taxes, economic theory suggests that the incidence is the same whether the tax is imposed on the buyer or the seller. A tax on interstate commerce designed and intended to complement a tax on intrastate commerce violates the Commerce Clause only if it places a palpably disproportionate burden on interstate commerce.[86] Because the point at which a carbon tax is levied alters neither the level of burden nor the distribution of the incidence of the tax, it should be possible to set the point of taxation based on administrative convenience without running afoul of the Commerce Clause.

4. Reasonable Relationship to State Services

The final prong of the *Complete Auto* test is whether the tax is reasonably related to services provided by the state. This test does not ask the courts to balance the tax rate against the value of the services the state provides, but rather asks if "the measure of the tax is reasonably related to the taxpayer's activities or presence in the state."[87] The principal remaining impact of the requirement that a tax be rea-

85. An ad valorem tax set at a fixed rate will impose a higher burden on delivered coal than on coal at the mine mouth because of the increase in value and price attendant on delivery.

86. Alaska v. Arctic Maid, 366 U.S. 199 (1961).

87. Commonwealth Edison Co. v. Montana, 453 U.S. 609, 628 (1981) (upholding a severance tax on coal which was almost entirely borne by out-of-state purchasers).

sonably related to services would appear to be some stricture against applying flat taxes equally to interstate and intrastate commerce where state residents are likely to enjoy greater benefits from the subject of the tax.[88] This restriction is not relevant to the carbon tax.

F. Point of Taxation

Economic theory suggests that the point in the chain of distribution at which the carbon content of a fuel is taxed does not affect the economic incidence of the tax. The point of collection may be very important, however, in determining how easy the tax is to administer and audit, and thus may have an important direct impact on the compliance rate and indirect impact on the tax revenue. Because a carbon tax is essentially a broad-based tax on fossil fuels, it is important to coordinate the carbon tax with the other energy taxes imposed by a state.

To simplify collection, it is commonly proposed that a national carbon tax be levied at the point fossil fuels enter the economy, i.e., the mine mouth, wellhead, or dock.[89] In most cases, state carbon taxes will be collected in the same manner and at the same time as the states' other taxes on the same fuels. For instance, a state which now taxes gasoline on import should probably impose the carbon tax on gasoline on import. If the state taxes gasoline at the pump, it should impose the carbon tax at the pump. The carbon tax can be rolled into existing taxes without any need for additional administrative procedures and without creating any additional compliance burden.

It is important to examine the entire range of current energy taxes in a state and the state's pattern of fuel use in determining how a carbon tax is collected. For instance, motor fuels sold to common carriers are taxed under a separate system in most states. A state like Montana which consumes only in-state coal could roll the coal portion of its carbon tax into its severance charge, while a state that both produces

88. American Trucking Ass'ns v. Scheiner, 483 U.S. 266 (1987).
89. DOWER & ZIMMERMAN, *supra* note 34, at 5.

and imports coal might wish to levy the tax on import and at the mine mouth, or to levy the tax on consumption. For new taxes, it normally makes sense to look for narrow points in the distribution scheme, points where the number of taxpayers and the possibilities of evasion are smallest.

The tax on electricity and gas might be levied on electric and gas utilities, narrow points in the supply system at which many states already collect taxes. Direct consumption of coal should be taxed at a point appropriate to a state's supply and use patterns. For electricity, the tax should vary with the fuel mix of each utility. Accounting rules will be needed to establish the fuel mix for utilities that participate in power-sharing pools or purchase out-of-state power. The tax should be designed to avoid double-taxation of such things as co-generated electricity. Federalism concerns suggest that a carbon tax should also be designed to avoid taxing electricity and fossil fuels which are exported from the state. As a matter of fiscal policy, however, some states may choose to apply the tax to exports of fuel or electricity. West Virginia, for instance, currently applies its utility tax to electricity which is sold outside the state as well as within the state.[90] From the perspective of selecting a base for an environmental tax within a federal system, the decision to tax exported fuels or electricity is best supported if the primary goal is to reduce local environmental impacts from fossil fuel consumption rather than from global warming.

A carbon tax differs from other fossil fuel excises in several ways that may alter the point at which it is taxed or require additional administrative procedures. For example, fossil fuels used as feedstocks rather than burned, such as oil used in the manufacture of plastics, should be exempted from tax. Often a taxpayer will use a fuel both for energy and for a feedstock. The simplest way of dealing with this problem is to create a refundable credit in the state's general business tax for carbon tax paid on fuels used as feedstocks, which

90. "The measure of th[e] tax shall be the value of all the electric power generated or produced in this state for sale, profit, or commercial use, regardless of the place of sale or the fact that transmission may be to points outside this state." W. VA. CODE § 11-13-2m(b) (1994).

would require taxpayers to maintain auditable records of feedstock use. If the state imposes its tax on the fuel in question at the point of sale to the final consumer, however, it may be possible to exempt those who use the fuel only as a feedstock, perhaps by creating a program of exemption certificates for feedstock users. Even under a feedstock exemption program it is important that the recipient of exempt fuel maintain auditable records of exempt fuel use to forestall the sort of illicit trade in untaxed fuel that has developed in the kerosene industry.[91]

The second difference is that because the fundamental rationale of a carbon tax suggests that the tax should be applied to the entire fossil fuel base, the tax should not include many of the exemptions that some states have allowed against other fossil fuel taxes. For instance, it is inappropriate to exempt fuel used in farming, home heating oil, or fuels used by state agencies, as many states have now done. This may require that the tax be collected from different parties or from sources who are unused to paying fossil fuel taxes. As an example, dealers in home heating oil in a state which exempts such oil from taxation would be brought into the excise tax system if the tax is imposed on sales to the final consumer. This may also create political opposition from groups that have been accustomed to receiving preferential treatment under existing taxes on fossil fuels.

The existence of a tax, even at a low level, which applies to all fossil fuels may aid states in assuring compliance with their existing taxes on fossil fuels. The Federal Highway Administration estimated that 5% of gasoline taxes and about 25% of diesel fuel taxes were evaded in 1990, at a cost to states of more than three billion dollars.[92] The higher level of evasion on diesel fuel is largely a product of an extensive trade in exempt fuels. A carbon tax which applies to all fuels

91. See FEDERAL HIGHWAY ADMINISTRATION, REPORT NO. FHWA-PL-92-028, FUEL TAX EVASION: THE JOINT FEDERAL/STATE MOTOR FUEL TAX COMPLIANCE PROJECT 89 (1992) for a discussion of evasion problems relating to fuel tax exemptions.

92. *Id.*

consumed in a state would lead to more efficient accounting for fuels and fewer opportunities to manipulate the system.

VII. Selected Cases

Four examples of possible state carbon taxes follow. The first proposal, designed to raise general revenue, was considered by the Maryland state legislature during its 1992 session. Two examples are taken from California: a proposal put forward in the 1993 legislative session to introduce a carbon tax as an alternative to extending a temporary increase in the sales tax, and a proposal developed by the Center for Global Change for a small carbon tax to finance environmental technology development. The final example, from Minnesota, is also designed to raise revenue for environmental purposes.

A. Maryland

Faced with a widening gap between projected state revenues and expenditures, the Maryland General Assembly in mid-1991 established a joint House-Senate study group to review the state's revenue system. The group solicited ideas for new environmental taxes. The environmental community advanced various proposals that would generate revenues for state environmental programs, including a pesticides tax and solid waste fees. Although these proposals attracted interest, they failed to address the legislators' central concern of raising sufficient revenue to avoid deep spending cuts in general programs.

Among the substantial revenue options proposed by the legislature's fiscal staff were additional conventional energy taxes, including a sales tax on residential fuels and an increase in utility and electricity taxes.[93] The governor also proposed a five cent increase in the motor fuels tax. Unlike these options, a carbon tax would discriminate between clean and dirty fuels. It also raises more revenue at equivalent tax rates because it is more broadly-based than the alternatives,

93. MARYLAND DEP'T OF FISCAL SERVICES, JOINT STUDY GROUP ON REVENUES: FINAL REPORT (1991).

applying to all fossil fuels and all end use sectors. In response to a request from several legislators, the Center for Global Change developed a proposal for a carbon tax at $7.50 per ton.[94] Table II compares the revenue, environmental, and household impacts of this proposal and the alternative energy tax increases.[95]

TABLE II. STATE TAX PROPOSALS AFFECTING ENERGY USE, MARYLAND, MARCH 1992.

TAX OPTION	ESTIMATED ANNUAL REVENUE	DIRECT HOUSEHOLD IMPACT	FUELS/SECTORS AFFECTED	ENVIRONMENTAL BENEFITS
AIR POLLUTION TAX @ $7.50 per ton @ $3.75 per ton	$200 million $100 million	$45 to $55 /yr $23 to $28 /yr	• all fossil fuels • electricity from fossil fuels • all sectors	• general energy conservation • switching from dirty to clean energy sources • promotes renewables
SALES TAX ON RESIDENTIAL ENERGY USE (5%)	$110 million	$60 to $75 /yr	• electricity, natural gas, fuel oil & LPG • residential sector only	• residential energy conservation
RAISE UTILITY GROSS RECEIPTS TAX (2% to 5%)	$116 million	$15 to $35 /yr	• electricity & natural gas • all sectors	• electrical energy conservation
RAISE ENVIRONMENTAL SURCHARGE ON ELECTRICITY (0.147 to 0.5 mills per kwh)	$18 million	$4 /yr	• electricity only • all sectors	• electrical energy conservation • switching from electricity to gas
RAISE MOTOR FUELS TAX (18.5 to 23.5 cents per gallon)	$120 million	$50 /yr	• gasoline & diesel only • transportation only	• motor fuels conservation

94. On file with author at CGC, University of Maryland at College Park.

95. Estimates of air pollution and sales tax revenues from ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, PUB. NO. 0214, STATE ENERGY DATA REPORT 1992 (1994). Other revenue estimates from MARYLAND DEP'T OF FISCAL SERVICES, *supra* note 93. Household impact, estimated by Center for Global Change, represents average annual increase in household energy expenditures, including gasoline but excluding price increases in non-energy goods. Ranges reflect differences in average consumption and fuel mix between utilities.

The carbon tax proposal was included among a long list of revenue options submitted by the study group to the General Assembly, but was called an air pollution tax to emphasize its broader air quality benefits.[96] Air pollution is an important policy concern in Maryland because a large proportion of the state's population lives in areas which do not meet national air quality standards. For example, Baltimore is the fourth worst city in the nation for smog.

A $7.50 carbon tax would raise around $200 million in Maryland.[97] Figures 1 and 2 in Appendix 3 show the share of revenue raised by fuel type and end use sector. It translates into 2.25 cents per gallon on gasoline, fuel oil and other petroleum products, 1.2 cents per therm on natural gas, and $5.30 per ton on coal. For electricity, the tax would be 1.2 mills per kilowatt hour for customers of the state's largest utility, Baltimore Gas and Electric, which has a nuclear plant. Customers of the remaining major utilities, which are heavily coal-based, would be taxed 2 mills per kilowatt hour. As Table III below shows, a $7.50 per ton carbon tax results in price increases of approximately two percent for the fuels and electricity used by households. It also shows that substantially higher state and local energy taxes are already levied in Maryland.[98]

96. On file with author at CGC, University of Maryland at College Park.

97. This is a first year estimate which assumes the tax has no impact on fuel consumption or expected revenues. As discussed in the text, revenues will decline as the tax and other policies affect demand. Estimate based on DOE state energy consumption data for 1989. ENERGY INFO. ADMIN., *supra* note 95.

98. Estimates based on data compiled by Center for Global Change. Prices and tax rates are for residential customers. Prices include federal, state and local taxes. State tax rate for electricity and gas includes a two percent utility tax and a small per kilowatt-hour environmental surcharge. County taxes vary; Prince George's County is included as an example of a high energy tax county.

TABLE III. TAX RATE COMPARISON: PROPOSED AIR POLLUTION TAX (AT $7.50 PER TON) AND EXISTING ENERGY TAXES IN MARYLAND, MARCH 1992

	price (approx)	air pollution tax rate	state taxes	Prince George's County taxes
gasoline (per gallon)	$1.15	$0.0225	$0.185	-
fuel oil (per gallon)	$1.00	$0.0225	-	$0.0832
natural gas (per therm)	$0.60	$0.012	$0.012 (est)	$0.0428
electricity (per Kwh)	$0.08	$0.0011 to $0.0020	$0.0017 (est)	$0.0047

For the average household, the tax would increase expenditures for direct purchases of energy by around $50 per year, which includes about $23 for gasoline. An additional indirect burden on households would arise from the tax on businesses. But the carbon tax still compares favorably with other tax options, which tend to fall more heavily on households than businesses.[99]

In January 1992, a bill was introduced into the state Senate by Senate Majority Leader Charles Blount and Gerald Winegrad, the Chairman of the Environment Subcommittee, Senate Economic and Environmental Affairs Committee, for an air pollution tax at $3.75 per ton.[100] This bill earmarked $21 million in revenues for low income weatherization and energy assistance programs, which had suffered federal cutbacks in recent years, and measures to improve energy efficiency in state buildings.[101] The bill was the product of an alliance between representatives interested in raising revenue and serving environmental and social justice objectives. The bill went to hearings of the Senate Budget and Taxation Committee.

Negotiations for a budget deal were concurrently taking place in the House of Delegates. The House Ways and Means Committee subsequently circulated a draft bill for a carbon tax at $7.50 per ton and held hearings on the proposal.[102]

99. See Table II.
100. 1992 Md. S.B. 665.
101. *Id.*
102. MARYLAND HOUSE OF DELEGATES, *supra* note 64.

This version was directed more clearly at raising revenues and did not include the specific dedications of the Senate bill. It attracted interest from a wide spectrum of delegates, including supporters of broad-based indirect taxes.

Several important features were included in both proposals:[103]

- the tax would be collected from petroleum product distributors, electric and natural gas utilities and industrial consumers of coal, thereby taking advantage of existing tax collection systems and simplifying administration;
- revenues collected from motor fuels would go to the state's transportation trust fund but could only be spent on public transit projects and measures to reduce vehicle use;
- the amount of tax payable by an individual manufacturer would be capped to protect energy intensive industries facing interstate and international competitive pressures.

A wide range of environmental groups supported the tax idea at Senate and House hearings.[104] Most environmental groups supported adding the Senate's specific dedications to the House version and dedicating additional revenues to clean air programs currently financed through the state's general fund.

The tax was strongly opposed at the hearings by electric and gas utilities and large industrial energy consumers who argued that the additional tax burden would damage the state's economy.[105] Although they participated in the utility-led business panels at both hearings, legislators saw two interest groups as tacit supporters of the proposal: service station owners who preferred the air pollution tax (at 2.25 cents per gallon) to a proposed five cent increase in the motor fuels

103. *See id.*

104. On file with author at CGC, University of Maryland at College Park.

105. On file with author at CGC, University of Maryland at College Park.

tax, and developers of co-generation projects associated with the state's chemical industry.[106]

The Center for Global Change responded to utility criticism by pointing to Maryland's relatively low rate of taxes on electricity, natural gas, and business compared with surrounding states, as shown in Table IV.[107] Although the concerns of energy intensive industries such as steel, aluminum and paper mills that compete internationally were addressed with the cap on the amount of tax payable, they remained opposed.

TABLE IV. STATE BUSINESS AND ENERGY TAXES IN THE MID-ATLANTIC REGION, 1991

	MD	DE	DC	NJ	PA	VA	WV
Tax rate on corporate income	7%	8.7%	15%	9.4%	12.25%	6%	9.15%
Motor Fuels Tax	18.5%	19%	18%	10.5%	10.4%	17.5%	20.4%
Electric & gas utility receipts tax	2%	4.3%	9.7%	5.6%	5%	2%	4%
% of revenues from business taxes	3.6%	19.1%	7.0%	9.6%	8.1%	3.7%	6.4%

The air pollution tax proposal remained an option until the final days of the legislative session when a budget deal was sealed. Legislators finally opted for changes to the income and sales tax to balance the state's general fund and up to a five cent increase in the motor fuels tax for the transportation fund.[108] Nonetheless, many observers were surprised how far such a major new tax idea had progressed in just one year.

106. On file with author at CGC, University of Maryland at College Park.

107. Data compiled by Center for Global Change from state agency sources. Delaware exempts residential sales from the utility tax; the West Virginia utility tax is 4.3% for gas and 2% for sales to large electricity consumers. Revenue share data is for FY 1989.

108. *See* Acts of 1992, ch. 3, § 9, MD. CODE ANN. TAX-GEN. § 9-305(2) (1994). The 1992 Amendments increased the tax on four categories of motor fuels. The greatest increase, five cents per gallon, was in the second category of "gasoline other than aviation gasoline." *Id.*

B. California

1. Reducing the Sales Tax

For several years the global recession and defense cutbacks have depressed the California economy and severely strained the state's finances. In 1992 and 1993 the California legislature faced extremely difficult revenue and expenditure choices in balancing the state's budget. A major issue of concern during the 1993 legislative session was the disposition of a one-half percent portion of the state's sales and use tax that was due to expire on June 30, 1993. Expiration would have resulted in an annual revenue loss of $1.56 billion by fiscal year 1994-95.[109] At the start of the session, many legislators supported extending the tax to avoid further cutbacks in state services, but Governor Wilson opposed such an extension.[110]

Assemblyman Tom Bates introduced alternative legislation to replace the half percent increment with a $3 per ton carbon tax on fossil fuels consumed in the state, which was later amended to include a schedule of annual increases so as to reach a $21 per ton carbon tax by the year 2003.[111] The Bates proposal was estimated to raise $1.47 billion per annum, which was to be directed into the state's General Fund.

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109. 1993 Cal. A.B. 1725 (as amended May 5, 1993). *See also* Cal. Assembly Committee on Revenue and Taxation, Memorandum on A.B. 1725 (May 10, 1993) (on file with authors) [hereinafter A.B. 1725 Memorandum].

110. Interview with Chris Calwell, Natural Resources Defense Council, in San Francisco, Cal. (1993).

111. A.B. 1725 Memorandum, *supra* note 109. The actual tax rate in the bill is $3 per ton of CO_2 emitted and the base includes both the direct emissions from fuel combustion and the indirect emissions from other stages of the fuel cycle, such as extraction, refining, and transportation. Such a tax raises more revenue than an equivalent carbon tax assessed solely on fuel consumption and arguably provides a better environmental signal. On a statewide basis the California Energy Commission (CEC) estimated direct and indirect emissions of carbon dioxide associated with California's energy consumption for the year 1988. CALIFORNIA ENERGY COMM'N, 2 GLOBAL CLIMATE CHANGE: POTENTIAL IMPACTS AND POLICY RECOMMENDATIONS (1991). Assessing a tax on indirect emissions, however, which can vary considerably among different sources of the same fuel, may present administrative and fairness problems. The bill directed the CEC to estimate direct and indirect emissions and set fuel-specific tax rates.

Like the Maryland proposal, the tax applied to imported electricity,[112] and its rate was to be adjusted annually in line with the Consumer Price Index.[113] Unlike the Maryland proposal, the bill did not provide offsets for energy-intensive industries. However, an exemption for households up to a baseline level of electric and gas consumption was proposed.[114]

The Bates proposal received strong support from the environmental community and from some segments of business, including the Ford Motor Company.[115] However, it was opposed by the California Manufacturers Association, electric and gas utilities, and other energy industry interests.[116] The bill went to a hearing in the Assembly Revenue and Taxation Committee at which it was suspended, pending further discussions on the state budget.[117] A deal was ultimately reached between the Governor and the legislature that balanced the budget by diverting certain local property tax reve-

112. Approximately 20 percent of the electricity consumed in California is generated at coal-fired power plants located outside the state. CALIFORNIA ENERGY COMM'N, *supra* note 111.

113. Assemblyman Bates started with a more ambitious proposal. When first considering this issue, Bates favored a carbon tax starting at $11 per ton in 1994 and increasing annually to reach $77 per ton in 2003. A.B. 1725 Memorandum, *supra* note 109. Under this scheme the rate of the sales and use tax would be adjusted downward each year with a revenue loss equal to the revenue gain from the carbon tax. *Id.*

114. *See id.* Assemblyman Bates introduced the baseline exemption in the May 13, 1993 version of the bill. A baseline exemption would reduce revenues from the tax unless the rate on above-baseline use was increased to make up the shortfall.

115. Interview with Chris Calwell, Natural Resources Defense Council, in San Francisco, Cal. (1993); Letter from Marilyn R. Riley, Assistant Regional Manager Governmental Affairs, Ford Motor Company, to Tom Bates, California Assembly Member (Apr. 19, 1993)(on file with the PACE ENVIRONMENTAL LAW REVIEW).

116. Letters from David R. Doerr, Chief Tax Consultant, California Taxpayers' Association (May 3, 1993), Ronald C. Myron, Executive Vice President, Western Liquid Gas Association (Apr. 23, 1993), Chris Micheli, Tax & Corporate Counsel, California Manufacturers Association (May 5, 1993), Joel D. Anderson, Executive Vice President, California Trucking Association (May 5, 1993) to Tom Bates, California Assembly Member (on file with the PACE ENVIRONMENTAL LAW REVIEW).

117. Interview with Chris Calwell, Natural Resources Defense Council, in San Francisco, Cal. (1993).

nues and earmarked state funds, and extending the sales tax increment for a further six months.[118]

A possible barrier to the Bates proposal, and other carbon tax proposals in California, is a state constitutional requirement that the proceeds of motor fuel taxes be used for transportation-related purposes.[119] Nearly one third of revenues associated with the Bates proposal were estimated to come from motor gasoline alone. Supporters of the proposal argued that the tax was not a motor fuel tax per se, but an emissions tax. This matter would likely have been contested in the courts if the bill had passed.

2. Investing in Environmental Technologies

As part of a project on pollution prevention and renewable energy in the Los Angeles air basin, the Center for Global Change developed a proposal for a small carbon tax to finance a California environmental technology fund.[120] The purposes of the fund would be to speed commercialization of emerging zero-emission technologies in the energy sector and to promote technological leadership and economic growth for California.

Renewable energy technologies have declined in cost dramatically over the past decade, partly due to the innovative regulatory and legislative policies of California. The future cost of these technologies will be influenced heavily by present investment levels. The regulated utility sector, however, tends to invest at a low level in the commercialization of new technologies. Moreover, California's high electricity prices limit the potential for continued investments at the expense of ratepayers. Aggressive development of end use renewable technologies and renewable electric generation coupled with an electrification strategy can help solve California's air quality problems and reduce greenhouse gas emissions. Indeed, only by expanding the renewable share of electricity genera-

118. *See* S.B. 509, Reg. Sess., 1993 Cal. Stat. ch. 73.

119. CAL. CONST. Art. XIX, § 1.

120. FRANK MULLER & HARVEY M. SACHS, CENTER FOR GLOBAL CHANGE, A REPORT FOR THE SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (Jan. 1993).

tion will California be able to fully realize the environmental benefits of its efforts to promote electric vehicles. A small carbon tax can provide funds for investment in the commercialization of renewable technologies while spreading the cost across all energy users.

The proposed California environmental technology fund would be financed through a $3.75 carbon tax which would generate about $450 million per year in California.[121] This tax would translate into 1 cent per gallon on gasoline, 6 mills per therm on natural gas and an average of 0.4 mills per kilowatt hour on electricity. The fund would provide incentives for commercial projects involving selected near-competitive technologies. Incentives would be provided on an expanding volume/declining incentive basis through long-term competitive contracts running from five to ten years. Candidate technologies include advanced renewable electric generation, photovoltaic charging systems for electric vehicles and solar thermal end use technologies.

California's lead in renewable energy technologies is currently being challenged by European and Japanese companies aided by supportive government policies. For example, the German government provides a 4 cent per kilowatt hour production credit for new wind projects[122], whereas the Federal Energy Policy Act of 1992 provides only a 1.5 cent credit for the same type of projects.[123] The proposed carbon tax would therefore serve both competitive and environmental purposes.[124]

C. Minnesota

In 1990 the Minnesota Legislature requested a report from the state's Pollution Control Agency and Department of Natural Resources on the status of and possible incentives to reduce carbon dioxide emissions in Minnesota.[125] The result-

121. *See supra* note 73 and accompanying text.

122. INTERNATIONAL ENERGY AGENCY, THE ROLE OF IEA GOVERNMENTS IN ENERGY (1992).

123. 42 U.S.C. § 13317(e) (1988 & Supp. 1993).

124. MULLER & SACHS, *supra* note 120.

125. 1990 MINN. LAWS ch. 587, § 2.

ing report proposed a tree planting program to be funded by a fee on carbon dioxide emissions.[126] In 1991, the Legislature formally established a tree planting program, Minnesota ReLeaf, and requested a further report from the Pollution Control Agency with an implementation plan and recommendations for a fee structure.[127] This report, released in December 1991, recommends introducing a "carbon content fee," which is essentially a carbon tax on fossil fuels, at a rate of 60 cents per ton of carbon.[128] It discusses implementation issues and includes draft legislation for the proposed fee. The legislature did not act on this proposal. Although tree planting can help slow global warming and improve urban air quality, it does little to reduce energy imports or boost competitiveness. Using carbon tax revenues for investment in energy efficient infrastructure and technologies promises longer term benefits and offers greater potential for linking energy, economic and air quality goals.

The carbon taxes initiatives continued in April 1992 as a bill known as the Sustainable Energy Transition Bill was introduced into both houses of the legislature.[129] Revenues from a proposed $6 per ton carbon tax would be used for the development of a Minnesota sustainable energy transition strategy, for energy assistance and energy efficiency programs for low income families (at least 15% of revenues), and for financing energy efficiency and renewable energy programs and capital investments (at least 80% of revenue).[130] The tax would raise about $150 million per year.[131] The bill was not considered during the 1992 session of the Minnesota legislature, but was reintroduced in 1993 at the lower tax

126. DIVISION OF FORESTRY, MINNESOTA DEPARTMENT OF NATURAL RESOURCES, CARBON DIOXIDE BUDGETS IN MINNESOTA AND RECOMMENDATIONS ON REDUCING NET EMISSIONS WITH TREES: REPORT TO THE MINNESOTA LEGISLATURE (1991).

127. 1991 MINN. LAWS ch. 88, §§ 20-22.

128. MINNESOTA POLLUTION CONTROL AGENCY, CARBON FEES TO SUPPORT PROJECT RELEAF: IMPLEMENTATION RECOMMENDATIONS - REPORT TO THE MINNESOTA DEPARTMENT OF NATURAL RESOURCES (1991).

129. 1992 Minn. H.F. 3054, 1992 Minn. S.F. 2803.

130. *Id.*

131. DAVID MORRIS, INSTITUTE FOR LOCAL SELF-RELIANCE, MAKING THE POLLUTER PAY: THE CASE FOR A MINNESOTA CARBON TAX 5 (1991).

rate of $2 per ton.[132] Although a committee hearing was held in the State senate, the bill was not reported out of committee. It is expected the proposal will be revived again during the 1994 legislative session.

VIII. Conclusion

The prices paid by consumers do not reflect the true social costs of energy use. Many countries are considering the restructuring of energy taxes to reflect differences in environmental impact. A carbon tax is likely to be a cost-effective way of achieving reductions in emissions of both conventional air pollutants and carbon dioxide.

Political debate over a carbon tax and other energy taxes in the United States has lagged behind discussions in other countries. However, an array of fiscal and environmental challenges facing governments and voter resistance to income and sales taxes is likely to stimulate growing interest in such taxes. Modest carbon taxes may be an attractive option for addressing both environmental and fiscal concerns in a number of states. A carbon tax proposal was seriously considered in Maryland in 1992, and another generated considerable interest in California in 1993. These and other examples of legislative initiatives from Minnesota and California illustrate that various options are available to use carbon taxes for environmental programs and for general revenue purposes. State carbon taxes are a potential valuable addition to the arsenal of state energy taxes. State adoption of such taxes would be a valuable step toward rationalizing state energy taxation and incorporating environmental values into state tax systems.

132. Interview with David Morris, Institute for Local Self Reliance (1993).

Appendix 1

Comparison of State and National CO_2 Emissions DO STATES MATTER? (million tons of CO_2)					
Rank	Nation/State	Emissions	Rank	Nation/State	Emissions
1	United States	5,328.7	62	Sweden	63.7
2	U.S.S.R.	4,116.3	63	Pakistan	63.4
3	China	2,517.2	64	Maryland	63.4
4	Japan	1,069.3	65	Colorado	59.0
5	India	695.5	66	Iowa	57.5
6	Germany, Dem. Rep.	692.5	67	Arizona	56.8
7	United Kingdom	618.9	68	South Carolina	56.2
8	Texas	568.7	69	Colombia	55.9
9	Canada	495.7	70	Finland	55.7
10	Poland	477.8	71	Austria	54.4
11	Italy	409.6	72	United Arab Emirates	54.2
12	France	380.5	73	Malaysia	51.4
13	Mexico	339.5	74	Wyoming	51.4
14	California	322.5	75	Denmark	50.7
15	South Africa	302.2	76	Norway	50.0
16	Australia	280.3	77	Utah	49.1
17	Czechoslovakia	243.5	78	New Mexico	48.9
18	Pennsylvania	232.7	79	Algeria	47.7
19	South Korea	227.0	80	Arkansas	46.9
20	Romania	226.2	81	Mississippi	45.8
21	Ohio	222.7	82	Philippines	43.0
22	Brazil	214.4	83	Portugal	41.8
23	Spain	210.6	84	Switzerland	40.3
24	Louisiana	188.0	85	Libya	40.2
25	New York	187.8	86	North Dakota	40.0
26	Indiana	187.5	87	Singapore	38.6
27	Saudi Arabia	186.3	88	Israel	35.0
28	Illinois	184.4	89	Connecticut	34.9
29	Iran	176.2	90	Kuwait	34.4
30	Florida	170.3	91	Alaska	31.8
31	Michigan	161.6	92	Ireland	31.5
32	North Korea	161.2	93	Nebraska	29.8
33	Indonesia	144.1	94	Syria	29.1

Appendix 1 (continued)

COMPARISON OF STATE AND NATIONAL CO_2 EMISSIONS
DO STATES MATTER?
(million tons of CO_2)

Rank	Nation/State	Emissions	Rank	Nation/State	Emissions
34	Yugoslavia	141.8	95	Oregon	28.4
35	Netherlands	135.8	96	New Zealand	28.3
36	Argentina	127.8	97	Nevada	27.9
37	Georgia	126.8	98	Montana	25.3
38	Turkey	125.9	99	Trinidad & Tobago	20.3
39	Bulgaria	114.9	100	Hawaii	20.0
40	Kentucky	108.7	101	Maine	16.5
41	Belgium	104.4	102	Ecuador	15.8
42	New Jersey	104.2	103	Delaware	15.4
43	Venezuela	103.2	104	Qatar	14.5
44	Alabama	101.8	105	Bahrain	13.4
45	West Virginia	98.6	106	New Hampshire	13.0
46	North Carolina	98.2	107	South Dakota	10.4
47	Tennessee	97.0	108	Idaho	10.3
48	Missouri	94.8	109	Luxembourg	9.9
49	Nigeria	85.4	110	Gabon	8.5
50	Virginia	84.1	111	Cote d'Ivoire	8.0
51	Egypt	82.3	112	Rhode Island	7.4
52	Oklahoma	79.6	113	Vermont	4.8
53	Thailand	77.4	114	Cyprus	4.1
54	Wisconsin	77.4	115	Dist. of Columbia	4.0
55	Massachusetts	74.1	116	Costa Rica	2.5
56	Greece	71.0	117	Guinea-Bissau	2.5
57	Minnesota	70.6	118	Nicaragua	2.3
58	Iraq	69.1	119	Iceland	2.1
59	Hungary	68.5	120	Malta	1.8
60	Washington	65.9	121	Paraguay	1.7
61	Kansas	64.1			

State estimates are for 1990 and are calculated by the authors using data from ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, PUB. NO. 0214, STATE ENERGY DATA REPORT 1992 (1994). National estimates are for 1989 from WORLD RESOURCES INSTITUTE, WORLD RESOURCES 1992-93 346-347 (1992), excluding emissions from cement manufacture. Some countries have significant CO_2 emissions from the destruction of natural carbon sinks, such as forests, not included here.

Appendix 2

CARBON TAX AS A PERCENTAGE OF ANNUAL SHIPPING VALUE BY INDUSTRY: REVENUE AND REVENUE SUBJECT TO PERCENT OF SHIPMENT CAPS (based on 1988 shippings and energy use)

SIC Code	Industry	Carbon Tax Rev. ($ mill)	Clinton Btu Tax Rev. ($ mill)	Value Shipments ($ mill)	Carbon Tax as a % of Shipments	Carbon Tax Revenue with Various % of Shipment Caps ($ mill)						
						0.1%	0.2%	0.3%	0.4%	0.5%	0.6%	0.7%
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
33	Primary Metal Industries	$570.2	$883.2	$149,079.8	0.38%	$149.1	$298.2	$447.2	$570.2	$570.2	$570.2	$570.2
3312	Blast Furnaces and Steel Mills	$391.3	$542.8	$ 47,706.3	0.82%	$ 47.7	$ 95.4	$143.1	$190.8	$238.5	$286.2	$333.9
3334	Primary Aluminum	$ 76.2	$146.5	$ 6,860.3	1.11%	$ 6.9	$ 13.7	$ 20.6	$ 27.4	$ 34.3	$ 41.2	$ 48.0
	Prim. Metals Excluding Alum & Steel	$102.7	$193.8	$ 94,513.2	0.11%	$ 94.5	$102.7	$102.7	$102.7	$102.7	$102.7	$102.7
32	Stone, Clay & Glass Products	$165.7	$300.2	$ 63,059.4	0.26%	$ 63.1	$126.1	$165.7	$165.7	$165.7	$165.7	$165.7
26	Paper & Allied Products	$213.3	$425.2	$122,556.2	0.17%	$122.6	$213.3	$213.3	$213.3	$213.3	$213.3	$213.3
2621	Paper Mills	$112.0	$218.9	$ 31,922.9	0.35%	$ 31.9	$ 63.8	$ 95.8	$112.0	$112.0	$112.0	$112.0
2631	Paperboard Mills	$64.5	$126.3	$ 15,497.2	0.42%	$ 15.5	$ 31.0	$ 46.5	$ 62.0	$ 64.5	$ 64.5	$ 64.5
	Paper excluding Paper & Paperboard Mills	$36.8	$ 80.0	$ 75,136.1	0.05%	$ 36.8	$ 36.8	$ 36.8	$ 36.8	$ 36.8	$ 36.8	$ 36.8
28	Chemicals & Allied Products	$401.8	$799.0	$259,699.1	0.15%	$259.7	$401.8	$401.8	$401.8	$401.8	$401.8	$401.8
2819	Industrial Inorganic Chemicals	$53.4	$104.2	$ 11,079.1	0.48%	$ 11.1	$ 22.2	$ 33.2	$ 44.3	$ 53.4	$ 53.4	$ 53.4
2821	Plastics and Resins	$40.4	$ 81.4	$ 34,235.3	0.12%	$ 34.2	$ 40.4	$ 40.4	$ 40.4	$ 40.4	$ 40.4	$ 40.4
2869	Industrial Organic Chemical	$113.9	$228.4	$ 42,806.2	0.27%	$ 42.8	$ 85.6	$113.9	$113.9	$113.9	$113.9	$113.9
2873	Nitrogenous Fertilizers	$24.2	$ 50.9	$ 3,280.7	0.74%	$ 3.3	$ 6.6	$ 9.8	$ 13.1	$ 16.4	$ 19.7	$ 23.0
	Chemicals excluding Industrial Org., Ind. Inorg., Plastics & Fertilizers	$170.0	$334.1	$168,297.8	0.10%	$168.3	$170.0	$170.0	$170.0	$170.0	$170.0	$170.0
29	Petroleum & Coal Products	$152.9	$361.2	$131,414.8	0.12%	$131.4	$152.9	$152.9	$152.9	$152.9	$152.9	$152.9
2911	Petroleum Refining	$142.6	$333.4	$112,988.8	0.13%	$113.0	$142.6	$142.6	$142.6	$142.6	$142.6	$142.6
	Petroleum excluding Refining	$10.3	$ 27.8	$ 18,426.0	0.06%	$ 10.3	$ 10.3	$ 10.3	$ 10.3	$ 10.3	$ 10.3	$ 10.3

Appendix 2 (continued)

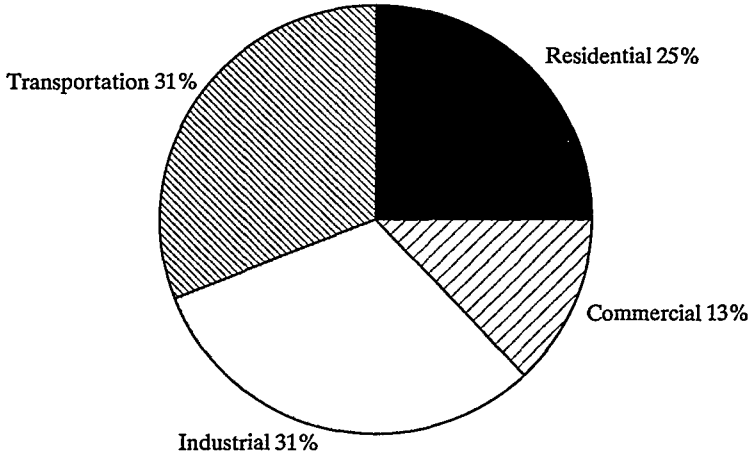
CARBON TAX AS A PERCENTAGE OF ANNUAL SHIPPING VALUE BY INDUSTRY:
REVENUE AND REVENUE SUBJECT TO PERCENT OF SHIPMENT CAPS
(based on 1988 shippings and energy use)

SIC Code	Industry	Carbon Tax Rev. ($ mill)	Clinton Btu Tax Rev. ($ mill)	Value Shipments ($ mill)	Carbon Tax as a % of Shipments	Carbon Tax Revenue with Various % of Shipment Caps ($ mill)						
						0.1%	0.2%	0.3%	0.4%	0.5%	0.6%	0.7%
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
22	Textile Mill Products	$57.5	$114.6	$ 64,767.9	0.09%	$ 57.5	$ 57.5	$ 57.5	$ 57.5	$ 57.5	$ 57.5	$ 57.5
30	Rubber & Misc. Plastics Products	$54.0	$111.1	$ 94,200.2	0.06%	$ 54.0	$ 54.0	$ 54.0	$ 54.0	$ 54.0	$ 54.0	$ 54.0
20	Food & Kindred Products	$163.8	$327.2	$357,514.9	0.05%	$163.8	$163.8	$163.8	$163.8	$163.8	$163.8	$163.8
24	Lumber & Wood Products	$ 27.8	$ 62.0	$ 72,065.4	0.04%	$ 27.8	$ 27.8	$ 27.8	$ 27.8	$ 27.8	$ 27.8	$ 27.8
34	Fabricated Metal	$ 63.9	$130.7	$158,833.8	0.04%	$ 63.9	$ 63.9	$ 63.9	$ 63.9	$ 63.9	$ 63.9	$ 63.9
31	Leather & Leather Products	$ 3.3	$ 7.4	$ 9,663.7	0.03%	$ 3.3	$ 3.3	$ 3.3	$ 3.3	$ 3.3	$ 3.3	$ 3.3
25	Furniture & Fixtures	$ 10.6	$ 22.2	$ 39,226.1	0.03%	$ 10.6	$ 10.6	$ 10.6	$ 10.6	$ 10.6	$ 10.6	$ 10.6
36	Electronic & Other Electric Equip.	$ 49.5	$ 99.6	$186,950.8	0.03%	$ 49.5	$ 49.5	$ 49.5	$ 49.5	$ 49.5	$ 49.5	$ 49.5
35	Industrial Machinery & Equip.	$ 59.0	$117.9	$243,357.6	0.02%	$ 59.0	$ 59.0	$ 59.0	$ 59.0	$ 59.0	$ 59.0	$ 59.0
39	Misc. Manufacturing Industries	$ 8.0	$ 16.5	$ 34,869.4	0.02%	$ 8.0	$ 8.0	$ 8.0	$ 8.0	$ 8.0	$ 8.0	$ 8.0
38	Instruments & Related Products	$ 25.9	$ 49.6	$114,528.4	0.02%	$ 25.9	$ 25.9	$ 25.9	$ 25.9	$ 25.9	$ 25.9	$ 25.9
37	Transportation Equipment	$ 72.8	$147.0	$354,047.8	0.02%	$ 72.8	$ 72.8	$ 72.8	$ 72.8	$ 72.8	$ 72.8	$ 72.8
23	Apparel & Other Textile Products	$ 11.5	$ 23.6	$ 65,032.0	0.02%	$ 11.5	$ 11.5	$ 11.5	$ 11.5	$ 11.5	$ 11.5	$ 11.5
27	Printing & Publishing	$ 25.7	$ 51.7	$143,906.8	0.02%	$ 25.7	$ 25.7	$ 25.7	$ 25.7	$ 25.7	$ 25.7	$ 25.7
21	Tobacco Products	$ 5.1	$ 7.9	$ 23,831.8	0.02%	$ 5.1	$ 5.1	$ 5.1	$ 5.1	$ 5.1	$ 5.1	$ 5.1
SUM OF MANUFACTURING (Million $)		$2,142.4	$4,057.7	$2,682,605.9	0.08%	$1,317.8	$1,585.7	$1,769.9	$1,870.5	$1,940.0	$1,997.8	$2,055.7
Percentages of Revenue Lost from Industrial Sector						38.5%	26.0%	17.4%	12.7%	9.4%	6.7%	4.0%

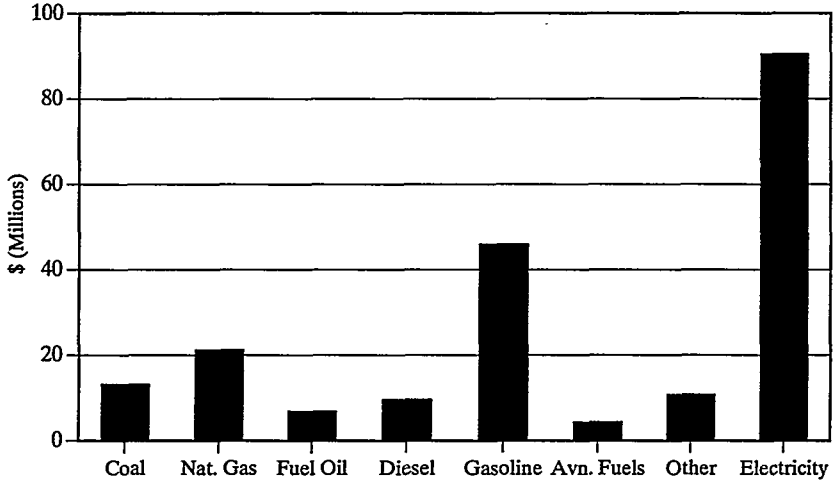
Energy use by industry from ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, PUB. NO. 0512, MANUFACTURING ENERGY CONSUMPTION SURVEY: CONSUMPTION OF ENERGY (1988). Shipping data from Annual Survey of Manufacturers, Statistics for Industry Groups and Industries. Fuel consumption by electric utilities and electricity consumption from ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, PUB. NO. 0214, STATE ENERGY DATA REPORT ON CONSUMPTION 1992 (1994).

Appendix 3

Estimated Revenue Shares by End Use Sector



Estimated Revenue by Fuel Type



Revenues calculated by authors using state energy consumption data published by U.S. Department of Energy (DOE/EIA-0214(92))