ENVIRONMENTAL LAW • INSTITUTE®

ENVIRONMENTAL LAW INSTITUTE
RESEARCH REPORT

Implementing an Emissions Cap and Allowance Trading System for Greenhouse Gases: Lessons from the Acid Rain Program

September 1997

IMPLEMENTING AN EMISSIONS CAP AND ALLOWANCE TRADING SYSTEM FOR GREENHOUSE GASES: LESSONS FROM THE ACID RAIN PROGRAM

Environmental Law Institute

Acknowledgements

This report was prepared by the Environmental Law Institute under Cooperative Agreement CR-822795-01, with the collaboration of Erik Haites and Trexler & Associates, Inc., and with funding from the U.S. Environmental Protection Agency. ELI staff who contributed to this report include Byron Swift, Jay Pendergrass, Eric Wilkinson, Vanessa Reeves and Carol Riegelman. ELI wishes to express particular appreciation to EPA's Office of Policy, Programs and Evaluation, project manager Lisa Carter of the Office of Economy and Environment, and EPA's Acid Rain Division for their full cooperation. Finally, ELI would like to thank the numerous representatives of government agencies, universities, NGOs and private businesses who have generously provided information and recommendations for this report.

Disclaimer

Although the information in this document has been funded in part by the United States Environmental Protection Agency under Cooperative Agreement CR-822795-01 to ELI, it may not necessarily reflect the views of the Agency and no official endorsement should be inferred.

Implementing an Emissions Cap and Allowance Trading System for Greenhouse Gases: Lessons From the Acid Rain Program

ELI Project #941722

Table of Contents

Executive Summary

This report discusses specific lessons learned from the Acid Rain Program, contained in Title IV of the Clean Air Act Amendments of 1990 (CAAA), that apply to an emissions cap and allowance trading system for greenhouse gases (GHGs). Chapter II discusses the basic design features in applying an emissions cap and allowance trading system to emissions of CO_2, methane and other GHGs. Chapter III evaluates lessons from Title IV, and discusses specific issues in establishing a similar regulatory system for GHGs.

The essential elements required to impose an emissions cap and allowance trading system are present with GHGs. First, none of the principal GHGs cause local health or ecosystem effects, and they are not criteria or toxic pollutants. Second, because the temporal or spatial concentration of GHGs is of concern only at the global level, an emissions cap and allowance trading system is well suited for their control.

CO_2 emissions. Lessons from Title IV can be applied to either a fuels or an industrial model for CO_2 control. A fuels model would apply to energy providers like coal and oil companies, and has the advantage of capturing 98% of all CO_2 emissions in regulating only 3,000-6,000 entities. An industrial model would regulate major industrial users of energy. It could capture approximately 67-80% of domestic CO_2 emissions by covering the utility, transportation and selected major manufacturing industries in a system covering about 4,000-10,000 entities; it would, however, fail to capture emissions relating to home, commercial and certain industrial energy use. Under either option, therefore, the number of entities regulated would not be significantly greater than the 2,000 utilities to be covered under Phase II of the Acid Rain Program.

Methane emissions. An emissions cap and allowance trading program for methane can result in significant early reductions because many sources of methane can feasibly and cheaply reduce emissions. Methane is generated by five discrete sectors, only some of which can be reasonably included in an emissions cap and allowance trading system. These include landfills (36% of US emissions), coal mines (11%) and some sources of emissions from oil and gas production systems. Methane from ruminant animals and animal waste systems are generated by too many small sources to include in this regulatory system, although large sources could participate through a voluntary opt-in procedure.

Other GHG emissions. Several greenhouse gases, such as hydrofluorocarbons, perfluorocarbons and nitrous oxide, are emitted in small volumes but have global warming potential hundreds or thousands of times greater than carbon dioxide. Most of these emissions can be captured by including the sources, primarily the manufacturers, in a regulatory system.

Applying the lessons learned from Title IV to a GHG program requires the consideration of differences between SO_2 - the focus of Title IV - and the GHGs to be regulated. These differences include the greater number of gases and emitting industries in a GHG system, differences in characteristics of the gases and the industrial sources, and the lack of practical treatment strategies for CO_2, the principal GHG.

Our review shows that many elements of Title IV are directly applicable to a GHG emissions cap and allowance trading system, and these are described immediately below. Other elements should be modified in part, and are described in the subsequent section.

Elements of Title IV Directly Applicable to a GHG System. Important elements of Title IV can be directly incorporated into a GHG system. These include:

- a **fixed emissions cap** is the backbone of Title IV, and establishes a performance standard that allows flexibility in compliance alternatives. The legislative branch should set the GHG cap, with reference to international treaties;

- **full banking and trading** of allowances allows firms significant flexibility in compliance investment and decision-making;

- **high quality monitoring** is essential to allow effective monitoring of compliance as well as banking and trading;

- a publicly open **allowance tracking system** helps to create a transparent and self-enforcing compliance system;

- automatic **high penalties for non-compliance** help to achieve a high compliance rate with low transaction costs;

- an **opt-in program** can expand the number of entities covered in a regulatory systems, although experience has shown its high administrative costs may reduce its usefulness.

Studies by the Government Accounting Office and other researchers have concluded that Title IV's emissions cap and allowance trading approach has achieved strict environmental goals at dramatically lower costs than traditional forms of regulation. These benefits appear to derive primarily from the flexibility and innovation due to the emissions cap approach itself, though banking and trading have added to cost reductions. Title IV's combination of high quality monitoring, a public Allowance Tracking System, and high penalties have also resulted in 100% compliance without the need for enforcement action in 1995 and 1996.

Elements of Title IV which May Require Different Treatment in a GHG System. Differences between the industries that emit SO_2 and GHGs, together with differences in the nature of these gases themselves, indicate the following possible modifications to the approach followed in Title IV should be considered:

- **inter-gas trading** is feasible, and could encourage implementation of inexpensive methane reductions;

- the **phased inclusion of gases or industries** may be feasible if there is little interconnectivity between them; however, the **phased inclusion of entities within a source category** has created significant problems in Title IV;

- **allowance allocations** to individual entities based on a rolling average of actual emissions or an auction of allowances, instead of a fixed historical baseline, may better address issues dealing with new entrants and shutdown sources;

- **simple allocation formulas** should be used if possible, which may work best if established in the statute;

- **predictive emissions monitoring** is feasible for CO_2, which may significantly lower monitoring costs and allow a fuels-based model to be considered;

- a regular **auction** is useful, but should be designed to provide an accurate price signal;

- a **federal administrative model** based on Phase I of Title IV which is administered by EPA and not connected to Title V permits, should be considered as potentially a more efficient, uniform and effective model than the state delegation process contemplated in Phase II of Title IV;

- **price information** could be included in the Allowance Tracking System, in order to facilitate trading;

- **allowances** might be given a long, but limited (20 year) life;

- a small **administrative fee** could be charged for each allowance issued, to pay for administering the program.

More attention is also needed to correct non-EPA barriers to trading, including state **Public Utility Commission and FERC laws and policies** which discourage trading in the utility sector, and the **IRS tax treatment of allowance transactions** that creates a high tax burden on the first seller of an allowance.

Chapter One:

Introduction and Overview

Increasing scientific evidence indicates that human activities are raising atmospheric concentrations of greenhouse gases, and leading to regional and global changes in climate and climate-related parameters such as temperature, precipitation, soil moisture, and sea level. These changes may affect human health, ecosystems and socio-economic systems such as agriculture, forestry, fisheries and water resources, which are vital to human development and are sensitive to changes in climate.

The Framework Convention on Climate Change (FCCC) entered into force in 1994, with the objective to stabilize greenhouse gas concentrations in the atmosphere at a level that would "prevent dangerous anthropogenic interference with the climate system." As an interim step the United States and other developed countries have agreed to aim to return their emissions to 1990 levels by 2000. The parties to the FCCC have recognized that this interim target is not sufficient to meet the objective, and have agreed to negotiate further emissions reductions commitments for the period after 2000 by 1997.

This paper presents the results of research conducted on the structure and design of an emissions trading market in the United States for greenhouse gases (GHGs), emphasizing lessons learned from the Acid Rain Program contained in Title IV of the Clean Air Act Amendments of 1990 (CAAA).[1] The purpose of the study is to research and evaluate one of the options the United States might take in the future to address climate change domestically. Discussion of policy instruments to address climate change have focused recently on emissions cap and trading systems and other mechanisms that use market incentives. These instruments offer the possibility of reducing greenhouse gases at lower costs than might be possible with traditional regulatory approaches.

This report addresses lessons learned from Title IV because Title IV is the largest and most prominent nationwide application of emissions trading in the United States. Title IV established an emissions cap for SO_2 and a market trading system for SO_2 emissions allowances. The program focuses on electric utilities, which emit 70 percent of the nation's SO_2, and requires them to ultimately reduce their emissions by 8.5 million tons per year, approximately half of what they emitted in 1980. The program operates in two phases. The first requires the 110 dirtiest plants to make initial reductions starting in 1995, and the second imposes an emissions cap of 8.95 million tons on all major plants starting in 2000. Title IV

---

[1] Clean Air Act, 42 U.S.C. § 7651 *et seq.* (1994).

grants utilities flexibility in meeting these strict standards by allowing them to bank reductions for future use, and trade emissions reductions with other utilities.[2]

Results from the first years of operation show that Title IV has succeeded in achieving lowered emissions at a significantly lower than expected cost. In 1995 and 1996, Phase I plants reduced emissions more than required, emitting only about 65 percent of authorized emissions.[3] The cost of an SO_2 emissions allowance has also been low, averaging about $100 in 1996 -- far less than the $300-700 cost estimated when Title IV was passed in 1990.[4]

The General Accounting Office (GAO) has credited the Title IV program with roughly halving the costs of emissions control, to between $1.2 and $2.5 billion by the beginning of Phase II, compared to $4.5 billion under a more traditional regulatory approach.[5] More recent data suggest that Phase I compliance costs less than $1 billion, and some plants which switched to low-sulfur coal may actually be complying at a net profit because the continuing low price of low-sulfur coal and fuel blending technologies have precluded the need for expensive capital investments to accommodate low-sulfur coal.[6]

The lower than anticipated cost of compliance appears to result from Title IV's design, including both the emissions cap, which departed from traditional emissions rate limitations, and the trading provisions. The emissions cap has provided industry the flexibility to choose cheaper technologies and compliance methods for SO_2 abatement such as

---

2 *See generally*, U.S. GENERAL ACCOUNTING OFFICE, GAO/RCED-95-30, AIR POLLUTION TRADING OFFERS AN OPPORTUNITY TO REDUCE EMISSIONS AT LESS COST (Dec. 1994) [Hereinafter GAO REPORT].

3 EPA data for 1995 show that 8.7 million allowances were issued in 1995 (consisting of 5.7 million basic or Table I allowances, 1.3 million for compensation and substitution units, 1.3 million extension allowances, and .4 million other) compared to recorded emissions of 5.3 million tons. U.S. EPA, EPA 430-R-96-004, ACID RAIN PROGRAM UPDATE NO. 3, at 4 (May 1996). 1996 data show emissions were 2.9 million tons below the 8.3 million ton allowable limit as determined by 1996 allowance allocations. U.S. EPA, EPA 430-R-97-025, 1996 COMPLIANCE REPORT: ACID RAIN PROGRAM, p. 3 (June 1997).

4 The price of a current period allowance was $68 in EPA's March 1996 auction, and reached $115 in April 1997 before falling in May 1997 to $100. U.S. EPA, EPA 430-R-97-025, 1996 COMPLIANCE REPORT; ACID RAIN PROGRAM, p. 10 (June 1997).See generally, D. Ellerman & J.P. Montero, *Why are Allowance Prices So Low? An Analysis of the SO2 Emissions Trading Program* (Massachusetts Institute of Technology, Feb. 1996).

5 GAO REPORT, *supra* note 2, at 37.

6 Recent research by the MIT Center for Energy and Environmental Policy Research confirms that about a third of Phase I utilities are achieving Phase I compliance without added cost, and the total costs of phase I in 1995 to have been about $725 million. A. D. Ellerman, R. Schmalensee, P. Joskow, J.P. Montero & E.M. Bailey, SULFUR DIOXIDE EMISSION TRADING: EVALUATION OF COMPLIANCE COSTS (MIT, in press, 1997). *See also*, Resource Data International, Inc., PHASE I 1995 DATABOOK - PERFORMANCE UNDER THE CLEAN AIR ACT AMENDMENTS OF 1990 (1995); *Electric Utilities are Over Complying with Clean Air Act*, WALL STREET JOURNAL at B8 (Nov. 15, 1995) ("For electric utilities, compliance with the Clean Air Act -- far from costing the $4 billion or more they once warned - has become a profitable experience, mainly because of falling prices for low-sulphur coal.")

fuel switching and fuel blending, and the allowance trading provision has allowed use of measures such as power shifting and the purchase of SO_2 allowances. This flexibility, combined with competition in the rail industry, has led to a dramatic reduction in the delivered cost of low-sulfur coal to eastern power plants, allowing many plants to choose this relatively cheap method of compliance instead of building expensive scrubbers.[7] Another effect of stimulating competition between low-sulfur coal and scrubbing has meant that scrubber technology has improved such that the price per ton of removing SO_2 by scrubbing has fallen 50 percent since 1989.[8] Together, these technologies have allowed utilities to achieve the cost savings mentioned above.

Early environmental concerns about the emissions cap and allowance trading approach embodied in Title IV also appear to have been satisfied to date. Utilities actually over-complied with the Phase I emissions cap in 1995 and 1996, and there appears to be no regional concentration of SO_2 emissions, which some had feared the trading system would create.

In applying lessons from Title IV to GHGs, it should first be recognized that GHGs are appropriate candidates for an emission cap and allowance trading system, which works best when emissions have regional or global effects, and not local effects. None of the principal GHGs cause local health or ecosystem effects, and are not criteria or toxic pollutants, so they appear well suited to an emissions cap and allowance trading system. There are however, certain dissimilarities between the acid rain and the global warming problem that limit some of the potential lessons from Title IV.

The first difference is that the environmental problems associated with climate change are attributed to a somewhat larger number of gases and many more sources than are the problems associated with acid rain. Acid rain is caused primarily by SO_2 emissions from utilities, although nitrogen oxide emissions also plays a role.[9] Although CO_2 accounts for 85 percent of GHG contributions to warming, methane accounts for 11%, and nitrous oxides

---

7 *See generally* GAO REPORT, *supra* note 2, at 29; Dallas Burtraw & Byron Swift, *A New Standard of Performance: An Analysis of the Clean Air Act's Acid Rain Program*, 26 ENVTL.L. REP. 10411 (August, 1996). This article analyzes why prices have fallen, and identifies the technological choices allowable under different regulatory regimes. Together with the above technology advances, Title IV triggered a $2 billion investment in railroads to bring low-sulfur western coal from Wyoming's Powder River Basin east, lowering costs dramatically. In addition, the number of expected scrubber contracts declined from 35 to 13 after passage of the CAAA.

8 Air and Waste Management Assoc, Proceedings of Conference Acid Rain and Electric Utilities Report #VIP-46 (Jan. 1995). Paper by Ireland, Keith and Radcliffe (EPRI).

9 *See* U.S. EPA, EPA 430-R-95-001A, ACID DEPOSITION STANDARD FEASIBILITY STUDY REPORT TO CONGRESS, 56 (Oct.1995). "Sulfur deposition appears to be the primary cause of long-term chronic acidification in all affected sensitive areas." *Id.*

and hydrofluorocarbons (HFCs) also make measurable contributions.[10] Emissions sources for CO_2 alone number in the millions -- cars and buildings burn fossil fuel -- as compared to the roughly 2,000 utility units covered by Title IV.[11] A GHG regulatory program, however, can be imposed at the fuels or industry level with a manageable number of regulated entities similar to Title IV, as discussed below.

A second significant difference is that SO_2 emissions can be reduced through process change, source reduction, and treatment, whereas treatment for CO_2 is considered impractical. The cost of such treatment is well over $50 per metric ton of CO_2 removed, not including long-term disposal costs.[12] Since emissions of CO_2 exceed those of SO_2 by a factor of over 100[13], emissions reduction at the stack through the use of CO_2 scrubbers would be extremely expensive. Therefore, abatement of CO_2 emissions focuses on fuel switching, greater energy efficiency, reducing usage and sequestration.

Third, CO_2 emissions can be accurately predicted by the carbon content of fuel, potentially allowing more flexibility both in regulatory models and in monitoring technology for this gas. In contrast, Title IV requires that Continuous Emissions Monitors -- hardware inserted in each stack -- or their equivalent be used to monitor SO_2. The limitations caused by these dissimilarities are not overwhelming, however, and an emissions cap and allowance trading model similar to Title IV can be adapted to GHG emissions.

This report discusses specific lessons learned from Title IV which are applicable to an emissions cap and allowance trading system for GHGs, and addresses the differences in sources, program structure and other technical differences in developing a set of options and recommendations. Section II discusses the basic design features of an emissions cap and allowance trading system which could be applied to CO2, methane and other GHGs. Section III evaluates lessons from Title IV, and applies them to each of the key elements needed to establish an emissions cap and allowance trading system for GHGs. These include setting the emissions cap, defining regulated sources, establishing the emissions baseline, allocating allowances, developing a market and administrative infrastructure, defining the nature of allowances, as well as other issues.

---

10 U.S. DEPARTMENT OF ENERGY, GPO, DOE/EIA-0573(87-94), ENERGY INFORMATION ADMINISTRATION, EMISSIONS OF GREENHOUSE GASES IN THE UNITED STATES 1987-1994, (Oct. 1995). [hereinafter EIA EMISSIONS].

11 *See* U.S. EPA, EPA 230-R-94-014, INVENTORY OF U.S. GREENHOUSE GAS EMISSION AND SINKS: 1990-1993 (Sep. 1994) [hereinafter EPA INVENTORY]; GAO REPORT, *supra* note 2.

12 U.S. EPA, POLICY OPTIONS FOR STABILIZING GLOBAL CLIMATE: REPORT TO CONGRESS (1990) [hereinafter POLICY OPTIONS].

13 Title IV caps SO_2 emissions at 9 million tons; in comparison, 5 billion metric tons of CO_2 (equivalent to 1,373 million metric tons of carbon) were emitted in the U.S. in 1990. EIA Emissions, supra note 10, at ix, xi.

Chapter Two:

✲

Greenhouse Gas Trading Systems

A. CO_2 EMISSIONS

A CO_2 emissions cap and allowance system might be structured either as an industrial model in which allowances are allocated to major energy-using industries, a fuels model in which allowances are allocated to fossil fuel providers, or a final consumers model where they are allocated to individual consumers. This paper considers the first two of these models, as the lessons of Title IV apply primarily to these models. In addition, they are the only ones which can capture a significant share of total emissions while minimizing the number of regulated entities.[14]

For either model, the number and variety of industries to be included and the number of regulated entities to be covered in each must be carefully considered in designing a practical emissions cap and trading system. These issues are discussed below.

1. Industrial Model

The option for a CO_2 regulatory system most parallel to Title IV would regulate major energy-using industries. This system would apply to utilities, the transportation sector, and selected large industrial sources.[15] As shown below, it could capture about 60-80% of energy emissions in a regulatory system with relatively few (2000-4000) participants. It would not, however, be able to capture the 11% of emissions generated by commercial and residential sources.

---

14 It may be impractical to consider a model imposed at the point of the final consumers of energy as there are millions of such consumers, including households, industries and vehicle owners. A.E. SMITH, A.R. GJERDE, L.I. DELAIN AND R.R. ZHANG, CO2 TRADING ISSUES, VOLUME 2: CHOOSING THE MARKET LEVEL FOR TRADING 5-4 (May 1992) (prepared for the Environmental Protection Agency by Decision Focus Incorporated, Washington, D.C.),[hereinafter Decision Focus Vol. 2].

15 A.E. SMITH, A.R. GJERDE, L.I. DELAIN AND R.R. ZHANG, CO2 TRADING ISSUES, VOLUME 1: EMISSIONS FROM INDUSTRY S-1(May 1992) (prepared for the Environmental Protection Agency by Decision Focus Incorporated, Washington, D.C.) [hereinafter Decision Focus Vol. 1] notes that the disadvantages of a trading program covering utilities and large industrial sources are that it excludes potentially low cost emission reduction opportunities in other sectors and so raises the cost per ton of CO2 abated, the complexities that arise due to the regulation of electric utilities, and the added administrative costs due to operation of two or more programs to control CO2 emissions by different categories of sources.

TABLE 1. ANTHROPOGENIC SO_2 AND CO_2 EMISSIONS BY INDUSTRY SECTOR, SHOWING NUMBER OF ENTITIES TO BE REGULATED [16]

	SO_2 Emissions (percent)	SO_2 Entities covered	CO_2 Emissions (percent)	CO_2 Entities covered
Utilities	70	2000	36	2000
Transportation	5	n/a	31	< 100
Indust. energy (key industries)	14	n/a	22 (11)	n/a 1900
Residential/ Commercial	3	n/a	11	n/a
Industrial process	8	n/a	1	n/a
Totals		2000		4000

As can be seen In Table I, Title IV captures 70% of SO_2 emissions and regulates approximately 2000 utility plants. One defect in Title IV which should be corrected is its exclusion of the 14% of emissions created by non-utility industrial electric generation for use in their own plants.[17]

Under the industrial model for CO_2 regulation, the combination of utilities and vehicle manufacturers alone is shown to capture 67% of CO_2 emissions, covering only 2000

16 *See* EPA INVENTORY, *supra* note 11, at 12 (Fig. I-3), 28 (Table II-1), E-1 (Table E-1)(sum of columns may not equal the total due to rounding). The number of regulated entities and emission from large industrial sources are taken from Decision Focus Vol. 1, p. 2-1 (1992), and represent 1991 data - in 1993 the amount of industrial emissions were slightly higher.

17 The CAAA of 1990 limits Title IV to sellers and not generators of electricity, and so does not regulate non-utility industries which generate electricity for their own use. 42 U.S.C. § 7651 (17) (1994); CAA § 402(17). Although such industries are allowed to be voluntarily included under Title IV through opt-in provisions, all electricity generators should be included under Title IV since it is the production of electricity that creates SO_2 emissions.

utility plants and a few dozen vehicle manufacturers. The number of regulated entities and the amount of emissions covered would be very similar to Title IV, which regulates the same number of utility plants and captures 70% of SO_2 emissions.

However, it is important to capture other industry sources in a CO_2 regulatory system, as they emit 22% of CO_2 emissions. While regulating all industrial sources may be impractical as it would include hundreds of thousands of sources, regulating only five industries would capture 11% of non-utility industry emissions and add only 1,900 regulated entities. These five industries are the cement, paper mills, petroleum refining, organic chemical and steel industries, which tend to have large, energy-intensive facilities. Adding the chemical industry in general would add another 2% of total emissions, but would also add another 8,300 establishments to be regulated.[18]

This methodology would regulate all plants in the key industries that contribute the most to CO_2 emissions. This covers the majority of CO_2 emission while limiting regulation to five or six industries with relatively large plants. Another option would be to require all large plants with emissions greater than some level between 5,000 and 25,000 mT of carbon emissions in the program. However, this creates competitiveness problems in many industries, where large firms in the industry would be regulated while their smaller competitors are not. The former method avoids this problem by covering all plants in key industries.

Compared to the fuels option, described below, this system has the disadvantages that it covers more industries, but captures a lesser percentage of total CO_2 emissions. The lower coverage is due to the difficulty of capturing all industrial sources without expanding the system so much that it becomes unworkable, and also due to the need to exclude residential and commercial sources because fuel-switching could not be controlled[19]. These sources can be practically included only in the fuels model.

Another disadvantage of the industrial model is that compliance options in the transportation sector are less than in the fuels model. Including transportation in the industrial model requires the estimation of overall emissions from the vehicle fleets produced by major manufacturers. This provides incentives for fuel-efficient cars or alternative fuels, but does not provide incentives for lowering vehicle miles traveled. These incentives, which are major, could only be captured under a fuels model.

---

[18] Decision Focus Vol. 1, *supra* note 15, at 2-3, 2-5. All emissions come from fuel combustion except that the estimates for paper mills include 27 mT of carbon emissions from wood, and for cement plants 9 mT from calcing.

[19] An industrial model would attempt to regulate the residential and commercial sources by regulating the industry providing home heating oil and similar products. However, the concern is that residential and commercial consumers could easily switch to unregulated diesel fuel, thereby escaping the regulatory system.

Compared to these disadvantages, there are relatively few advantages of the industrial model. It could be argued that this model works better than a fuels model when treatment technologies to reduce emissions of a GHG are competitive in cost with other emissions reduction options. If so, the potential emitter of the gas could chose between treatment and fuel efficiency/switching to find the least-cost alterative. The fuels model may not provide similar incentives to the fuel provider.

However, consideration of this issue leads to quite different results under Title IV and a CO_2 regulatory system. Title IV's required reductions of SO_2 can be achieved either by treatment -- scrubbing -- or by fuel switching to low-sulfur coal or other fuels. However, treatment of CO_2 is considered to be impractical. Fossil fuels create CO_2 when combusted, and the costs of catalytically converting or treating CO_2 by any foreseeable technology is currently considered to be prohibitively expensive. Therefore, the advantage of a potentially greater selection of compliance technologies under an industrial model does not exist.

Other differences between the two models have to do with equity concerns and political acceptability. The industrial model would regulate utilities (which are already required to monitor CO_2 emissions), the transportation sector, and certain major industries. The fuels model would instead regulate energy producers. Although difficult to predict, it may become more politically feasible to regulate one set of industries than the other, and this will be an important consideration in choosing between the models. Potential equity concerns are discussed below under the fuels model.

2. Fuels Model

Another option for a CO_2 emissions cap and allowance trading system is to regulate at the level of the producers or distributors of fuels. This model imposes the emissions cap on, and provide allowances to, coal, natural gas and petroleum producers, exporters and importers. Alternately, it could be imposed on the distributors of such products.[20] Since CO_2 emissions are directly proportional to the carbon content of fuel consumed,[21] regulating at the level of fuels can accurately control future CO_2 emissions.[22] This model may be the most effective way to limit CO_2 emissions, as it affects a smaller number of both industries and entities, and achieves almost complete coverage of CO_2 emissions from energy sources.[23]

---

20 *See* discussion in Decision Focus Vol. 2, supra note 14, at 2-2.

21 "Although stack monitoring is an option here, it is probably more precise, straightforward and less costly to base emission estimates on fuel use by industry." Decision Focus Vol.2, *supra* note 14, at 4-2, 5-3. *See also* EPA INVENTORY, *supra* note 11, at 14.

22 Title IV, on the other hand, generally requires continuous emission monitors at the smokestack in order to achieve the necessary accuracy in the critical task of measuring the emissions.

23 "[I]t is the recommendation of the report that, if a carbon permit market approach is adopted for CO_2 emission control, it should be implemented on the supply side of energy markets. A supplier permit

(continued...)

Although this model covers only the coal, oil and natural gas industries, the number of regulated entities included varies depending on the point of regulation in the production process. The maximum number of regulated entities in the fuels model would be 863,000, if defined as the point of extraction at the actual well or mine. The minimum number is 4-6,000 if the regulatory system were instead imposed at the level of fuel processors or distributors. This would include 3,600 coal companies, either 200 oil refineries or 2000 oil companies, and 133 gas pipeline companies.

The advantages of regulating at the point of energy extraction or processing is that potential leakage from energy extraction, processing or transmission is prevented. However, this system involves many regulated entities. The advantage of regulating at the point of distribution is an enhanced ability to exclude energy used for industrial feedstocks or export from the trading system, as well as lowered costs of monitoring and enforcement. Regulating at this point also creates a more manageable number of entities, similar to regulating at the industrial level.[24]

TABLE 2. NUMBER OF REGULATED ENTITIES FOR ALTERNATIVE MODELS

	Title IV	Industrial Model	Fuels Model
Number of Regulated Entities	2000	2,030-10,000	3,000-6,000
Percent of Emissions Captured	70%	67-80%	98%

A fuels model appears to have three major advantages over an industrial model: it regulates fewer industries; it is more comprehensive, especially concerning residential and commercial energy use; and it provides for greater compliance alternatives in the transportation sector. The industrial model only provides incentives for fuel-efficient cars rather than for use reduction. Thus the fuels model would be expected to raise prices of high-

(...continued)
market for carbon is expected to be a more cost-effective CO_2 control policy than a consumer permit market. However, it is not clear which point in the supply chain is the most promising for implementation of a carbon permit market without further study." Decision Focus Vol. 1, *supra* note 15, at S-1, S-3.

[24] Decision Focus Vol.2, *supra* note 14, at 2-2, 2-11. This study notes that since these industries are concentrated, regulating only the top twenty companies in each field would capture 55-78 percent of the market. *Id.* at 2-6. As to importers, it notes that "[i]nclusion of importers in a producer permit market probably presents no serious administrative problems, but needs to be considered in the regulatory design." *Id.* at 3-8.

carbon fuels, stimulating a more complete set of compliance options by end-users.

The most important advantage of a fuels model is that it is more comprehensive than an industrial model, thus more effective and equitable in burden-sharing. It would encompass almost all (98%) energy end users in a regulatory system,[25] instead of the roughly two-thirds achievable with the industrial model. In particular, only a fuels model can capture effectively the residential and commercial energy users in a regulatory system. Another attractive feature is that the fuels model allows greater consideration of compliance options in the transportation sector. The industrial model only creates incentives for fuel-efficient cars or alternative fuels, whereas the fuels model also provides incentives for lowering vehicle miles traveled.

This greater comprehensiveness introduces fewer distortions to the economy, and allows greater program effectiveness. Energy efficiency improvements would be made by a wider group of entities, not only the selected industries included in the industrial level regulatory model, which may minimize overall costs. Trading would be also more effective if more sources are included, as there would be more opportunities for trades between sources with differing costs of abatement. Also, with more sources covered, the reductions needed from any particular source would be lowered.

The fuels model also has some difficulties. A potential disadvantage of the fuels model is that it would not create as strong incentives to discover more effective treatment or end-of-the-pipe technologies for CO_2 abatement. As discussed above, it could be argued that Title IV regulates SO_2 emissions at the industrial level and allocates allowances to utilities in part because this allows them to consider both process-related and treatment abatement options. However, there are currently no effective scrubbing or treatment technologies for CO_2,[26] which limits the force of this argument in a GHG regulatory system. In addition, this limitation could be addressed by issuing allowances for documented end-of-pipe reductions.

Another potential difficulty with this model is that the emissions cap system would be expected to restrict the supply of high-carbon fuels. On the one hand this has been criticized as being a quota on fossil fuel use.[27] On the other, there is an equity concern as restricting supply would allow providers of these fuels to raise prices and potentially earn windfall

---

25 Decision Process, *supra* note 15, at 3-5. Fuel emissions captured by a fuels model were calculated as 1,284 mT carbon out of a total 1988 level of 1,310 mT.

26 The capture and disposal of CO2 impose very high costs, and "[n]o industry would be expected to install any direct CO2 emissions capturing devices in the near future [should regulations be started]." Decision Focus Vol.1, *supra* note 15, at 3-4. Alteration of industrial processes, other than for efficiency, is possible in some industries (i.e. chemical and cement), but is of minor importance to the CO2 problem. *See Id.* at 3-4.

27 W. Fang, *Tradeable Emission Permits: The US SO_2 Experience from the Electric Utility Industry Perspective - Successes, Failures, Lesson and Prospects for Future Use* (Edison Electric Institute, March 1997).

profits.[28]

[28] Presentation by Dr. Daniel Lashof, Natural Resources Defense Council, April 14th, 1997 (Washington, D.C.).

The concept of a quota is not strictly true, as the emissions cap places a limit on the carbon content of fuels, not on the fuels themselves. Considerable substitution among fuels is likely, and some measure to blend fuels with non-carbon additives are possible, such as ethanol in gasoline or used tires in coal. It could also be argued that any set of policies to limit GHG emissions will reduce fossil fuel use, possibly to an equal extent. In addition, incorporating other sources and gases into a fuels model would reduce the impact on fossil fuels.

The equity concerns about windfall profits are legitimate and require further study. However, some economists would argue that any allowance allocation or regulatory system could have a similar effect in raising prices and therefore reducing output, due to a firm's internalizing the opportunity cost of the allowances or the regulatory constraints.[29] Furthermore, these equity concerns could be addressed through a windfall profits tax, or by an auction of allowances.

Finally, a regulatory system at the fuels level requires selection of a point of regulation within the production chain. The model creates the need to separate fuel used as industrial feedstocks (28 percent of total industrial use of petroleum products), from that used for energy. This would be easiest to do if the regulatory system were imposed at the point of energy distributors, and monitoring and compliance costs may be lowest at this point also. However, such a model would not, without adjustment, capture the considerable amount of energy used in the petroleum refining process itself.[30]

3. Hybrid Model

A hybrid model is possible which combines some of the features of both the fuels and the industrial model. Such a model might attempt to capture most of the emissions from coal and some from natural gas by regulating utilities and large industries in essentially an industrial model and adopt the fuels model for petroleum and the remaining uses of natural gas. Careful research would be needed on implementing an appropriate system of offsets to avoid overlap, but this appears reasonably straightforward.

The advantages of the hybrid model described above is that it could resolve some of the key deficiencies of the industrial model. Adopting the fuels model for oil and non-utility natural gas would allow the inclusion of the residential and commercial sectors, which are

---

[29] See, e.g., I. Perry, R. Williams, L. Goulder, WHEN CAN CARBON ABATEMENT POLICIES INCREASE WELFARE? THE FUNDAMENTAL ROLE OF DISTORTED POLICY MARKETS (National Bureau of Economic Research, March 1997); R. Morganstern, Environmental Taxes: Dead or Alive? Resources for the Future, Discussion Paper 96-03, p.2 (October 1995); W. Oates, Green Taxes: Can we Protect the Environment and Improve the Tax System at the Same Time? Southern Econ. J. 61:914-22 (1995).

[30] Decision Focus Vol. 2, *supra* at note 14, at 3-3, 4-4. The study further notes that the need to separate energy products used for industrial feedstocks may not exist if one assumes that all the final products, such as plastic goods, asphalt, etc. will eventually deteriorate and release their carbon to the atmosphere anyway. Only a very few of these products, such as asphalt, permanently lock up the carbon.

left out of the industrial model, and would provide a more complete set of incentives in the transportation sector. It would not, however, address the inability of the industrial model to cover more than half of industrial emissions without becoming unworkable in size. Another advantage of this hybrid model is that it may resolve some of the equity issues present with the fuels model. To adequately evaluate the hybrid model, research would be needed on the incentives it creates in the various sectors, especially whether it creates significant advantages at the utility level in allowing for more effective consideration of alternative abatement options.

4. Biotic Sources and Sinks

Land-use related sources and sinks of CO_2 comprise an important piece of the overall carbon cycle. Annual biospheric carbon fluxes in the United States far exceed fossil fuel emissions, although natural sinks balance the natural sources, rendering anthropogenic sources responsible for the incremental growth. It would be desirable to include anthropogenic changes to biotic sources and sinks in a GHG regulatory model, especially as there are potentially significant ancillary benefits.

Title IV offers relatively little guidance on treatment of biotic sources except in principle because it deals exclusively with industrial emissions from energy use. This paper will not therefore extensively address biotic sources, but will define some general lessons which can be drawn from Title IV.

Overall, a review of the CO_2 trading literature finds few references to the inclusion of biotic sources and sinks in a CO_2 emissions cap and allowance trading system. The GAO concluded that biotic sources and sinks should simply be omitted from a trading system altogether,[31] and others have identified major problems associated with such inclusion. These problems include the number of entities involved, the variation of sources and sinks and the difficulties associated with effectively monitoring and verifying biotic carbon flows.[32]

---

[31] The United States General Accounting Office, for example, concludes that "including [biotic] sources of CO2 in a carbon trading program could make it unworkable," GAO REPORT, *supra* note 2, at 66.

[32] A United Nations study, for instance, outlines some of the issues that would be involved with incorporating offset projects into a trading system, including the need to define the commodities eligible for transfer; the need to specifically define what sinks would be accepted as a basis for tradable Entitlements; and the need to solidly establish baselines against which to compare offset projects for the purpose of crediting. Roland, Kjell, "From Offsets to Tradeable Entitlements," in *Combating Global Warming, Study on a Global System of Tradeable Carbon Emission Entitlements*, United Nations, New York, (1992)).

An analysis by the Acid Rain Division at U.S. EPA points out that major administrative, regulatory, monitoring and verification challenges must be addressed before forestry offsets could be incorporated into an emissions trading system. Specifically, "[f]orestry projects currently lack general procedures to estimate production/growth rates, CO2 emissions baselines and offsets, and to account for capital leakages beyond project lands. Moreover, the growth and carbon sequestration rate for different tree species is highly variable . . . and in many cases a long-term monitoring plan would be required." (Solomon, Barry, 1994. "U.S. SO2

(continued...)

The first problem to be dealt with in designing an emissions cap and allowance trading system for biotic sources is the high number of sources, potentially including every landowner. This problem can be resolved by limiting the number of regulated entities, which is feasible but gives rise to significant problems of leakage to unregulated entities.

The number of regulated entities may be limited to owners of large tracts of managed forest lands, a few hundred entities. These include the federal government, which owns 20% of timberlands, state and municipal governments (7%), and industrial forests (14%), which are owned by about 250 different companies. Private non-industrial forests comprise 59% of U.S. timberlands, but are owned by tens of thousands of landowners. For example, 72,000 tree-farms comprise only 30% of all non-industrial private timberlands.[33]

The leakage problems with a large landowner system however appear severe, as the large industrial forests could maximize carbon sequestration on their land, while shifting production to private forest lands that are too small to include in the system. Further research would be required to determine if a regulatory system could be devised which could halt such leakage.

Measurement is the second major problem with including biotic sources, both in determining a baseline and in monitoring CO_2 fluxes. These measurement problems could be minimized by limiting carbon estimates to trees and excluding soil carbon, for which there is little scientific consensus on measurement.

Because of these problems, it appears at present that an opt-in process where a project can be specifically analyzed may be the best option for including biotic sources and sinks in the regulatory program. There is a developing literature and experience with specific sequestration projects, such as with the United States Initiative for Joint Implementation.[34] There are, however, high transaction costs to this project-specific approach.

An interesting option may be to include the States in a regulatory system as a proxy for regulating the private forests within them. The sheer size and permanence of the States would minimize problems of leakage or additionality. Monitoring programs would need to

(...continued)
Emissions Trading: Lessons for a Global Carbon Budget," paper prepared for presentation at the *90th Annual Meeting of the Association of American Geographers,* San Francisco, California, April 2, 1994, and at the Air & Waste Management Association International Specialty Conference: *Global Climate Change - Science, Policy, and Mitigation Strategies,* Tempe, Arizona, April 8, 1994 at 23). *See also*, Dudek, D., 1992. "Preserving Tropical Forests and Climate: The Role of Trees in Greenhouse Gas Emissions Trading," paper presented at the EDF/UNCTAD Workshop on Tradable Carbon Emission Entitlements, Rio De Janeiro, June 1-4, 1992, 47 pp.); United Nations Conference on Trade and Development, 1995. *Controlling Carbon Dioxide Emissions, The Tradeable Permit System.* United Nations, Geneva, UNCTAD/GID/11 at 31).

33 AMERICAN FOREST AND PAPER ASSOCIATION, U. S. FORESTS FACTS AND FIGURES 1995, at 11-15 (1995). Timberlands comprise two thirds of all forests, and include all forest capable of growing 20 cubic feet of commercial wood per year. *Id.* at 7.

34 *See generally*, U.S. Initiative for Joint Implementation, International Partnerships Reports (1994-1996) (Washington, D.C.) The USIJI Secretariat is jointly administered by the US Dept. of Energy and U.S. EPA.

be developed which would annually determine the total biomass located in non-federal forest in each State. This system would encourage States to experiment with programs creating private incentives for reforestation and soil conservation which would result in carbon sequestration benefits.

B. METHANE EMISSIONS

Control of methane emissions are important because they may offer an inexpensive route to significant early GHG reductions. Unlike CO_2 emissions, anthropogenic sources add more methane to the atmosphere than non-human sources, about 375 million metric tons (mT) compared to 160 million mT from natural sources.[35] This means that a relatively small reduction in anthropogenic emissions, on the order of 10%, could eliminate the U.S.'s annual net increase of 35-40 million mT of methane in the atmosphere. Major reductions in methane emissions are feasible and relatively inexpensive, and could contribute substantially to meeting initial GHG reduction goals.

Domestic emissions of methane (CH_4) are second only to carbon dioxide (CO_2) as an anthropogenic contribution to the greenhouse effect, contributing about 11 percent of U.S. radiative forcing as indexed by global warming potential (GWP).[36] Though actual emissions are small in volume compared to CO_2, a molecule of methane is much more effective in trapping heat in the atmosphere. Its GWP is 62 times greater than CO_2 over a twenty year time horizon, 24.5 times greater over 100 years, and 7.5 times greater over 500 years.[37]

Unlike CO_2 emissions, which derive largely from burning fossil fuels, methane is emitted from a variety of discrete sectors. The largest anthropogenic sources of methane in the U.S. are landfills (39%), livestock and their waste (31%), coal mining operations (13%), and oil and gas production and distribution (12%).[38] Relatively little research has been done on applying an emissions cap and allowance trading system for these methane sources.

The fuels model is the only appropriate model for a methane emissions cap and allowance trading system, as there is no equivalent of the industrial model as with CO_2 emissions. Each of the above sources generates methane, which is either dissipated into the atmosphere, or is captured by the source. Once captured, the methane is either combusted, which converts the methane to CO_2 and water, or sold to an end user for combustion. The emission of methane is entirely under the control of the generator, making these the appropriately regulated entities.

---

35 EIA EMISSIONS, *supra* note 10, at 3 (1995). Natural sinks, primarily decomposition into CO2 in the atmosphere and in the soil, are estimated to total 500 million mT each year.

36 EPA INVENTORY, *supra* note 11, at ES-8.

37 EIA EMISSIONS, *supra* note 10, at 5. Note that the previous factor derived from the IPCC was 22.

38 *Id.* at 25.

A methane emissions cap and allowance trading program could be created to include the former sectors, either independently of a CO_2 program, or as part of a comprehensive GHG emissions cap and allowance trading program.

There are two prerequisites to include a methane source category in an emissions cap and allowance trading regulatory model. First, there must be a manageable number of participants so the regulatory structure does not become unmanageable. Second, there must be an accurate way to monitor emissions. It is also useful to consider the accuracy of the baseline emissions measurement, and the availability and cost of technologies to reduce emissions.

We discuss below the application of these criteria to the different methane source categories, and find that a regulatory system could be imposed practically on certain of them. These include coal mining (13%) and landfills where recent concentration of the industry helps a regulatory model (39%). Possibly some oil and gas operations and livestock manure sources may also be included, totaling in all roughly 50% to 60% of emissions. It does not appear practicable at this time to design a regulatory system that captures emissions from most agricultural sources, due primarily to the large and disaggregated number of entities in these sectors.

We note that including methane in a GHG regulatory system gives rise to certain technical issues not present with CO_2. It provides the possibility of allowing inter-gas trading based on the gases' GWP, which could provide the opportunity for financing from CO_2 sources to fund relatively inexpensive methane reductions, helping to achieve early reductions and reduce the market price of allowances. We note, however, that sources which capture methane for later combustion should not receive full credit for their combustion, which should be reduced by the amount of CO_2 created, or else the source should included in the CO_2 regulatory program as a CO_2 emitter.[39] Finally, because emissions reductions are being required, or are profitable, from certain sources, some unique baseline and policy considerations are present in certain source categories.

1. Landfills

Landfills are the largest single source of anthropogenic methane emissions in the United States, accounting for 39% of emissions in 1993.[40] Recent regulation of municipal landfills under the CAA imposed new source performance standards on all new landfills and emissions guidelines for active landfills, as well as required monitoring of methane emissions.

---

[39] This would not be necessary if the science indicates that all methane releases will be converted into CO_2 in the atmosphere anyway.

[40] *Id.* at 35.

These are expected to result in a 38% reduction of methane emissions over baseline emissions estimates.[41]

Current technology allows methane capture at or near a profit for most landfills, and in 1992 approximately 10 percent of gross methane emissions from landfills was recovered for energy use.[42] EPA estimates that technically feasible emissions reductions may range from 50 percent for old landfills to nearly 100 percent for new landfills.[43] Including methane in the GHG emissions cap and allowance trading system could generate significant funds for such capture.

There are approximately 6,000 landfills in the United States, with 1,300 of the largest accounting for 90 percent of the emissions.[44] This is a manageable number for a regulatory system. Most of these entities are municipal solid waste landfills, which receive over 70 percent of U.S. solid waste and account for approximately 90 to 95 percent of landfill methane emissions. Industrial landfills contribute the remaining 5 to 10 percent.[45]

The most significant issue in including landfills in an emissions cap and allowance trading system has to do with the problems of measurement of methane emissions. Methane production in a landfill varies according to factors such as temperature, acidity, moisture content and time. These conditions vary across landfills and within a single landfill, which produce methane at different rates and volumes.[46] Although this makes uncovered landfills extremely difficult to measure, methane emissions can be measured more readily for landfills equipped with gas collection systems, which are now required for all active municipal solid waste landfills. For these, accurate monitoring of captured methane is possible, but emissions of methane which are escaping the system can only be estimated. These estimates, however, should be accurate enough to allow landfills to be included in a regulatory system.

These same measurement problems make it difficult to determine the baseline for landfills. As noted above, landfill methane emissions can only be estimated in 1990, before

---

41 In March of 1996, EPA issued its final rules on Municipal Solid Waste Landfills. 61 Fed. Reg. 9905 (March 12, 1996). These imposes new source performance standards (NSPS) on large landfills (those with design capacities above 2.5 million Mg) commencing operations after the proposal date of May 30, 1991, and emission guidelines on all active existing municipal landfills.

42 EIA EMISSIONS, *supra* note 10, at 34.

43 U.S. EPA, EPA-R-93-012, OPPORTUNITIES TO REDUCE ANTHROPOGENIC METHANE EMISSION IN THE UNITED STATES, 4-2 (Oct. 1993). We note that another significant source of emission reduction could come from modifying waste management practices at the source to reduce the quantity of waste produced. Examples include fee-based systems for trash generators, municipal composting programs, and voluntary waste reduction programs.

44 *See Id.* at 4-11. *But see* EPA Inventory, supra, n.11, p. ES-9 (stating these sources emit half of all emissions).

45 EPA INVENTORY, *supra* note 11, at ES-9.

46 EIA EMISSIONS, *supra* note 10, at 34.

they were required to be covered by EPA. Therefore a more current baseline year may need to be chosen, reflecting the improved information available from covered landfills. A related policy issue is whether to allow landfills to profit from trading allowances deriving from methane reduction measures they are required by EPA's regulation to do anyway. If this is believed to be unfair, a recent year baseline should be chosen, or the landfill's allowance allocation should be reduced to compensate for the regulation's effect.

Another measurement problem is that the gas recovery systems required of landfills may actually increase methane production. Since the historic measurement of emissions from the uncovered landfill cannot be determined accurately, this increase can only be estimated. Again, there would be policy reasons to reduce the amount of allowances given to landfills by the amount of this estimated increase. A contrary argument would be to ignore this problem, since at worst it provides a small excess of allowances to municipal owners.

Even with these caveats, there are strong reasons to include landfills in the regulatory system. With these potential deductions, a significant number of allowances would still be provided to landfill owners, providing financing and incentives for future methane reductions and technological advances. Title IV has demonstrated that economic incentives to emissions reductions can drive investment and technological advances considerably in excess of what is possible with a strictly regulatory regime.[47]

2. Coal Mining

Methane emissions from coal mining can be included in a regulatory system because the fundamental requirements of a cap and trade program can be met. Notably, there are relatively few sources to include as only 60 gassy mines contribute roughly 80 percent of all methane emissions.[48] In addition, since these methane emissions are point sources, they can be accurately monitored. Current technology could capture 60 percent of these methane emissions, a significant portion of which could be sold profitably.[49] In addition, companies

---

47 *See* Burtraw, *supra* note 5, at 10416 (discussion of investment and technology advances in Title IV).

48 In 1988, even though there were over 3000 coal mines, only 60 mines classified as large and gassy accounted for 80 percent of all methane released from U.S. coal mining activities. Methane recovery at smaller, less gassy mines is not considered technologically feasible at this time, although companies are attempting to solve technological barriers to capturing the methane from coal vent gas with low concentrations of methane. U.S. EPA, EPA-R-93-012, OPPORTUNITIES TO REDUCE ANTHROPOGENIC METHANE EMISSION IN THE UNITED STATES, *supra*, n. 42, p. 3-2.

49 The EPA Office of Air and Radiation estimates that is technologically feasible to recover approximately 60 percent of methane released during the mining stage for most large and gassy underground mines. EPA estimates methane emissions from coal mines can be profitably reduced by 32 to 44 percent of projected emissions from U.S. coal mines in 2000 and 40 to 45 percent in 2010.

are actively developing technologies to capture and commercially sell the methane from coal mines with less concentrated methane emissions.[50]

3. Oil and Gas Production, Processing and Distribution

Oil and natural gas production processes contributed approximately 12 percent to the U.S. anthropogenic methane emissions in 1993, although preliminary research results indicate that actual emissions may be much larger.[51] Emissions derive from numerous small point sources. About 43% from leakage in natural gas distribution pipelines, 36% comes from leakage and maintenance during oil and gas production and processing, and 18% from venting of associated gas at oil wellheads.[52] It is particularly important to regulate emissions from this sector, as otherwise the GHG benefits of fuel switching to natural gas would be overstated.

There appear to be two options for including these emissions in a regulatory system. One would attempt to monitor each of the many point sources, such as equipment leaks, that cause the emissions. This will be difficult due to the large number of point sources occurring through an entire chain of production and distribution. Perhaps only the emissions from gas venting at wellheads could be included in such a system, as such emissions are substantial and could be monitored separately.

The second option for capturing the remaining emissions would be to measure not individual point sources, but overall system loss of methane from the origin of a pipeline or processing system to its destination. The difference from measurements of the amount of methane entering the system and that leaving it would be assumed to be emitted to the atmosphere. For this option to be viable, however, accurate methods of estimating such system loss are required.

If this approach is feasible, most of the emissions from leakage in natural gas transmission pipelines, and at least some of the methane emissions from oil and gas production could be included in the regulatory system. There are numerous technologies for reducing such emissions, from low-emission plastic pipe to improved management practices, some of which are currently cost-effective only with higher prices for natural gas.[53] Creating

---

50 Information from Charles Estes, Appalachian-Pacific Coal Mine Methane Power Company (January 13, 1997)

51 EIA EMISSIONS, *supra* note 10, at 29-30.

52 Since methane is also present in crude oil, leaks and venting of vapors during oil transportation and storage also result in some methane emissions. *See Id.* at 29-31. *See also* IPCC 1.105.

53 Information from Gas Research Institute (Washington, D.C., January 1997) and NOVA Gas Transmission, Ltd. (Calgary, Alberta, Jan 17, 1997).

economic incentives through an emissions cap and allowance trading system for methane reductions would be expected to boost the application of such technologies.

4. Enteric Fermentation in Domesticated Animals

Methane emissions from livestock, principally ruminant animals such as cattle, sheep, and goats, accounted for approximately 21 percent of total U.S. anthropogenic emissions in 1993.[54] Surprisingly, there are fairly accurate monitoring devices to measure the methane emissions of a single animal through gas tracers, which can be extrapolated to the entire herd.[55] However, there are two major problems to including this sector in an emissions cap and allowance trading system.

The first is the disaggregated nature of the ownership of America's animal herd. There are tens of thousands of ranchers and herders, and though some have large operations, there is not the same degree of concentration as in manufacturing industries. The largest 7,000 milk cow owners have 35% of all animals and the largest 9,000 cattle owners only 23% of all animals.[56] Secondly, there is a "leakage" problem, as the nature of each owners herd may shift over time. An allowance allocation system would therefore need to be based on the characteristics of the owner's present herd, rather than historical data. Although these problems could be surmounted if the regulatory stem were applied only to the very largest farmers, only a relatively small percent of emissions would be captured, and leakage problems would persist.

Finally, it is possible to consider applying the regulatory system further downstream, as only three beef packing companies process most beef cattle, and 33 entities market dairy products. Applying the regulatory system to these entities, however, could only offer a limited range of incentives to the individual herders to reduce their methane emissions. Further research is needed on the effects and feasibility of this option.

5. Solid Waste of Domesticated Animals

Domesticated animal waste accounted for approximately 10 percent of total U.S. anthropogenic emissions in 1992.[57] Three animal groups account for approximately 90

---

54 EIA EMISSIONS, *supra* note 10, at 25.

55 Washington State Univ., A SF_6 Tracer Technique: Methane Measurement from Ruminants (Pullman, Washington, August 1995).

56 USDA, NATIONAL AGRICULTURAL STATISTICAL SERVICE, CATTLE, 13, 22 (Feb. 1996).

57 EIA EMISSIONS, *supra* note 10, at 25.

percent of total emissions: swine, 50%; dairy cattle, 35%; and beef cattle, 10%.[58] Liquid-based manure management systems account for over 80 percent of total emissions from animal wastes[59], and it is possible to include larger emitters in this category in a regulatory system. Controls for methane include technologies such as floating covers over pools to create a liquid manure system. This captures almost all methane emissions and also improves water quality.

Farms with over 1000 animal units are considered point sources under federal water quality regulations. These farms are mainly vertically integrated hog farms and "western" type dairies, with a large portion located in California and North Carolina. EPA currently is working with the largest 3000 hog and dairy farmers to voluntarily implement controls, with the incentive that the methane can be sold. A regulatory system could cover these largest emitters, which may constitute 15% of the sector's emissions.[60]

Since these entities are point sources, emissions can be monitored, but some of the same problems of baseline estimation arise as discussed above with landfills. Because of the number, locations and type of manure systems in use, it is not possible to know exactly what the emissions are from each unit before a recovery systems is installed. To the extent that methane capture systems may increase aggregate methane production, the baseline emissions estimate should be adjusted downward to compensate.

C. OTHER GHG EMISSIONS - CFC SUBSTITUTES, PERFLUOROCARBONS AND NITROUS OXIDE

Several human-made greenhouse gases are emitted in small volumes, but the gases themselves have global warming potential hundreds or thousands of times greater than carbon dioxide. These include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and nitrous oxide.

Because CFCs and HCFCs also destroy the stratospheric ozone layer, they are regulated under the Montreal Protocol and its amendments. Production of CFCs ended in January of 1996, and HCFC production is to end by 2020.[61] Because the Framework Convention on Climate Change deals only with gases not regulated by the Montreal Protocol, the trading system need only consider the remaining gases, HFCs and perfluorocarbons.

58 *Id.* at 40.

59 EPA INVENTORY, *supra* note 11, at ES-9.

60 Information of Mark Orlic, U.S. EPA (Nov. 26, 1996).

61 EIA EMISSIONS, *supra* note 10, at 51, 56-67. HCFC usage, however, is expected to increase before its phase-out date.

HFCs are powerful GHGs, with global warming potential hundreds or thousands of times that of CO_2, and are used as refrigerants, blowing agents, and solvents. The market for HFCs is expanding as CFCs are being phased out. For example, practically all new car air conditioners are using HFC-134a with a global warming potential of 1,200, and nearly all of the refrigerant can be expected to leak out over a 5 year time horizon. Estimated emissions of HFC-134a in 1994 are 10,000 mT, twenty times that of 1993.[62]

Imposing a cap on producers is the most simple regulatory method because these human-made chemicals are produced by only a few manufacturers that could be included in the emissions cap and allowance trading regulatory system.[63] This approach is equitable since it can be assumed that all HFCs will eventually escape into the atmosphere regardless of their use. The other option would be to regulate HFC users, which would involve regulating many more companies in varied industries, including automobile and semiconductor manufacturers.

Since HFC production was negligible in 1990,[64] it could be recommended that no baseline allowances be allocated to HFC emitters, who would be required to purchase allowances equal to production like other new entrants. Overall, the very high global warming potential of these gases indicates they should be included in the system and supports the equities of a zero baseline approach. Other baseline options are discussed below in Section III.

Perfluorocarbons have global warming potential 6,000-12,000 times that of CO_2. Total emissions of .003 mT are caused primarily as a by-product of aluminum smelting, where they arise during periods of process inefficiency; one U.S. manufacturer also produces them as a purging agent.[65] PFCs can be included in a regulatory model, since they come from a limited number of sources and monitoring is feasible, although the method used to estimate emissions from aluminum smelting still requires refinement.[66]

Nitrous oxide (N_2O) is a little-studied gas with a 100-year GWP of 320, and which contributes approximately 2% of domestic warming. Approximately 70% of estimated

62 *Id.* at 58.

63 *Id.*

64 *Id.* at 54 (table 34). The EIA only records 4,000 mT of HFC23, produced as a by-product of HCFC22 production.

65 *Id.* at 58. That manufacturer, Dupont Chemical reportedly plans to double its capacity in 1995, while encouraging customers to reduce emissions substantially.

66 *Id.* at 53; EPA INVENTORY, *supra* note 11, at 37.

emissions derive from fertilizer use and vehicle fuel combustion, with additional contributions from industrial sources, primarily the production of adilphic and nitric acids.[67]

It appears that most sources of nitrous oxide could be included in an emissions cap and allowance trading system. Agricultural sources could be included by regulating relatively few manufacturers of nitrogen fertilizers, though it is not clear whether emissions can be affected by the type of fertilizer used. Vehicle emissions can be included through regulations of vehicle manufacturers, which could be expected to give added impetus to the use of energy-efficient and alternative fuel vehicles. Finally, there are only a handful of firms producing adilphic or nitric acids, which could easily be incorporated into the regulatory system.

[67] EIA Emissions, *supra* note 10, at p. 45.

Chapter Three:

✲

Lessons from the Acid Rain Program

A. THE EMISSIONS CAP

1. Setting the Cap

The Experience of the Acid Rain Program

An emissions cap is the essential feature of a closed system of allowance trading, such as Title IV. The cap sets an inviolable standard which limits the total emissions of all sources. Title IV creates by statute a permanent cap on annual SO_2 emissions at 8.95 million tons, which will reduce emissions to 10 million tons below 1980 levels by 2010.[68] According to Brian McLean, head of EPA's Acid Rain Division, "the inviolate 8.95 million ton allowance cap has been the key provision ensuring environmental protection and anchoring the allowance market."[69]

The cap set by Title IV was established by a political process which considered the science involved in the relationship between SO_2 emissions and acid rain damage.[70] Recent research however indicates that the cap may have been set too high to allow ecosystem recovery in the Northeast states due to the cumulative effects of past sulfur deposition.[71]

The data for 1995 and 1996 SO_2 emissions show that the emissions cap approach created significant early reductions, alleviating concerns that Title IV's stepped reductions would cause economic hardship. Although 8.7 million allowances were available in 1995 and 8.3 million in

---

68 *See* U.S. EPA, EPA/430-R-96-012, 1995 COMPLIANCE RESULTS: ACID RAIN PROGRAM, 11 (July 1996)[hereinafter EPA 1995 COMPLIANCE RESULTS].

69 Brian McLean, *Lessons Learned Implementing Title IV of the Clean Air Act*, EPA 95-RA120.04 (Washington, DC, 1995).

70 For legislative histories *see*: Nancy Kete, The Politics of Markets: The Acid Rain Control Policy in the 1990 Clean Air Act Amendments (1992)(Ph.D. Dissertation, The Johns Hopkins University (Baltimore, MD)); Karl Hausker, *The Politics and Economics of Auction Design in the Market for Sulfur Dioxide Pollution*, 11 J.POLICY ANALYSIS & MGMT. 553-572; and Paul R. Joskow & Richard Schmalensee, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, MIT-CEEPR 96-003WP, THE POLITICAL ECONOMY OF MARKET-BASED ENVIRONMENTAL POLICY: THE U.S. ACID RAIN PROGRAM (March 1996).

71 *See* Likens, Driscoll & Buso, *Long-term Effects of Acid Rain: Response and Recovery of a Forest Ecosystem*, 272 SCIENCE 244 (April 12, 1996).

1996,[72] utilities only emitted 5.3 and 5.4 million tons of SO_2 in these years, creating a bank of 6.3 million allowances to be used in future years.[73] This not only created environmental benefits from early reductions, but also indicates that banking provisions may smooth the transition between stepped phases, allowing emissions to decline gradually.

Lessons for an Emissions Cap and Allowance Trading System for GHGs

a. Let the legislature set the emissions cap

One lesson for policy makers as they design a GHG regulatory system is to follow the practice of Title IV and have the law determine the emissions cap. The alternative is to leave the establishment of a cap to an administrative decision by EPA. Title IV has worked well with virtually no litigation on the matters surrounding the setting of the cap amount. On the other hand, experience under the Regional Clean Air Incentives Market (RECLAIM)[74] program in Los Angeles and the North East States for Coordinated Air Use Management (NESCAUM) attest to the difficulty and controversy of leaving decisions up to an administrative process. Indeed, because of the financial implications involved, EPA's effort to establish NO_x effluent controls under Title IV have been litigated heavily and are being finalized now, more than six years after the passage of the CAAA.

If it is not possible to leave the cap setting process to the legislature, one option may be to include in the statute a deadline by which time the cap must be implemented. This creates an incentive for the industry, government and other stakeholders to reach consensus about rulemaking provisions.

b. Controversy surrounding the setting of a cap may be avoided by reference to international agreements

Establishment of the emissions cap is a political process informed by public policy choices. The decision on the cap for the Acid Rain Program was based on the science relating SO_2 emissions to acid rain damage, as discussed above. For GHGs, an emissions reduction target may be set by international agreement under the FCCC. The current target set by the Convention, a return to 1990 levels of emissions by the year 2000, or a future FCCC target, may

---

72 This amount is comprised of 5.55 million Table I allowances to the Phase I utilities, 1.33 million compensation and substitution allowances, 1.35 million extension allowances, and .3 million early extension credits to Union Electric in St. Louis (not available in 1996).

73 EPA 1996 COMPLIANCE REPORT, *supra* note 3, at 7.

74 *See* South coast Air Quality Management District, RECLAIM Program Summary and Rules (Diamond Bar, CA, Oct. 1993).

frame the debate over a GHG regulatory program and serve to establish the cap limit.

Since further emissions limitations may be made under the FCCC, further reductions in the cap may be necessary. A statute creating a GHG regulatory program could provide that these further reductions agreed to by the United States under the FCCC automatically become reductions in a domestic emissions cap, or it could leave further reductions to Congressional amendment of the legislation.

2. Changing the Cap

The Experience of the Acid Rain Program

Title IV establishes two discrete steps in emissions reductions, five years apart. Phase I lasts from 1995 to 2000 and achieves early clean-up of the 110 dirtiest utility plants, limiting their emissions to 5.7 million tons of SO_2. Phase II lowers the cap to 8.95 million tons for all utilities, starting in 2000.[75] Since banking of allowances is allowed and additional allowances are allocated for special purposes, the actual amount emitted in any one year may not exactly equal these amounts.

Lessons for an Emissions Cap and Allowance Trading System for GHGs

Scientific evidence indicates that stabilizing atmospheric concentrations of greenhouse gases -- the ultimate objective of the United Nations Framework Convention on Climate Change -- will require a large reduction in global GHG emissions from current levels over a century or more. Political realities suggest that it may not be possible to immediately establish an emissions cap that is stringent enough to achieve stabilization. The scientific evidence suggests that periodic downward adjustments may be needed.

a. If the cap is to be reduced over time, step reductions are practical

Options for such phasing include a percentage reduction each year, a method adopted by programs like RECLAIM in Los Angeles, or step-wise reductions like Title IV. Step-wise reductions, if they are too early or too severe, may create economic difficulties for firms by accelerating investments to create the needed emissions reductions. However, the experience of Title IV has shown that the allowance banking provisions, which permit regulated entities to store early emissions reductions for use in later years, have smoothed the curve between two phase levels, so that emissions reductions proceed progressively without causing undue economic hardship.

---

75 The emission cap of Phase I is set to be equivalent to an emission rate of 2.5 pounds of sulphur per million Btu in the baseline year, and the Phase II cap is equivalent to one of 1.2 pounds per million Btu for that year.

b. Establishing the initial cap and any phased reduction in the cap substantially in advance of the reduction creates efficiency and certainty for regulated entities

A second lesson from Title IV is that establishing the phased reductions well in advance creates certainty for regulated entities and orderly achievement of emissions reductions targets. In fact, experience under Title I was that, in the period between passage of Title IV in 1990 and imposition of the Phase I standard in 1995, sources began to reduce emissions such that by 1994 emissions reductions had almost achieved the Phase I target established to begin in 1995.[76]

B. REGULATED SOURCES

1. Leakage

Leakage occurs when sources subject to the regulatory system shift production to sources that are not covered by the regulatory system. This may be caused when larger firms shift production to smaller firms that are below regulatory thresholds, between industries from a regulated industry to one that is not, or to a production facility beyond U.S. borders.

The Experience of the Acid Rain Program

Title IV has experienced little leakage. First, Title IV covers all but the smallest plants, as it includes all existing plants over 25 megawatt capacity. The second source of leakage could be a problem under Title IV, as it does not cover industries which generate electricity for their own use.[77] This may create an incentive for an industry to generate its own energy off-grid, but this effect is expected to be minor. There is little leakage of the third type, as it would be infeasible for utilities to generate a substantial amount of their power from plants located outside U.S. borders.

Lessons for an Emissions Cap and Allowance Trading System for GHGs

Leakage of CO_2 is of concern in a GHG system principally if the industrial model is chosen. With the fuels model there is little leakage when all CO_2-producing fuels are included and when importers as well as domestic producers are covered. In the fuels model, the only concerns may be leakage to small entities, which can be addressed in establishing an appropriate size for participating entities, and leakage created by shifting the production of energy intensive products to countries where the price effects of GHG policies may be lower. While the latter

---

76 U.S. EPA, EPA-430/R-95-012, ACID RAIN PROGRAM EMISSION SCORECARD 1994 (Dec. 1995).

77 *See supra* text accompanying note 17.

problem may be of concern, the price effects would need to be quite large to cause significant leakage.

Concerns for an industrial model arise because only several large industries are included in the regulatory program, giving rise to several issues not present in Title IV, which covers only electric utilities. These are discussed briefly below.

a. Prevent Leakage to Unregulated Small Sources

The selection of industries to be included in the regulatory program is heavily influenced by the need to prevent leakage. As described above, the preferred option is a "deep and narrow" approach which includes all firms in key industries. The broader alternative system is to include the large plants in any industry, but this gives rise to a significant potential for leakage, as the large plants could shift production to smaller plants. The preferred option chosen for the industrial model includes almost all plants in the five key industries which have large, energy intensive plants.

b. Prevent Leakage in Shifting Production Elements to Other Industries

Even with an industrial model which regulates only key industries, leakage can occur if production elements are shifted to other, unregulated industries. For example, components currently manufactured at and considered part of the regulated industry could be purchased from an unregulated industrial source, or a participating firm could reorganize itself into a regulated entity and an unregulated entity at the same site. The magnitude of the potential leakage due to shifting production to unregulated sources requires further study.

A similar concern involves power shifting, as industrial sources could transfer their compliance burden to electric utilities by switching some processes from fossil fuels to electricity. However, it may be that costs of the GHG allowances will simply be part of the negotiations between the utility and industrial source, as has already occurred under Title IV's opt-in provisions.[78] A rolling baseline allocation system, described below in part III, or other allowance reallocation system would largely resolve this power switching problem by reallocating allowances according to actual use or emissions.

c. Prevent Leakage to Foreign Competition, and Consider Competitiveness Impacts

GHG regulation may initiate leakage by creating incentives to shift production abroad. A related problem is that firms may be vulnerable to competition from foreign firms producing

[78] One of the two industrial source opt-ins approved under Title IV represented just this situation, when an industrial source shutting down its generating units obtained allowances in order to provide them to the utility from whom it would purchase power.

the same or competing products if the foreign firms are not subject to GHG emissions reduction requirements.

These concerns ar not unique to an emissions cap and allowance trading system, but are common to all reduction polices as long as Annex I countries have more stringent targets. Ensuring that GHG emissions reduction requirements are implemented as cost-effectively as possible and in concert with actions by other countries is the only way to limit these concerns.

2. Opt-Ins

The Experience of the Acid Rain Program

Title IV allows two forms of opt-in programs, whereby GHG emitting entities that are not regulated may voluntarily choose to be regulated under Title IV's provisions. Sources may be expected to opt-in if they can cheaply reduce emissions, and could derive economic benefits from their excess allowances.

The first type of opt-in is temporal, and allows utility sources that would normally not be covered until Phase II to opt into Phase I, receiving allowances for their established baseline amount before 2000. This has been a heavily used option in Title IV, and in 1995 an added 1.22 million substitution allowances were allocated to such sources.[79]

In addition, Title IV provides for non-utility industries with SO_2 emissions to opt into the regulatory system. This opt-in program allows these important sources of emissions to participate in Title IV, which otherwise would not cover them. EPA has promulgated opt-in rules for industrial combustion sources[80], which emit 14% of all SO_2, though it has not promulgated rules for process sources.[81] This provision has only recently been used, as EPA approved the opt-in applications of two industrial sources for the first time in 1996.[82] Interestingly, one of these represented a trade from an industrial source to a utility in compensation for the shut-down of the industry's energy generating plants, and consequent added electric demand from the utility.[83]

---

79 EPA 1996 COMPLIANCE REPORT, *supra* note 3, at 6.

80 40 C.F.R. § 74 (1996). *See generally* U.S. EPA, EPA 430-F-95-032, THE OPT-IN PROGRAM (Mar. 1995).

81 EPA ACID RAIN UPDATE NO. 3, *supra* note 3, at 3. *See also supra* Table 1(industrial sources emit 14% of SO2).

82 [27 Current Developments] Env't Rep.(BNA) 374 (May 31, 1996).

83 Alcoa will receive approximately 89,000 allowances per year for three electricity generating units. Dupont will receive approximately 8,000 allowances for shutting down four steam generating boilers in 1996, and will give these to the Tennessee Valley Authority, from whom Dupont will now buy the steam. Information from Kenon Smith, Analyst, EPA-ARD (January 7th, 1997).

Key requirements of Title IV for any opt-in source is that it have a definable baseline and accurate emissions monitoring to guarantee that any further reductions they make contribute to the environmental goals of the statute. The industrial combustion sources mentioned above must demonstrate their baseline emissions and an adequate monitoring plan to be accredited as opt-in sources.[84] These requirements, together with the individual application process, demand greater administrative capacity, making the opt-in process only appropriate if the source category as a whole cannot be included in the regular emissions cap and allowance trading system.

Lessons for an Emissions Cap and Allowance Trading System for GHGs

a. An Opt-In Program can Expand Coverage if Conditions are Met

An opt-in program has the advantage of expanding coverage of sources and sinks within the system. Opt-ins can allow sources to participate which are under the size thresholds for a category, or which have not been regulated as a sector for political or other reasons. The principal disadvantage of an opt-in system is the high transaction cost.

An opt-in program can either treat the source as a permanent part of the program, receiving annual baseline allocations of allowances, or on an individual credit trading basis. For the latter, a set of standards need to be established to define the verifiability, permanence, quantifiability, credibility, timing, and monitoring of carbon emissions reductions or sequestration. Entities believing they meet the standards would be able to apply for certification of their GHG benefits, which if approved would result in the issuance of allowances on a transaction basis.

Neither approach would be simple. The existing Title IV opt-in programs show how certain entities may opt-in to become permanent parts of the program. Although a number of policy processes have grappled with the kinds of issues that would be involved in credit trading, such as the U.S. Initiative for Joint Implementation on an international basis, none have attempted this on a broad scale. The kinds of issues requiring analysis include:

- problems in measurement of the GHG for the source;
- determining the net additionality of the GHG benefits;
- treatment of potential "leakage" in determining GHG benefits;
- how to discount future GHG benefits back to the present;
- how to treat projects that result in temporary instead of permanent sequestration or reductions in emissions; and
- how to account for risks in quantifying GHG benefits (this problem can be addressed by allowing for discounts to reflect uncertainties and risks).

[84] 40 C.F.R. §§ 74.14, 74.16 (1996).

The following discussion gives examples of what may be significant categories requiring opt-in treatment.

(1) Biotic Sources as an Opt-In

Biotic sources, as mentioned above in section II, may not be able to be included as a group in an emissions cap and allowance trading system due to problems such as measurement and leakage. However, specific kinds of biotic interventions may be judged sufficiently certain and credible to be allowed to opt in to the CO_2 trading system on either a permanent or a credit trading basis. The US Initiative for Joint Implementation, for example, has approved projects internationally for sequestration of biotic carbon, and the state of Oregon recently included biotic sequestration in its consideration of GHG emissions of a fossil fuel-fired utility.[85]

(2) Waste Streams as an Opt-In

Another potential opt-in source would be firms which reduce their organic waste streams, and hence reduce the carbon dioxide or methane generated by disposal of these wastes. This would require the firm to convincingly prove the average emissions for the waste treatment source they had been using and account for any methane reductions that would already be included in the regulatory system.

A particular example for such a system would be the brewing and distilling industries, whose organic waste streams are far higher in biological oxygen demand than most industries. Technologies are now available which dramatically reduce this waste stream by converting it to and using methane. Employing an opt-in provision could provide the capital needed for greater application and use of these technologies.[86]

(3) Recycling and Energy Savings as an Opt-In

Another potential opt-in source would be firms which save energy through programs such as recycling which reduce the carbon dioxide or methane generated by the production or disposal of goods. We note that to some extent, incentives for energy reduction programs may already exist. With the inclusion of utilities in the regulatory system, incentives already encourage demand reduction in order to save allowances.

---

85 Laura Kosloff & Mark Trexler, *Global Warming, Climate-Change Mitigation and the Birth of a Regulatory Regime*, 27 ENV'TL L. REP. 10012, 10015 (Jan. 1997).

86 Information from Anhauser Busch, Inc. and Bacardi Corp. (1996).

(4) Methane reductions as opt-ins

Several sectors which are responsible for significant methane releases cannot be included in a regulatory program because there are too many entities to regulate, or because of uncertainties in measuring baseline or current emissions. Because this includes most agricultural sources, research could profitably be spent on defining how they could participate most effectively in a GHG regulatory system. A cap-and-trade regulatory system could cover the largest emitters, or participation could be structured on an opt-in basis.

3. Source Phasing

The Experience of the Acid Rain Program

Title IV is implemented in two phases. Large sources with relatively high SO_2 emissions are regulated first in Phase I which lasts from 1995 to 2000. Phase II starts in 2000 and includes most other significant sources. Because the electric utility industry is highly interconnected, sources in Phase I can easily shift their load (and emissions) to unaffected sources which would not be covered until Phase II. This load shifting capability has made implementing a phased approach extremely difficult.

The head of EPA's Acid Rain Division has stated that the phased approach is "perhaps the most serious flaw in the allowance program".[87] Others have noted that "Such complications, especially the two phases, while essential to the passage of the 1990 CAAA have increased the cost of implementation and provoked some litigation."[88] The GAO agreed that the source phase-in is a serious design flaw in Title IV, commenting that the separation creates needless complexity and has separated sellers from buyers. "Modification[s] to make in adapting the SO_2 program to CO_2 include eliminating the phased approach, thus requiring all sources to reduce emissions at the start of the program. This change would bring all prospective traders to the table at the same time, increasing the likelihood of trading and cost savings."[89]

---

87 McLean, *supra* note 69, at 7. He adds: "[Phase I] strives to accomplish three goals, not necessarily in harmony with one another, that reflect the battleground of interests in the acid rain debate: to provide some early emissions reductions, to provide some protection for high sulfur coal mining, and to minimize costs." *Id.*

88 Barry Solomon, Global CO2 Emissions Trading: Early Lessons from the US Acid Rain Program, p. 12 (EPA 1994).

89 "Plants in Phase I generally have lower costs to reduce emission per ton of SO2 than plants subject only to Phase 2, making Phase 1 plants more likely sellers and Phase 2 plants more likely buyers of allowances." GAO REPORT at 4,5. The opt-in provisions only encourage more sellers, which has led to surplus allowances (NY Times, Jan. 4 1996).

a. Avoid Phased Coverage of Sources within an Industry

Applying this lesson to a GHG system indicates that phasing the coverage of two or more sets of sources within one industry is not desirable or necessary. All covered sources within an affected industry should be included in the regulatory program at the outset to avoid the shifting of production and emissions to unregulated entities. This conclusion applies with particular force to the utility and other industries which are highly inter-connected.[90]

b. Phased Coverage of Industries is Possible but Should be Approached with Caution

The experience of Title IV does not answer other questions relevant to a GHG regulatory system, as Title IV regulates a single industry. A GHG system may consider applying a phased-in approach to the different industries it may cover. In the industrial model in particular, it may be possible to consider phased inclusion of the transportation, utility or industrial sectors, as there is limited inter-connectivity between these sectors. It could be argued however that the possibility of load shifting between the utility and industrial sectors is real, and there should be no phasing between these sectors. There may be both technical and political perils in a phased approach, however, as it would limit cost-effective trading, and make it more difficult to achieve the goals of the FCCC, which my require that all sectors be covered.

The lesson of avoiding phased coverage applies with particular force to the fuels model, as regulating one fuel and not the others would create severe leakage problems due to the inter-changeability of fuels, and make the system unworkable.

c. Phased Coverage of Gases is Possible

The lessons of Title IV also do not address the possibility of phased coverage of gases, as Title IV currently only addresses SO_2. It may be possible to initiate a GHG regulatory system with one gas, such as methane, and leave others for later inclusion. There is little interconnectivity between the CO_2 sources included in either model and the sources of other gas emissions. However, methane leakage from natural gas distribution systems should be addressed if a CO_2 system is implemented first. Other gases may be included later if there are problems with determining the equivalency of gases, or political or technical problems with the inclusion of a particular gas.

---

90 *See* McLean, *supra* note 69, at 7-8.

However, in considering these options, efforts should be made towards inclusion, as costs may be significantly increased by limiting the participating sources. Dramatically different costs of abatement may exist for different industries or different gases, and limiting trading will limit the effectiveness of the program. An analysis of an emissions cap and allowance trading model for NO_x and VOC emissions showed that savings could be ten times higher if three industries were included in the model than if only a single industry were included.[91] In addition, there are environmental considerations in leaving the minor gases for later inclusion, as some have very high GWPs, and are virtually permanent once emitted.

C. SETTING THE BASELINE

The Experience of the Acid Rain Program

In an emissions cap and allowance trading system, the baseline refers to the period of time used as a reference to allocate allowances among sources. In Title IV, allowances were allocated to utility units on the basis of their actual activity level during the years 1985-87, which become the baseline years. These years were used even though the goal of the program is to reduce emissions from 1980 levels, because they were the most recent data available to characterize typical operation of the units.[92]

Lessons for an Emissions Cap and Allowance Trading System for GHGs

If a historical baseline will be used, 1990 data can be used for most sources; if not, credible baseline estimates will be needed

It is expected that emissions data for the base year 1990, established in the FCCC, are sufficiently accurate to serve as the baseline for allowance allocations between units. Another period of time could be chosen for certain sources if, for example, the economic situation in 1990 were considered atypical. An average of several years around 1990 could also be used to smooth irregularities. If data are inadequate, collecting accurate data that can be used as a baseline should be a priority. Controversy and difficulty can be minimized by having good data.

There is another reason why a different baseline may be chosen for landfill methane sources. EPA in 1995 promulgated a final rule which requires large landfills to be covered and capture emissions of methane. These are expected to result in a 38% reduction of methane

---

91 John Henry et al., *Trading VOCs and NOx for Ozone Attainment Could Save Billions*, Compliance Strategies Review, Supplement (Fieldston Pub., Washington D.C., Feb. 27, 1995).

92 There was also controversy in determining the amount for emission reductions that had taken place from 1980 to 1985.

emissions over baseline emissions estimates.[93] These reductions could be considered in setting an emissions cap, to prevent a windfall to affected landfill owners, who have to achieve these emissions reductions anyway. The baseline for landfill methane sources could therefore be established in a current year after these regulations have taken effect.

There is another special issue with HFCs, as there were virtually no emissions of HFCs in 1990.[94] A zero baseline option would require HFC sources to purchase allowances equal to production like other new entrants. Overall, the very high global warming potential of these gases indicates they should be included in the system as well as supports the equities of a zero-baseline approach. The alternative option would be to allocate HFCs a reasonable share of the 1990 emissions resulting from CFCs and HCFCs (adjusted for GWP), as HFCs are primarily used as a replacement for these substances. This number may be very high, however, and it will be difficult to calculate what proportion of this number should equitably be allocated to HFC sources.

D. ALLOWANCE ALLOCATION

1. Initial Allowance Allocation

With any emissions trading program, entitlements under an emissions cap need to be allocated among the regulated entities. This can be done through a variety of methods ranging from an allocation based on historic activity levels to more flexible allocations such as moving averages or an auction. This is an especially contentious process, as it involves the distribution of rights with economic value.

Before entering a discussion of specific options, it is useful to consider the fundamental issues involved in allowance allocation. If emissions of a pollutant are viewed as the use of a public resource, the right to use it may require payment of a fee and regular renewal. This is how airwaves are regulated, through the auction of licenses valid for a number of years. On the other hand, almost all pollution laws operate on a grand-fathering basis, allowing existing sources to continue to emit pollutants, albeit on a modified basis and without payment of fees. The following text discusses these options as well as those which take a middle round between these alternatives.

The Experience of the Acid Rain Program

All existing trading programs, including Title IV, have allocated allowances to sources based on historic activity levels and without payment of fees. Under Title IV, all allowances are

---

93 42 Fed. Reg. 99005 (March 12, 1996).

94 EIA EMISSIONS, *supra* note 10, at 54 (table 34)(1994). The EIA only records 4,000 mT of HFC23, produced as a by-product of HCFC22 production.

allocated to existing sources based on their share of historic baselines. As the cap declines, the number of allowances each entity receives declines. In such a system, new sources must purchase allowances to cover all of their emissions.[95]

The allocation of allowances is controversial and difficult since the allowances have economic value and individual sources or groups of sources can benefit greatly depending on the allocation formulas chosen. In Title IV, the legislation itself established the allowance allocations for each Phase I unit,[96] and defined the formula for Phase II allocations to be implemented by EPA.[97] In Phase I, allowances were calculated for each unit based on its average BTU consumption in the baseline years (1985-87) multiplied by 2.5 pounds of sulfur per million BTU. The formula for Phase II allocates allowances based on the unit's baseline multiplied by only 1.2 pounds of sulfur per million BTU.[98] This system in effect grand-fathers the rights of existing sources.

While this method reduced future controversy at the administrative level, it created many politically-inspired exceptions. The political recognition of significant differences among existing sources due to different fuel usage and historic levels of control evolved into 29 allocation formulas for special situations in Title IV. " As a result, the allocation process was lengthened, made more costly, and provoked litigation. The multitude of formulas and particularly their data demands and ambiguous wording, have not served either the environment or market efficiency, but special interests at public expense. The lesson here is to keep formulas and data requirements to a minimum and define requirements clearly and consistently."[99]

In addition to these formulas, Title IV has bonus allowance programs which affects allowance allocation. A 3.5 million allowance extension reserve in Phase I is given to utilities which install 90% sulfur removal technology. This pool was developed in response to political recognition of the need to protect high-sulfur coal mining jobs by encouraging scrubbers which remove sulfur. Another special provision is the thermal energy exception to the opt-in program.[100] These bonus allowances are drawn from the general allowance pool, and so do not add to the cap amount. While bonus allowance pools do not interfere unduly with the functioning of the program, they have contributed to increasing the bank of allowances in Phase I which will be carried forward into Phase II.

---

95 In Phase II, Title IV requires all sources to have allowances equal to their emissions, but only allocates allowances to previously existing source units. 42 U.S.C. § 7651d (1994), CAA § 405.

96 42 U.S.C § 7651c(e)(3)(1994), CAA § 404(e)(3).

97 42 U.S.C. § 7651d (1994), CAA § 405.

98 42 U.S.C. §§ 7651c, 7651d (1994), CAA §§ 404 (Phase I), 405 (Phase II).

99 McLean, *supra* note 69, at 8.

100 *See id.* Other pools in Title IV include bonus allowances for utilities which install scrubbers or clean up early, and a reserve for energy conservation and renewable energy.

Two other regional programs illustrate the difficulty in setting allocations. The program for a NO_x emissions cap for utility and large boilers in the Northeast Ozone Transport Region established baseline for each state by agreement between the states.[101] Each state must now allocate its baseline among sources, which is proving to be politically difficult. In the Los Angeles area, the RECLAIM program proposed to allow businesses to choose their baseline year within a five-year period set by the State for the VOC element of the program. This VOC element has had to be postponed indefinitely due to intense disagreements between industry and other stakeholders over the method of selecting the baseline, as whether recession or other years were chosen made a great difference in business' reduction obligations.[102]

Lessons for an Emissions Cap and Allowance Trading System for GHGs

a. Leave the allocation process to the legislature

In Title IV, Congress not only defined the baseline, but defined each of the 263 units' individual emissions allowance allocations under Phase I and established the allocation formula for Phase II units. This option could be followed for a GHG regulatory system even though there is a somewhat greater number of sources involved under either the industrial or fuels model. If this proves too difficult, the legislature could at least define the relative allocation for different industries and the formulas by which allowance allocations could be calculated.

If it is not possible to leave the allocation process to the legislature, one option may be to design a statute with an allocation process that is implemented by a statutory deadline. This creates an incentive for the industry, government and other stakeholders to reach consensus about rulemaking provisions.

b. Establish as simple as possible an allocation formula; fuel neutrality will be an issue

Lessons from Title IV encourage simple allocation formulas, although these may not always be practicable. In one sense, formulas for GHGs may be simpler to establish because the equity concerns due to past investment in abatement technology, which was a major concern

---

101 *See* Northeast States for Coordinated Air Use Management, NESCAUM/MARAMA NOx Budget Model Rule (Boston, MA. February 1996).

102 *See* South Coast Air Quality Management District, RECLAIM Program Summary and Rules (Diamond Bar, LA, 1993). *See also* Clean Air Report, Environmentalists Slam RECLAIM VOC Offer, Press for Tougher Cuts, 17 (Nov. 2, 1995). Although potentially overlapping, Title IV and RECLAIM in practice regulate different sources. Title IV applies only to electric utilities, generally coal-fired. All of the generating facilities in the SCAQMD affected by RECLAIM use natural gas or renewable sources and hence are not affected by Title IV. The principal stationary sources of SO2 emission in the SCAQMD are oil refineries, which are not regulated by Title IV.

in SO_2 allocation, is less of an issue with GHGs. Some sources, however, may want credit for voluntary actions taken in response to the Climate Change Action Plan, which may complicate formulas. Factors which may make the GHG allowance allocation process more complex include the issue of fuel neutrality, and the need to create rules which apply to different industries and possibly also to different gases. The lesson learned for a GHG system is to avoid special provisions where possible, and design them to minimize interference with the functioning of the program.

Title IV does not address the issue of fuel neutrality because units without significant SO_2 emissions are not included in the program. A GHG program, however, would need to cover all major fuel types, and a fuel-neutral standard would heavily discourage high-carbon content fuels such as coal in either a fuels or industrial model. Political considerations may limit fuel neutrality, and require different allocation formulas for different fuel types.

c. The Acid Rain Program's Approach to Baseline and Allowance Allocation May Not be Most Appropriate for an Emissions Cap and Allowance Trading System for GHGs

Although a fixed allowance allocation based on a historic baseline has worked under Title IV, it presents somewhat greater difficulties when applied to a GHG system.

An allowance allocation based on a fixed baseline works best when the industry subject to regulation has stable participants and market shares, as was the case with utilities in 1990. As industries become more fluid and competitive, fixed baselines become increasingly less representative of actual industry composition as participants gain or lose market share. Although a fuels model GHG system more closely resembles Title IV in the relative stability of market participants, still more industries are involved, and in a competitive marketplace. An industrial GHG regulatory model includes more industries than Title IV, some much more competitive than the utility industry. In addition, increasing competition in the utility industry makes the fixed baseline less workable there as well.

There are several significant concerns with a fixed allowance allocation based on a historic baseline. Under this approach, owners of existing sources continue to receive allowances even after they retire, granting them inappropriate economic benefits. New sources entering the market must purchase all their allowances, creating economic disadvantages. This allowance allocation process may thereby provide inappropriate economic advantages and disadvantages to sources, a problem which becomes more severe the greater the fluidity within an industry. It also creates barriers to entry to newer, often cleaner, plants.

Another important problem with the fixed allowance allocation is that it creates an intense political fight over the allocation process because it creates significant permanent economic benefits. This has led to litigation of EPA's allocations for Phase II, has scuttled the

RECLAIM efforts to set a VOC cap in the Los Angeles area, and is one of the most difficult aspects of creating a utility NO_x cap and trading program in New England.[103]

The best way to approach this problem is not clear. On the one hand, the grand-fathering of the rights of existing sources may be a factor in helping industrial acceptance of a cap-and-trade program, leading to acceptance of the fixed allowance allocation approach. On the other hand, these problems may be resolved by more flexible allowance allocation approaches, described below.

d. An Emissions Cap and Allowance Trading system for GHGs might consider as alternatives: an allowance allocation system based on a rolling baseline, one based on an industrial performance model, or an auction of allowances

(I) Rolling Baseline and Allowance Allocation

To avoid the above problems with a fixed allowance allocation, one could reset allowance allocations every year based on plant's actual emissions or other indicators over the past several years. The number of years could be adjusted based on the need to provide firms with greater incentives to reduce emissions, or greater predictability. Also, each plant's allocation of allowances would need to be adjusted each year according to a "share" system so that the total number is equal to the emissions cap. Correctly designed, a moving average system appears to offer many benefits compared to the fixed allowance approach.

Principal advantages of an allowance allocation based on a rolling baseline or moving average include addressing the political problems in the initial allocation, treating new entrants more fairly and addressing the problem of shut-down sources. As this method sets allowance allocations equal to the actual performance of each source, it correctly allocates the economic benefits of allowances to each source. The advantages and disadvantages of the system are further described below.

A moving average approach may be especially easy to use with a GHG fuels model because allowance allocation would be based on fuel sales as an indicator of future emissions. Since each firm already acts to maximize its sales for competitive reasons, an allocation based on very few years sales could be used because it would not be expected to introduce any distortion in the firm's behavior. The only need may be to establish a short averaging period of, for example, three years to correct for any anomalous events or sales interruptions.

---

103 *See* Northeast States for Coordinated Air Use Management, NESCAUM/MARAMA NOx Budget Model Rule, (Boston, MA, May 1, 1996). Information of Jason Grumet, Director, NESCAUM.

ADVANTAGES

(a) Resolves new entrant problem. Under Title IV, firms entering the market are placed at an economic disadvantage because they must purchase allowances for all their emissions, whereas existing firms get free allowances. This new entrant problem can be expected to be greater with energy deregulation and with non-utility industries covered in a GHG program. As new entrants may often have cleaner technology, it is an environmental as well as economic problem if there are barriers to their entry.

The moving average system addresses this problem by allocating new firms allowances as soon as they have emissions to record. They could either be allocated a full amount of allowances based on the firm's estimated emissions, or the allocation for the first few years would be partial until the requisite number of years (3-7) of emissions history was completed. The former rule would lower the barriers to entry of new entrants, whose first years of operation can be the most difficult.

(b) Treats shut-down sources fairly The moving average system resolves the thorny issue of credits for shut-down sources. Other methods, such as confiscating the allowances of shut-down sources, gives firms incentives to stay in business simply to retain allowances, while continuing to grant such firms allowances gives them a windfall gain. The moving average system strikes a middle ground and limits windfall gains to sources which have reduced or ceased operations by gradually reducing their allowances over the time of the averaging period. This protects the public interest in allocating allowance rights to those most able to reduce emissions.

(c) Potentially reduces political problems in setting initial allowance allocation. Title IV's fixed allocation system resulted in intensive political lobbying by utilities during development of Title IV to receive additional allowances, as the initial allocation conferred such significant, and permanent, economic rights. This not only delays passage of legislation, but may prevent it. Such political issues have been so intense they played a major role in scuttling a RECLAIM VOC market and a NESCAUM cap and trade program for utility VOCs.

Since a rolling average system would lower the financial significance of the initial baseline determination, it may make it easier to reach a political accommodation on the initial allowance allocation required to initiate a GHG emissions cap and allowance trading system. If market participants knew that their allowance allocation would be annually recalculated based on an average of their actual emissions or other performance indicator over prior years, the economic significance of the allowance allocation would be less, and we may expect less intense political lobbying during the creation of an emissions cap and allowance trading program.

(d) Equity issues. A GHG system is expected to last for more than 50 years, at which time no current plant is likely to be operating. There are equity or public policy issues in continuing to allocate economic rights to entities which used to operate plants but no longer do. With wholesale changeover, what is left after 50 years is essentially an auction but with all proceeds going not to the public, but to grandfathered private entities.

(e) Technical advantages. There are several technical advantages to the moving average concept. First, a moving average allocation better addresses the fairness issues involved when an industry switches from generating its own power to using electricity off the grid. The moving average system would reallocate allowances between the two sources according to their actual usage, whereas the historical baseline approach may place a greater burden on the utility. Second, a moving average approach would allow better functioning of a system of allowance valuation using a fair market basis, which may be preferable for policy reasons as it resolves tax barrier issues.[104] A third improvement is that a rolling baseline self-corrects if poor initial data was used to estimate the baseline, creating increasing reliability of allowance estimates.

DISADVANTAGES

The potential disadvantages of the moving average system are few, and can be resolved by adjusting allocation rules.

(f) Reducing the incentive to bank or trade allowances. The most significant disadvantage to the moving average system of allowance allocation is that it potentially reduces the incentive to make reductions to trade or bank allowances in the future. This is because allowance surpluses created by a plant's abatement action would be progressively reduced as the allowance allocation is gradually lowered under the moving average system.

While important, this disadvantage is not critical, for two reasons. First, the principal factor motivating a firm to lower its emissions can be expected to be the lowered emissions cap, not the opportunity to trade surplus allowances.[105] Second, this problem can be minimized by calculating the rolling average on the basis of actual performance over a period of years. To take an extreme example, if the moving average were calculated over a twenty year time period, there would be virtually no change in a firm's incentives, as a loss of income twenty years in the future has almost no present value to a firm. In practice, a five to ten year rolling average would still provide strong incentives to invest in emissions reductions. Using a 15% discount rate, a five year moving average would allow a firm to capture 50% of the value of any reductions, and a ten year average would allow it to capture 75%. Such a term provides a reasonable trade-off between providing a return to sources that invest in additional mitigation actions beyond that required by the cap, and achieving the benefits of a moving average described above.

(g) Problem of anomalous years. A source may experience an unusual emissions profile in a certain year because of a labor strike, supply stoppage, or other anomalous event. If a rolling average system is set for a number of years, these events become insignificant in the process of

---

[104] *See* text at section G.2 *infra*.

[105] The experience so far under Title IV shows that compliance by most firms is driven by the emission cap, not the trading features of the program. *See* Burtraw, *supra* note 6, at 10417. In addition, relatively few firms are using trading as a major compliance tool, reinforcing the notion that the cap is the driving force. *See* B. Swift, *The Acid Rain Test*, 14 Environmental Forum p. 21 (May/June 1997); GAO REPORT, *supra* note 2 (only three utilities have engaged in substantial trading).

averaging numerous years. However, with a fuels model, emissions from only one year might be used to calculate an emissions history, and an anomalous year causes an equity problem if not accounted for. This situation is probably best dealt with by using at least a three year average even for a fuels model. Otherwise, a special administrative process would be needed to deal with these situations.

(h) Reducing predictability of allowance allocations and the trading of future year allowances. It could also be argued that a moving average system will discourage the trading of future year allowances by reducing the predictability of future allocations. As noted above, however, a multi-year averaging period creates reasonable certainty, as a number of allowances are guaranteed for future years: if a five year average were used, at least 80% of the allowances are guaranteed for the next year, 60% for the year after, etc. Additioanly, it could be argued that commodity markets have succeeded for many goods without such guarantees, and that firms are able to reasonably forecast future production. However, if additional certainty is desired it could be obtained by guaranteeing allowance allocations based on the moving average for a set number of years into the future. A five year guarantee, for example, would move the allowance allocation five years into the future, giving greater certainty to regulated firms but reducing the benefits to new sources.

(ii) Input or Output-based Performance Model

Another option would be to allocate sources allowances based on the average CO_2 emissions for each source category per unit of energy used (input) or produced (output). Title IV, for example, allocates allowances based on historical average consumption of BTUs by utility plants. A similar allocation model based on BTUs or kilowatts generated could be used in the utility sector, but it may be difficult to develop similar objective performance measures for other industries to be included in a GHG regulatory system.

Such a performance model would provide greater incentives for sources to switch to cleaner fuels than a model based on current or historic emissions. By rewarding owners of cleaner facities, it may also drive investment in clean technology. Its disadvantage is that it is not fuel-neutral, providing an economic windfall to generating facilities using natural gas or nuclear power (if they were included), and imposing higher costs on coal-fired plants. This may make it politically infeasible.

We note that this model could be combined with either an allocation process based on a moving average or one based on a historical baseline. In either case, it would provide greater incentives to reduce emissions or switch fuels.

(iii) Auction of Allowances

A substantial departure from Title IV would be to auction allowances each year. This eliminates the need to set a baseline, helping to ease the political efforts to establish a program. It also would automatically allocate allowances in an efficient manner, and facilitate trading. Although this method would virtually eliminate incentives for firms to reduce emissions in order to create allowances, there would be substantial, possibly greater, motivation for firms to reduce emissions to avoid the expense of buying allowances.

The principal problem with the auction method is that it is not revenue neutral to industry, and firms may view this as a tax. It therefore would likely be equally difficult to accept politically, and so may be an unrealistic option. Further research may be able to identify a way to refund the allowance cost to firms in a way which makes an auction system revenue neutral, thereby making an auction system more politically feasible.

However, some economists would argue that an auction system is an economically preferable system because it generates revenues which can be used to offset the negative effects of regulation. This argument posits that any system of allowance allocation or regulation of GHGs can be expected to cause firms to internalize costs and raise prices, and the net economic effects may be equivalent to an auction though not as evident. The auction system is therefore preferable as it is the only system which generates income which could be used to offset the negative effects.[106]

A modification to an auction approach may capture some of the benefits of an auction while reducing its revenue effects. A substantial number of allowances, say 50-75 percent, could be allocated free by traditional methods using a baseline, and the remainder auctioned. This may be politically more acceptable and would capture many of the benefits of auctions, such as ensuring efficient allocation and a supply for new entrants.

The auction approach could also allow the government to establish an innovative mechanism to automatically lower the emissions cap amount if cleanup costs become very inexpensive. Legislation establishing the auction could set a minimum price for allowances. Once the costs of compliance falls below this minimum, bidders should become unwilling to pay for the allowances, and prefer to abate their emissions instead. The allowances would remain unpurchased, thereby reducing the overall total of emissions. This self-executing provision would set the total number of allowances to a theoretical social optimum beneath the emissions cap, whenever technological advances make further cleanup relatively inexpensive.

---

[106] See, e.g., I. Perry, R. Williams, L. Goulder, WHEN CAN CARBON ABATEMENT POLICIES INCREASE WELFARE? THE FUNDAMENTAL ROLE OF DISTORTED POLICY MARKETS (National Bureau of Economic Research, March 1997); R. Morganstern, Environmental Taxes: Dead or Alive? Resources for the Future, Discussion Paper 96-03, p.2 (October 1995); W. Oates, Green Taxes: Can we Protect the Environment and Improve the Tax System at the Same Time? Southern Econ. J. 61:914-22 (1995).

2. New Sources

The Experience of the Acid Rain Program

Title IV allocates allowances to all participating sources that were operating when the legislation creating the program was passed. New sources must purchase allowances equal to their total emissions from existing sources or from the allowances sold at auction by EPA.[107] Existing sources that cease commercial operation continue to receive their allocation of allowances.

Lesson for an Emissions Cap and Allowance Trading System for GHGs

a. Title IV's Approach to New Sources May Not be Most Appropriate for a GHG Emissions Cap and Allowance Trading System

The Title IV arrangements may be suitable for a stable industry with long-lived plants such as electric utilities. However, the electricity industry is becoming less stable and other industries have considerable turnover in firms and plants. Assuming that a GHG regulatory program may be in place 50 years or more, it is useful to consider how best to deal with new and existing sources. There are two potential problems with using the Title IV approach for an emissions cap and allowance trading system for GHGs. Although they are not fatal flaws, they may encourage a search for a better solution.

First, if allowances are costly, but require new firms to purchase allowances while older firms get a significant number of allowances free, the system creates an added financial cost to enter the industry, and may create a disincentive to the construction of new and cleaner facilities. Also, since over 50 years virtually all existing sources may cease to exist, it seems strange to have them continue to benefit from allocation of free GHG allowances.

Second, requiring new sources to purchase GHG permits equal to their actual emissions may encourage leakage to unregulated sources domestically or internationally. Rather than build a new facility that will have to purchase permits equal to its total emissions, the firm has a small incentive to locate the facility in another country or structure the operation so that only part of its activities are governed by the trading program, while the rest occurs in less strictly regulated industries. International leakage is not a significant concern for electricity generators, since only a small fraction of electricity is traded internationally, but it could be significant for other industries involved in GHG regulation. In addition, the greater number of sources in a GHG industrial model creates greater opportunities for leakage domestically. These may be reason to structure a GHG industrial model program differently from Title IV.

---

[107] In both Phase I and Phase II, Title IV requires all sources to have allowances equal to their emissions, but only allocates allowances to previously existing source units. 42 U.S.C. §§ 7651c, 7651d (1994), CAA §§ 404, 405.

The systematic solutions that might be considered in the design of an emissions cap and allowance trading system for GHGs have been discussed above -- an allowance allocation based on a rolling baseline or the auction of allowances. A more specific solution to the new source issue designed to work with a traditional baseline and allowance allocation approach, would be to create an allowance pool taken proportionally from all existing sources or from shut down sources.[108] Allowances from this pool could then be allocated to new sources to cover all their forecast emissions, or at a reduced rate equal to some fraction, say 80%, of their estimated emissions to provide them an incentive to design new facilities so as to limit GHG emissions.

E. MARKET INFRASTRUCTURE

1. Auctions

The Experience of the Acid Rain Program

Title IV requires EPA to conduct an auction of allowances on a yearly basis. Each year 2.8 percent of all allowances are set aside by EPA and offered at the auction to the highest bidder.[109] Allowances can be purchased by the public as well, which has led to some being purchased for conservation purposes.[110] Early auction prices were much lower than expected and generally lower than private allowance transactions.

The auction is intended to speed the transition to a liquid market for allowances by serving two purposes. One is to ensure access to a supply of allowances for small and new sources to counteract the fear of market power on the part of large established sources. However, this problem has not arisen in Title IV, as an abundant supply of allowances has been available. A similar result may be anticipated in a GHG system, as there are many sources of supply and opportunities to reduce emissions.

The second purpose is to provide a price signal to the market. Under Title IV, the auction mechanism served to make widely known at an early date the relatively low cost of allowances and of compliance, compared with expectations before program implementation.[111] This helped lead to deferrals of decisions on scrubbers and the choice of other lower cost compliance options.

---

108 The argument against a method which takes away "shutdown credits" from a business is that it would provide an incentive for inefficient plants to continue in operation simply to collect the allowances.

109 42 U.S.C. § 7651o (b) (1994), CAA § 416 (b).

110 U.S. EPA, EPA 430-N-96-004, ACID RAIN PROGRAM UPDATE NO.3, at 13 (May 1996)(35,966 allowances retired to date).

111 *See* GAO REPORT, *supra* note 2, at 64; P. Joskow, R. Schmalensee & E.M. Bailey, AUCTION DESIGN AND THE MARKET FOR SULFUR DIOXIDE EMISSIONS (Massachusetts Institute of Technology, August 1996).

Some analysts have criticized the design of EPA's allowance auction in Title IV, and suggested that a better designed auction could serve as a better price signalling mechanism.[112] The structure of the auction mandated by Title IV is a discriminating price, sealed bid auction in which EPA sets no minimum asking price, and each bidder pays the price bid. This creates many different settlement prices, unlike a stock market where there is a single price at any one time. Early auctions resulted in widely varied prices, although since 1996 auction prices became more consistent, with most bids falling within 10 percent of the average price.[113] These analysts suggest the design may discourage trading by conservative utilities.

Lessons for an Emissions Cap and Allowance Trading System for GHGs

a. Maintain an Auction using a Small Percentage of Allowances but Allow EPA Discretion Regarding Auction Design

This option recognizes that auctions have a potentially useful role to play and attempts to correct the flaws in the current auction design. The purposes of an early auction, to provide price signals and protect against market power, are important. The price signalling effect of an early auction is especially important to provide information to firms which may have to make decisions on irreversible investments with long lead times.

This purpose would be better served by an improved auction design which does not distort the market, such as one similar to a stock market with a single market-clearing price. Creating a different auction design in the statute, or providing EPA with the flexibility to change auction design to address defects, has been suggested by the GAO and other commentators.[114]

b. Consider Eliminating Governmental Sponsored Auctions

This option would leave allowance transactions and development of an auction or trading mechanisms to the private sector. Considering the reasons for auctions as stated above, there may be less of a need for them with a GHG system because the possibility of a concentration of market power is less in a GHG market than in the SO_2 market, given the larger number of regulated sources. However, there is still a need for reliable price information, which would argue in favor of an improved form of auction, or else restructuring the Allowance Tracking

---

112 *See* GAO REPORT, *supra* note 2, at 53; T. N. Cason, *An Experimental Investigation of the Seller Incentives in EPA's Emission Trading Auction* 85 AM.ECON.REV. 905, 905-922 (1995)(the EPA's annual auction, which is mandated in the 1990 amendments, has been shown to provide buyers with a strategic incentive to under-represent their true willingness-to-pay for additional allowances).

113 U.S. EPA, EPA 430-N-95-012, ACID RAIN PROGRAM UPDATE NO.2, at 6, 10 (July 1995).

114 *See* GAO Report at 53.

System to reveal price information itself. Considering the role early auctions played in Title IV, some early objective method of price signalling such as an auction appears very useful.

2. Banking

The Experience of the Acid Rain Program

Banking refers to the ability to store allowances in excess of those needed for the current year for use in future years. Title IV permits allowances to be freely banked for an indefinite period. The experience in 1995 under Title IV has surprised most analysts because of the extent of the banking activity caused by early reductions of emission. In 1995, there were 8.7 million emissions allowances available, but utilities emitted only 5.3 million tons of SO_2, banking 3.4 million allowances, and in 1996 8.3 million allowances were available, but utilities emitted only 5.4 million tons and banked 2.9 million.[115]

This extent of banking has had two major effects. The first is that it creates significant environmental benefits -- an additional 6.3 million tons of SO_2 have been removed early in the program. The second is that, since banking results from relatively fixed investments such as installation of scrubbers or long-term contracts for low-sulfur coal, observers expect to see significant banking for several more years. This has led to predictions of a large pool of banked allowances lasting into the next decade and subsequently suppressing both trading and allowance prices.[116]

Lessons for an Emissions Cap and Allowance Trading System for GHGs

a. Banking should be allowed without discounting

Banking appears to be an important feature of a cost-effective emissions cap and allowance trading regulatory system. It allows participants in the program, even without trading, to make significant cost reductions by phasing their investments in emissions control technology according to their economic needs. This is more significant the greater the capital costs of emissions abatement. Banking also provides an incentive for early reductions, which is expected to be of even greater usefulness in a GHG system as earlier emissions reductions have greater environmental benefits due to the long life of GHGs. Finally, banking can also smooth the curve between progressive limits in a phased-in program, which can be expected in a GHG regulatory program. Banking therefore appears to be even more important for a GHG regulatory system than in Title IV, and should be encouraged.

---

115 EPA 1996 COMPLIANCE REPORT, *supra* note 3, at 7.

116 *See* Resources Data International, *supra* note 6, at 23-25.

There are two arguments against banking. The first is that banked allowances could be used over a short-term period to increase emissions with detrimental effects on the environment. This argument is less significant for greenhouse gases than for SO_2. The climate impacts of greenhouse gases are largely related to the concentration of those gases in the atmosphere. Since these gases have very long atmospheric residence times (decades to centuries), the atmospheric concentration responds very slowly to changes in emissions from year to year. Thus even large short-term changes in emissions of greenhouse gas would have only small environmental impacts. Furthermore, the experience under Title IV and other programs is that large increases in emissions are only a conceptual possibility, not a practical concern. The evidence shows that once sources implement measures to reduce emissions leading to banked allowances, they do not reverse these measures simply to use the allowances.

The second argument is that accumulation of a large bank of allowances could make rapid implementation of future emissions reductions, should they prove necessary, more difficult. If atmospheric concentrations of greenhouse gas concentrations are to be stabilized -- the objective of the FCCC -- global emissions ultimately will have to be reduced significantly below current levels over many decades. However, this concern can be met by giving allowances a long, but limited, life; in addition, the size of any future reduction can also be adjusted to reflect the size of the allowance bank.

An option that has been discussed in trading programs includes charging a percentage (such as 10 percent) reduction on all traded or banked allowances due to a desire to create an environmental benefit from industry activity which saves money. This would discourage early action. In addition, proper consideration of the total number of allowances should take place in determination of the emissions cap, not in exacting a fee on transactions which are being made for the purpose of economic efficiency.

b. Allowances should be given a long, but limited, life

As noted above, complying with the FCCC is likely to involve reductions of allowable emissions over many decades. This was not a consideration under Title IV. It has been suggested that allowances be given a long but limited life to prevent the possibility that a large allowance bank may build up and affect the government's ability to increase or decrease allowance allocations according to future international negotiated limits.[117] A long life, such as 20 years, is proposed to allow sources to capture all the benefits of banking, while allowing the government increased flexibility.

117 Personal communication of Brian McLean, EPA-ARD at 10/17/95 meeting.

3. Inter-gas Trading

The Experience of the Acid Rain Program

Title IV does not allow trading between the two gases it regulates, NO_x and SO_2, because their equivalency is not known with precision, and because their effect on the ecosystem varies regionally. In addition, both gases play different roles in other pollution issues, including urban ozone, particulate matter and visibility impairment. The possibility of future inter-gas trading is contemplated, however, and Title IV requires EPA to "furnish to Congress a study evaluating the environmental and economic consequences of amending this title to permit trading sulfur dioxide allowances for nitrogen oxide allowances."[118]

Inter-gas trading is particularly problematic in addressing acid rain damage because the relative effect of either gas upon the ecosystem varies greatly in different regions depending on the buffering capacity of the receiving waters and lands. According to EPA, "The relative contribution of sulfur and nitrogen to this problem differs among regions, depending not only on external differences in the deposition rates of these chemicals, but also on differences among the capacity of receptor watersheds to retain sulfur and nitrogen."[119] This makes inter-gas trading difficult under Title IV.

Lessons for an Emissions Cap and Allowance Trading System for GHGs

a. Inter-gas trading has greater feasibility for a GHG trading program

Inter-gas trading has greater feasibility for a GHG rather than SO_2 trading program for two reasons.[120] First, the receiving atmosphere for GHGs is global and so is the same for all gases, unlike the situation with SO_2 and NO_x. Second, the equivalent forces of the various gases have

---

118 42 U.S.C. § 7651b (c) (1994), CAA § 403 (c). This report has never been completed because of competing pressures for other work.

119 U.S. EPA, EPA 430-R-95-001A, ACID DEPOSITION STANDARD FEASIBILITY STUDY, at 56 & Chs. 2, 3 (1995). Such differences have led authorities in California, for instance, to focus on nitrogen control, whereas most eastern states focus on sulphur control.

120 *See generally* T. Teitenberg, IMPLEMENTATION ISSUES: A GENERAL SURVEY. COMBATTING GLOBAL WARMING: STUDY ON GLOBAL SYSTEM OF TRADEABLE CARBON DIOXIDE EMISSION ENTITLEMENTS, p.127 (United Nations Conference on Trade and Development, New York 1992).

already been the subject of much study and the IPCC and EPA have determined the carbon-equivalent force of different gases over various time horizons.[121]

However, as the values of Global Warming Potentials differ significantly depending on the time horizon chosen as well as the concentrations of the gases already in the atmosphere, the values will change over time. The global warming potential of methane, for example, is 62 time that of CO_2 at 20 years, 24.5 at 100 years, and 7.5 at 500 years. That of HFC-23 remains fairly constant around 10,000 times CO_2 during this period, whereas HFC-134a declines from a multiple of 3,300 to 420. This variability may complicate efforts to allow inter-gas trading, although conservative values could be chosen to minimize risk.

There are considerable advantages to allowing inter-gas trading. The first is that adding more sources makes a more vigorous and effective market. Initially, for example, methane sources could be expected to be sellers of allowances created at low cost, creating a supply for CO_2 sources. It would be anomalous for allowances to be trading at one price in a methane-only market and another in a CO_2-only market given the policy interest in achieving the emissions reduction goal at lowest cost.

The second benefit comes from creating a comprehensive system which reduces all emissions in a cost-effective manner. It may make sense, for example, for methane sources or HFC sources to reduce their emissions substantially and by a greater percentage than CO_2 sources. An integrated market would accommodate this readily, whereas a balkanized market would not create incentives for sources to reduce emissions beyond the emissions cap initially set for that market.

The alternative would be to allow only intra-gas trades, in effect creating separate markets for CO_2, methane, and other gases. However, for HFCs and other minor GHGs, there may not be enough sources to create a competitive market, or some sources may be so large as to influence a market. Second, the resulting obligation may be deemed inequitable, as reducing emissions by a given percent may be much less costly for sources of methane, for example, than for sources of CO_2. As noted above, separate markets would also limit the efficiency and effectiveness of the program.

The main benefit of this approach is that it creates increased security against any chance of error in the IPCC's calculations of carbon equivalency, or because of the variables in estimating such equivalency noted above. Although the Global Warming Potential for the 100 year horizon is frequently used, there is no compelling reason to choose that period, and choosing different time horizons would create significantly different Global Warming Potentials.

If inter-gas trading is allowed, a lesson of Title IV is that their equivalence should be set by statute to prevent litigation on the matter. In addition, since current estimates of GWPs may change in the future, there should be some kind of requirement that GWP values would only

---

[121] These numbers are set by the IPCC. Note that 42 U.S.C. § 7671a (1994), CAA § 602(e) requires EPA to list the global warming potential of ozone-depleting chemicals.

be changed by the regulatory authority with adequate advance notice to allow reasonable security in trading.

F. ADMINISTRATIVE INFRASTRUCTURE

1. Allowance Tracking System

The Experience of the Acid Rain Program

To ensure that utilities have sufficient allowances to cover their emissions each year, Title IV established an Allowance Tracking System (ATS) to record the trades and transfers of sulfur dioxide emissions allowances.[122] The ATS functions similarly to a bank, and monitors the issuance of all allowances and the holdings of allowances in accounts. It creates an open public process for the recordation and transfer of allowances, which is very useful for compliance and enforcement.

EPA established accounts for each utility governed by Title IV called "unit" accounts. Each one contains records of all of the utility's allocated emissions allowances. Actual emissions are recorded by continuous emissions monitoring devices and are deducted from the emissions allowances in the account to determine compliance. Utilities with insufficient allowances face penalties including a fine of $2,000 per missing allowance.[123]

Lessons for an Emissions Cap and Allowance Trading System for GHGs

a. An ATS is a useful management tool

The preferred option would be to continue the practice of Title IV and create an ATS for a GHG system because it creates an open, public process for allowance recordation which helps ensure compliance with the law. Indeed, the ATS coupled with the penalty provisions works so well for compliance purposes that a permit system may not even be necessary for Title IV.

A contrary argument that an ATS is not needed posits that the forces of the free market would create an adequate private sector equivalent. This overlooks the value that the government gains in the ease of compliance monitoring with an ATS. Under the current system, government regulators have only to check the ATS to ensure that utilities are complying with Title IV. Because it is a public process, there are added incentives for utilities to comply.

A primary difference for a GHG system ATS is that the volume of allowances would be 100 times greater due to the proportionately greater level of GHG emissions. An emissions cap

---

122 42 U.S.C. § 7651b(d)(1) (Supp. II 1990).

123 40 C.F.R. § 73.31(a) (1994). In addition to the "unit" accounts set up for affected utilities, any organization or individual may open a "general" account.

for CO_2 at 1990 levels would require around 1.5 billion allowances to account for US GHG emissions[124], versus Title IV's cap of less than 10 million allowances for tons of SO_2. While this makes operating an ATS more complex, the reasons for retaining an ATS remain valid.

b. It may be desirable to track and publish price information through the ATS

The ATS in Title IV does not record the price of allowance trades. The rationale behind this is that price information is "better collected and reported by the private sector through established exchanges or other trade information brokers."[125] If firms are reluctant to report prices, making them public could discourage trading. However, we believe that the lack of price information may increase the uncertainty about the market and thus discourage trading.

The GAO Report notes that the variable prices in allowances and the lack of price information has led to "continuing uncertainty among utilities as to what allowance prices should be". In contrast, it notes that utilities can readily obtain the market price of a scrubber or a ton of low-sulfur coal.[126] Since the GAO Report was published, private providers of price information have become more established, but these cannot include many trades, the price information for which is not disclosed.

We note that where there is uncertainty or variability as to price, as was the case in Title IV where estimated costs of allowances reached $1500[127] but current allowance prices are around $100, the market may benefit from the guidance that the public listing of prices may provide.[128] This is likely to be necessary for a fledgling CO_2 market. Therefore the inclusion of allowance trade price information in an Allowance Tracking System is recommended for a GHG regulatory system under either model to reduce uncertainty about the market, keep transaction costs low, and encourage trading.

---

[124] *See* EPA INVENTORY, *supra* note 11, at ES-3.

[125] U.S. EPA, THE ALLOWANCE TRACKING SYSTEM, ACCOUNTING FOR SO2 ALLOWANCES UNDER THE ACID RAIN PROGRAM (1994).

[126] GAO REPORT, *supra* note 2, at 34.

[127] This is the figure stipulated in the CAAA for direct sales by EPA. 42 U.S.C. § 7651o (c), CAA § 416 (c). *See* Dallas Burtraw, *The SO2 Emission Trading Program: Cost Savings Without Allowance Trades*, CONTEMP. ECON. POL'Y. (Apr. 1996).

[128] *See* U.S. EPA UPDATE, *supra* note 3, at 7.

c. Batch serial numbers should be considered under an Emissions Cap and Allowance Trading System for GHGs

Under Title IV, each allowance allocated to an account is assigned a unique identification number.[129] Individual serial numbers for allowances increases the complexity of the ATS, but arguably are valuable to see exactly where specific allowances end up and facilitate verification.[130] Batch numbers would be less costly to track, and could reduce transaction costs.

Given that GHG emissions will be 100 greater than SO_2 emissions, and the larger number of sources, a GHG ATS might become quickly overwhelmed by the number of trades if individual serial numbers are used. A possible solution to this problem is to create different denominations of permits, say of 1 ton, 10 tons, 100 tons or thousands of tons. Trades could be settled by the transfer of permits of different denominations.

2. Permit System

The Experience of the Acid Rain Program

Phase I of Title IV is unusual in that it is directly operated by EPA, and not the States, and requires no permits.[131] However, Phase II requires the integration of the acid rain regulatory system with the CAA's Title V operating permit process, which is delegated to the States to operate. There are two issues which may indicate the Phase I process is the better one.

First, Title IV establishes by law the standards for each plant, as well as the monitoring and compliance process. These are self-executing, as each utility unit must publicly record its annual emissions and holdings of allowances, and pay heavy fines if its emissions exceed its allowances.[132] There are no discretionary actions which require a permitting process. Arguably, there is also little reason for States to implement the program, which is currently effectively run by fewer than 100 employees at EPA.

The second issue is that the Title IV permit process established for Phase II is far simpler than that for Title V. States must first get their Title V program approved by EPA, and then have two years to process each permit. The Title IV permit application, on the other hand, is a

---

129 40 C.F.R. § 73.34(d) (1994).

130 Adam J. Rosenberg, *Emissions Credit Futures Contracts on the Chicago Board of Trade: Regional and Rational Challenges to the Right to Pollute*, 13 VA.ENVTL.L.J. 501, 511 (1994).

131 We note that the Title IV's restrictions on SO_2 emissions is in addition to other restrictions on SO_2 emission. Because SO_2 is a criteria pollutant, there are NSPS and ambient standards for SO_2 applicable to all sources, which require permits.

132 42 U.S.C. §§ 7651j, 7651k (1994), CAA §§ 411, 412.

page in length and can be filed out in a matter of minutes. [133] Integrating the two systems means the Title IV permit is issued only after the lengthy Title V process is completed, creating unnecessary delay and uncertainty.[134]

Lessons for an Emissions Cap and Allowance Trading System for GHGs

a. *Permits and State delegation may be unnecessary*

The above discussion would indicate that a federally operated system without permits may be both the most efficient and effective way to structure an emissions cap and allowance trading system. As indicated, each unit's allowance allocation is clearly spelled out in the establishing legislation or regulation, and the monitoring and compliance procedures leave no room for discretionary action. An option under this approach would be to have a federal system which allocates allowances to the states, which could then reallocate them to sources within the state.[135]

Also, unlike Title IV, no permits are currently required for GHGs as they are not criteria pollutants like SO_2. Since the GHG emissions cap would therefore be the only regulatory system applicable to GHGs, there is even less reason to integrate a GHG emissions cap regulatory system with other permitting systems.

3. Cost Recovery

The Experience of the Acid Rain Program

Title IV does not authorize any fee to be collected to support the regulatory administration of the program. Under Title V, however, states are allowed to collect a $25 per ton fee to support permitting and enforcement activities.[136]

The head of EPA's Acid Rain Division argues that

---

133 EPA, Phase II Permit Application, OMB No. 2060-0258.

134 *See* U.S.EPA, *supra* note 2; [95 Current Developments] Env't.Rep (BNA) 933 (Sep. 22, 1995) (four states have inadequate Phase II permit program).

135 This approach is proposed in current bills to cap NOx emissions. VIII Clean Air Report No. 15, p. 11 (July 24, 1997).

136 42 U.S.C. § 7661a (b)(3)(1994), CAA § 502. *See* U.S. GAO, GAO/T-RCED 94-68, AIR POLLUTION: PROGRESS AND PROBLEMS IN IMPLEMENTING SELECTED ASPECTS OF THE CAAA OF 1990(1993). North Carolina's Clean Air Act Advisory Council estimated that the actual cost for the permit program would be $36 a ton.

a fee based on emissions would have provided a stable source of funding for essential governmental administration. Since EPA is the principal implementor of Title IV, it would have been logical for the statute to have provided a similar funding mechanism for EPA. A fee of $1 per ton would have been sufficient to cover all federal administrative costs for development and operation of the allowance program, i.e., for all permitting, allowance allocation and tracking, monitor certification, and emissions tracking.[137]

Lesson for an Emissions Cap and Allowance Trading System for GHGs

a. Charging a per-ton fee may help defray program costs

Charging a modest per ton fee sufficient to cover all federal administrative costs for development and operation of the allowance program would recoup the administrative costs of permitting, allowance allocation and tracking, monitor certification, and emissions tracking. Since the administrative costs of an emissions cap and allowance trading program are low compared to other regulatory systems, the fee would not be excessive.

Charging a fee would apply the principle of polluter pays to the administrative costs of the program, and could help to facilitate administration of the program. This system may be most appropriate. A contrary argument is that government regulation is a public good and should be provided from the general governmental budget. A GHG regulatory system could apply either strategy.

4. Monitoring

The Experience of the Acid Rain Program

An emissions cap and allowance trading system requires accurate determination of emissions to ensure the emissions cap is not exceeded and to ensure the legitimacy of trades. One of the reasons Title IV has been successful is the high integrity of the allowance currency, due to the requirement that utilities install continuous emissions monitoring devices (CEMs) to accurately measure actual emissions.[138] Title IV also allows Predictive Emissions Monitors

---

[137] McLean, *supra* note 64, at 8.

[138] *See* U.S. EPA, *supra* note 2, at 5 ("Over 93 percent of all Phase I and Phase II monitors achieved relative accuracies of [within] 7.5 percent".)

(PEMs) for SO_2, which gauge emissions by considering the amount of sulfur in the fuel and other boiler parameters, if they can be shown to be accurate.[139]

Lessons for an Emissions Cap and Allowance Trading System for GHGs

a. *The integrity of the allowance currency must be high*

There must be a requirement for accurate emissions monitoring for an allowance cap and allowance trading program to function. Otherwise, the emissions reduction goals of the statute would not be met, and private parties would not have the confidence to trade allowances. Rigorous test procedures should be required for emissions monitoring, although the experience of Title IV shows that CEMs should not necessarily be mandated as a technology of choice. The test procedures should be flexible enough to allow accurate comparison of different types of technologies.

The need for flexibility in test procedures is greater for a GHG model because CO_2 emissions can be estimated accurately based on the carbon content of fuel, and predictive emissions monitoring is feasible. Indeed, the fuels model of GHG regulation can only function with predictive measurements since regulating fuels is an accurate proxy for predicted subsequent emissions.

Issues for methane monitoring include better systems for monitoring emissions from ruminant animals, coal mines, and leakage from oil an gas systems, as well as improved methods for predicting methane seepage from landfills.

b. *CEMs may not be necessary for an emissions cap and allowance trading system for CO_2 from fuel*

For the GHG industrial model, monitoring options include requiring CEMS, as in Title IV, or establishing more flexible procedures for emissions monitoring. Utilities covered by Title IV are required already to monitor CO_2,[140] but as CEMs are expensive, especially for smaller sources, and may not be more accurate than predictive methods, CEMS should not be required for a GHG system. As CO_2 emissions can be calculated accurately from the composition of fuel

139 One commentator discusses how the use of PEMs has been blocked by regulatory barriers in the test procedures required by Title IV, which require a greater burden of proof for non-CEM technologies than for CEMS. C.Foster Knight, *How Regulations Impact Innovative Environmental Technologies: A Recent Case Study*, TOTAL QUALITY ENVTL.MGMT.119 (Spring 1995).

140 40 C.F.R. § 75.13 (1994).

for most sources,[141] fair but accurate test procedures which do not require CEMs should be established for a GHG regulatory system.

A fuels model must of necessity rely on predictive estimates of emissions, since allowances would be allocated based on the carbon content of fuels. Their carbon content, however is an accurate indicator of future CO_2 emissions. One issue which this system must resolve is monitoring of the sales of fuels to industrial sources for process purposes, which would be excluded from the regulatory system.

5. Enforcement and Penalty Systems

The Experience of the Acid Rain Program

Title IV sets high penalties for non-compliance, which is a key ingredient of an effective emissions cap approach. Under Title IV, utilities must have adequate allowances to cover their emissions at the end of the year or they are fined $2000 per missing allowance and must forfeit an equivalent number of allowances in the next year. Since the utility could buy allowances in the market at $100 per allowance, Title IV creates very strong financial motivations for complying with the Act.

Actual compliance with Title IV is so far very positive. All 256 electric utility units required to report a full year of CEM data by the beginning of 1995 have done so, and only one utility has been fined for failing to complete a timely certification testing of its CEMs.[142] All utilities have complied with the emissions cap in both 1995 and 1996, a remarkable record.

Lessons for an Emissions Cap and Allowance Trading System for GHGs

Similarly penalties should be set at a high level for a GHG regulatory system, to encourage compliance with the regulations. As with Title IV, the penalty amount should exceed the upper estimation for the cost of compliance. Since the cost of a GHG allowance may be an order of magnitude less than that for SO_2, a penalty may be less than the amount imposed under Title IV.

G. NATURE OF ALLOWANCES

1. Property Rights

---

141 Decision Focus Vol. 2, *supra* note 14, at 4-2, 5-2, 5-3. "Although stack monitoring is an option here, it is probably more precise, straightforward and less costly to base emission estimates on fuel use by industry".

142 U.S. EPA UPDATE No. 3, *supra* note 3, at 3; U.S. EPA, EPA 430-N-95-012, ACID RAIN PROGRAM UPDATE NO. 2, at 15 (1995).

The Experience of the Acid Rain Program

Title IV states that allowances are not property rights. This is an attempt to avoid any takings issue if government decides to change the overall cap on SO_2 emissions. Although this provision could potentially discourage some traders from buying allowances, it has not been reported to have had any significant effect on the SO_2 allowance market to date.

Lessons for an Emissions Cap and Allowance Trading System for GHGs

a. Title IV's treatment of property rights is adequate

A GHG system could follow the practice of Title IV and have the law continue to state that the allowances are not property rights. An argument for the contrary is that, although not seen as a major impediment to trading now, making allowances property rights would make them more fully fundible and encourage trading.

Retention of the Title IV treatment is recommended as it has not hampered the willingness to trade. The overall cap on GHG emissions will need to be reduced over time. If this can avoid future litigation stemming from such reductions, it is highly desirable. The option of giving allowances a defined life, such as twenty years, also helps address concerns about the need for regulatory flexibility to reduce allowances.

2. Tax Treatment

The Experience of the Acid Rain Program

The current tax treatment of Title IV allowances, according to an IRS ruling, provides that allowances have a zero cost basis. This means that the full sale price is taxed as income when an allowance is sold. This creates a significant tax barrier to an initial allowance trade, and creates a disincentive to trades which for economic efficiency reasons should be made.

While this may have little impact on the behavior of utilities, which exist in regulated environments, it may have a greater influence on the behavior of other industries which would be included in a GHG regulatory system. This issue is therefore of greater importance for a GHG regulatory system than under Title IV.

Lessons for an Emissions Cap and Allowance Trading System for GHGs

a. Allowance tax treatment on a fair market value basis would avoid trading dis-incentives

An alternative method would be to establish a fair market basis value for allowances. This method would do away with the existing tax disincentive to trading caused by the existing IRS rule. An improved auction or other market price reflected in the allowance tracking system could be used to establish the fair market value basis for allowances.

Another policy reason favoring a fair market value approach is that it may encourage donations or retirement of allowances to non-profit groups as it would allow sources to receive a tax deduction on the fair market value of their allowances. Thirty five thousand allowances have already been donated by 1996, even without such encouragement.[143] A fair market value rule could be expected to encourage donations and create environmental benefits, though it would also represent a tax expenditure.

H. OTHER

1. Innovation and Investment

The Experience of the Acid Rain Program

Title IV has fostered significant innovation and investment both in utility plant and equipment, and in an unexpected quarter - the rail industry. Collectively, such innovations have reduced the cost of compliance from an estimate of $1.3 billion under traditional regulation to $725 million in 1997, and are expected to reduce it from $4.5 billion to $2.5 billion under Phase II.[144]

Title IV has had a decisive effect on the rail industry by creating a large market for low-sulfur western coal to move east to the Phase I power plants. This, coupled with deregulation of the rail industry, has led to a stream of innovations which have lowered significantly the delivered cost of low-sulfur coal to eastern utilities, including improved locomotives and car design, better coal hoppers, and track upgrades.[145] A study by Clean Air Capital Markets has

---

143 U.S. EPA UPDATE No. 3, *supra* note 3, at 13.

144 *See*, GAO REPORT, *supra* note 2, at 74; R. Research by the MIT Center for Energy and Environmental Policy Research shows that the total costs of phase I in 1995 to have been about $725 million. A. D. Ellerman, R. Schmalensee, P. Joskow, J.P. Montero & E.M. Bailey, SULFUR DIOXIDE EMISSION TRADING: EVALUATION OF COMPLIANCE COSTS (MIT, in press, 1997).

145 "The end result was that the transportation costs to deliver a ton of Power River coal to distant utility markets was lower [by over 40%] than it was in 1984". Design improvements included more powerful engines, extended cars of articulated sections that increased coal carrying capacity by 30-40 percent, more aerodynamic car design and lighter cars made of aluminum. MANAGEMENT INSTITUTE FOR ENVIRONMENT AND BUSINESS, COMPETITIVE IMPLICATION FOR ENVIRONMENTAL REGULATION: A CASE STUDY ON CAROLINA POWER AND LIGHT 5 (draft of Sep. 29, 1995).

identified $2 billion in investments in rail technology and another $6 billion in low-sulfur coal fields, some directly by utilities, made in significant part as a consequence of Title IV.[146]

Innovation has also taken place in the utilization of existing plant and equipment. Coal-fired power plants are designed for a particular type of coal and deviations in any of several important properties may impair plant performance or harm equipment.[147] Conventional thought has been that combustion of low-sulfur sub-bituminous western coal in eastern utility cyclone boilers would be most troublesome in this regard because it does not share the characteristics of commonly used bituminous coal, including moisture content, heat content and ash properties. Experimentation prompted by Title IV has led to an improved understanding of the ability to blend fuels, and the detrimental effects of blending have been found to be less than originally supposed. This has led to significantly lower costs of compliance in Phase I.

The technology of scrubbing has also evolved considerably in recent years. Previous to the 1990 CAAA, scrubber systems usually included a spare module to maintain low emissions rates when any one module was inoperative during periods of maintenance or unplanned outage. An important innovation in scrubber technology is the reduced need for spare modules, as long as emissions allowances are a sufficient compliance strategy. This allows utilities to save around a third of their capital costs by eliminating the spare module and using allowances.[148] In addition, new scrubbers exhibit increased efficiency and reliability now that the trading system provides incentives to go beyond the 90 percent reductions required by the past law. Improvements in scrubber design, such as various spray injections, and use of materials have reduced maintenance costs and increased effectiveness rates from 90 to 95 percent.[149] The incentives are such that upgrading of existing scrubbers through improvements including larger modules and elimination of reheat is likely to occur.[150]

---

146 Clean Air Capital Markets, unpublished data (Washington, DC, 1996). *See generally*, M. Lowe, *Back on Track: The Global Rail Revival*, WORLDWATCH PAPER #118 (Washington, D.C. 1994).

147 Equipment likely to be affected by blending coals include the coal handling system, the fuel preparation and firing system, the primary air system, the steam generator, the particulate removal system, and also plant issues such as ash and waste disposal, building and structural support, and plant cleanup and maintenance. U.S. ENERGY INFORMATION ADMINISTRATION, DOE/EIA-0582, ELECTRIC UTILITY PHASE I ACID RAIN COMPLIANCE STRATEGIES FOR THE CLEAN AIR ACT AMENDMENTS OF 1990, at 14-20 (1994).

148 The estimate of capital costs for a 488 megawatt plant with 3.2 percent sulfur would increase by one-third with a spare module. *Id.* at 92.

149 Institute of Clean Air Technologies, 1995; U.S. EPA, *supra* note 2, at 1. *See also*, Dallas Burtraw, *Call it 'Pollution Rights', but it Works*, WASHINGTON POST, Mar.31, 1996.

150 Torrens, Cichanowicz, and Platt, *The 1990 Clean Air Act Amendments: Overview, Utility Industry Responses, and Strategic Implications*, 17 Ann.Rev. Energy & Env't. 211, 221-222 (1992).

Lessons for an Emissions Cap and Allowance Trading System for GHGs

a. Initial Estimates of the Cost of GHG Cap and Allowance Trading System for GHGs May Be High

It is difficult to make conclusions at this point about the innovations and investments that would happen if the cap and allowance approach to GHG regulation were used. Although clearly preferable to command and control types of regulation, cost estimates still vary from highs of 1-2 percent of GNP to lows of net profitability due to cost savings in reducing energy use.[151]

Two effects are likely to result in the lower estimates. The first is the power of innovation that is released by flexible regulatory programs like an emissions cap with allowance trading.[152] The second is the large bank of profitable energy efficiency actions that have yet to be taken in the United States. Although anecdotal evidence suggests large savings are present in residential, commercial, industrial and governmental areas, research needs to be done to quantify their extent.

2. Secondary Environmental Impacts

The Experience of the Acid Rain Program

There are several significant secondary environmental effects of Title IV. The limits on SO_2 and the expense of Title IV allowances has engendered a shift to low-sulfur western coal,[153] and could be expected to create a disincentive to the use of coal in favor of natural gas. Indeed, the combination of pollution limits and other economic factors have meant that no major coal-fired electric unit has been built since 1990. Lowered coal usage reduces other criteria and toxic pollutants associated with the use of coal, creating significant secondary environmental benefits.

A significant indirect effect of the use of western coal has been the $8 billion invested in rail infrastructure and low-sulfur coal fields mentioned earlier. A significant amount of all rail freight is now committed to carrying low-sulfur western coal east to large power plants. The revived health of the rail industry may be considered an environmental benefit since it pollutes

---

151 *See* R. Repetto & D. Austin, THE COSTS OF CLIMATE PROTECTION, pp. 2, 5-15 (World Resources Institute 1997); W. Stevens, *Price of Global Warming? Debate Weighs Dollars and Cents*, NY TIMES, Oct.10, 1995, at C4.

152 For a discussion of how technology innovation has reduced the estimated costs of compliance with OSHA regulations, *see* OFFICE OF TECHNOLOGY ASSESSMENT, GAUGING CONTROL TECHNOLOGIES AND REGULATORY IMPACTS ON OCCUPATIONAL SAFETY AND HEALTH - AN APPRAISAL (USGPO, Sep. 1995).

153 U.S. COUNCIL ON ENVIRONMENTAL QUALITY, ENVIRONMENTAL QUALITY: THE 25TH ANNIVERSARY REPORT OF THE COUNCIL ON ENVIRONMENTAL QUALITY 320 (1997).

considerably less per ton mile than alternative forms of transportation.[154] The trend towards increased usage of low-sulfur western coal and decline in production of Midwestern high-sulfur coal may also be considered an environmental benefit, as the latter has a higher mercury content, takes more energy to mine and creates more difficult environmental problems in disposal compared to the large open-pit mines of the west.

Lessons for an Emissions Cap and Allowance Trading System for GHGs

a. The secondary benefits of GHG abatement could be significant and positive

The benefits of greenhouse gas abatement will not be limited to reduced climate change costs alone but are likely to produce effects in other sectors. These effects often are called the secondary benefits of carbon abatement. Because CO_2-removal technologies presently are not economical, attempts to limit CO_2 emissions currently concentrate on fuel switching and reducing the use of fossil fuels. Therefore, GHG regulation can be expected to create significant indirect effects, many of which are positive.[155]

An analysis of secondary effects would focus on the structural and behavioral changes GHG regulation would cause in each sector. An OECD analysis has set the basis for such work by analyzing the structural components of energy use patterns.[156] This analysis reveals many sectors which may be affected, depending on the extent of fuel substitution and size of any fuel price increases. In the building sector, for example, GHG regulation may raise the price of heating oil, thereby prompting reductions in the size of buildings. Increased gasoline prices may result in less travel and concentrate habitation near transport terminals, thereby limiting urban sprawl and creating more efficient transportation patterns. A similar investigation would need to be done for each structural or behavioral effect.

Secondary benefits may be especially significant from air quality improvements. Because CO_2 emissions reduction is likely to concentrate on fuel switching and reduction in the use of fossil fuels, it would also cause secondary benefits in reducing other environmental pollutants related to fuel combustion. Estimates of U.S. benefits from reduced air pollution levels as a consequence of carbon abatement include reductions of most criteria pollutants, including reduction in SO_2 ranging from 2-28 percent, and of NO_x from 6-25 percent. The value of these

---

154 *See generally* Lowe, *supra* note 145.

155 Intergovernmental Panel on Climate Change (IPCC), *The Economic and Social Dimensions of Climate Change*, 3 CLIMATE CHANGE 1995: THE IPCC SECOND ASSESSMENT REPORT, Chapter 6 (James P. Bruce et al. eds., Cambridge University Press 1996); Paul Elkins, *The Secondary Benefits of CO2 Abatement: How Much Emission Reduction Do They Justify?* 16 ECOLOGICAL ECON.13, 13-24 (1996).

156 L. SCHIPPER, CO2 EMISSION AND HUMAN ACTIVITY: FACTORIAL ANALYSIS OF TRENDS IN OECD COUNTRIES (OECD unpublished data, 1996).

emissions reductions is estimated to offset about 30-50% of the initial abatement costs in Norway and Japan, and over 100 percent in the UK.[157]

An alternative way to measure such secondary benefits is by estimating the change in the costs of meeting air quality standards, as many U.S. locales are committed to significant cuts in the emissions of air pollutants. Greenhouse gas abatement will lower the amount of traditional air pollution abatement needed to meet these targets. One researcher, for example, calculated that the introduction of a carbon/energy tax would reduce the cost of traditional SO_2 and NO_x abatement in the nine countries introducing the tax by 25-30 percent and 12-25 percent, respectively.[158]

It is important to note that secondary benefits occur locally or regionally and do not share the global character of greenhouse gas impacts on climate. The accurate estimation of secondary benefits must take into account location, affected populations, and the relative costs of traditional abatement for these pollutants.

3. Regulatory Treatment of Allowances

The Experience of the Acid Rain Program

The design of a domestic emissions cap and allowance trading system for GHGs may or may not involve the utility industry directly, but if it does, as in the industrial or a hybrid model, regulatory treatment of allowances becomes an important issue.

Regulatory treatment is important under Title IV because the electric utility industry is heavily regulated by state Public Utility Commissions (PUCs) and the Federal Energy Regulatory Commission (FERC). FERC regulates the generation and distribution of electricity in interstate commerce. State PUCs are responsible for making decisions governing how utilities may distribute the costs and profits associated with the business of providing electricity between their shareholders and ratepayers.

The GAO Report identifies regulatory treatment of allowances as a significant barrier to inter-utility trading.[159] So does another commentator: "A key problem area for a CO_2 emissions market is likely to be utility pricing regulation, which could diminish the participant of the single most important industry group. Regulation does not appear to be a problem

---

157 Intergovernmental Panel on Climate Change (IPCC), *The Economic and Social Dimensions of Climate Change*, 3 CLIMATE CHANGE 1995: THE IPCC SECOND ASSESSMENT REPORT, Chapter 6 (James P. Bruce et al. eds., Cambridge University Press 1996)(citing Alfsen (1992), Amano (1994), Barker (1993), Complainville and Martins, 1994 and Scheraga and Leary (1994)).

158 K.H. Alfsen, H. Birkelund ad M. Aaserud, Secondary Benefits of the EC carbon/energy tax, Research Dept. Discussion Paper No. 104, Norwegian Central Bureau of Statistics (Oslo, 1993). *See generally*, Intergovernmental Panel on Climate Change (IPCC), *Economic and Social Dimensions of Climate Change*, Climate Change 1995 at 215 (Cambridge University Press, 1996).

159 GAO REPORT, *supra* note 2, at 5, 45-48.

affecting the trading incentives of other industries."[160] These sources cite two primary reasons: a lack of overall FERC and State PUC guidance, and certain existing policies which limit shareholder reward and otherwise discourage trading.

Uncertainty about the evolution of these regulatory rules for utilities has inspired caution toward the Title IV market. The Federal Energy Regulatory Commission (FERC), which regulates interstate energy transactions, provided guidance for accounting rules regarding allowances in March 1993, but FERC and state PUCs have provided little guidance regarding cost recovery rules.[161]

State regulations regarding the allowed rate of return, the depreciation rate, and risk that expenses may not be recoverable in electricity rates are likely to differ among compliance strategies and consequently favor one strategy over another. Furthermore, typical prohibitions against shareholder earnings on capital gains (but not capital losses) imposes one-sided risk on utilities that purchase allowances.[162] Utilities are often described as "risk averse" indicating in the present sense that they are prone to strategies that minimize their risk rather than ones that minimize cost. Furthermore all states continue to review transactions one at a time,[163] which takes time and effort. This practice is ill-suited for a utility operating in a competitive market.

The other, and potentially the more important, reason for less than optimal trading under Title IV is that utility rules which have been developed erode the incentive to trade.[164] For example, all states except Connecticut treat allowances as current period expenses analogous to fuel purchases, and costs (or cost savings) are passed through to ratepayers. This provides little incentive for the utility to reduce costs through the purchase or sale of allowances because they expose the utility to risk for which there is little reward. In addition, in most instances allowance costs are not recoverable until the year in which the allowance is used (interest charges on capital

160 Decision Focus Vol. I, *supra* note 15, at 3-3.

161 For example, in New York, a state with 5 Phase I plants with a total of 27 generators, the Public Service Commission adopted a requirement in December of 1993 that all utilities which had received or would receive revenues from the sale of SO2 emission allowances or any related derivative, such as options for futures, defer these revenues for future Commission disposition. To date, a case has yet to come before the New York State Public Services Commission seeking a determination of allocation of funds between ratepayers and shareholders.

162 Douglas R. Bohi, Dallas Burtraw & Barry D. Solomon offer prescriptions for regulators to avoid these problems. *See* Douglas R. Bohi, Dallas Burtraw & Barry D. Solomon *SO_2 Allowance Trading: What Rules Apply?* PUBLIC UTILITIES FORTNIGHTLY at 22-25 (1994).

163 *Id.* at 45.

164 Fullerton, et al., find regulatory rules could more than double the cost of sulfur dioxide compliance in certain scenarios. Don Fullerton, Shaun P. McDermott & Jonathan P. Caulkins, Sulfur Dioxide Compliance of a Regulated Utility (University of Texas, Department of Economics, mimeo) (April 1996). For a contrary view on whether state regulators have impeded trading *see* Elizabeth M. Bailey, Massachusetts Institute of Technology, MIT-CEEPR 96-002WP, Allowance Trading Activity and State Regulatory Rulings: Evidence from the U.S. Acid Rain Program (Mar. 1996).

costs of allowances are recoverable), which discourages purchase and banking of allowances as a compliance strategy for use years into the future.[165]

As a consequence, utility representatives say that the lack of ratemaking regulations has dampened their enthusiasm for emissions trading.[166] This has led to utilities favoring compliance options such as scrubbers and fuel switching, the costs of which have traditionally been approved by PUCs even though allowances may costs less. Indeed, the GAO report found that only 2 of the 80 utilities that would benefit from trading were doing so, and a 1996 publication also identified few utilities were using allowances as a primary compliance mechanism.[167]

More recent data show that the amount of trading has increased significantly, and over 2 million allowances were acquired by utilities in 1996, in an increasingly varied number of state regulatory frameworks.[168] In addition, the coming deregulation of the electricity industry will lessen the importance of PUC policy barriers to trading. However, still a significant number of utilities are not participating in trading activity even where this would be a least-cost compliance alternative.

Lessons for an Emissions Cap and Allowance Trading System for GHGs

a. State PUCs and FERC policy may discourage inter-utility trading

Utility reluctance to trade, for the above reasons, can be expected to constrain trading under an industrial GHG regulatory system as it does under Title IV. The concern about PUC and FERC policies is not relevant to the fuels model of GHG regulation, as utilities are not directly involved in trading.

As utilities contribute the largest portion of CO_2 emissions (36%) in the industrial model, the constraints on their trading created by PUC and FERC polices will significantly affect inter-

---

[165] Only one state commission, Georgia, has adopted a procedure that links the market price of allowances and compliance costs in providing guidance to the utility. Rose, op cit. at 20 (1996).

[166] Telephone Interview with Gary Ganoung, Environmental Division, New York Electric & Gas (Dec. 1995), and Dave O'Reily, Environmental Division, Niagara Mohawk Corp. (Dec. 15, 1995). Officials at Niagara Mohawk Corporation, a large upstate electric utility, report that they are engaged in no emission trading at this time, despite their demonstrated innovative attitude towards the concept of emission trading, Niagara Mohawk is simply banking current allowances for Phase II, and any proceeds from auctions go into a deferred bank account and await a PUC ratemaking ruling. Telephone Interview with Dave O'Reily, Environmental Division, Niagara Mohawk Corp. (Dec. 15, 1995).

[167] Burtraw, *supra* note 7, at 10417.

[168] A total of 4.8 million allowances were acquired by utilities from 1994 through 1996, with over half (2.9 million) in 1996. Of these, 1.9 million were intra-utilities transfers between units, and 2.9 million acquired from other utilities, brokers or fuel companies. Information from Joe Kruger, Acid Rain Division, EPA (March 6, 1997).

utility trading, and also trading between utilities and other industries under a GHG model. Since it may be relatively cheaper for utilities to switch from high carbon fuels such as coal to lower carbon fuels such as natural gas than it would be for the transportation sector, the disincentives to utilities to trade may eliminate major opportunities to achieve cost-effective emissions reductions through trading under a GHG industrial model.

4. Pending Competition in the Utility Industry

The Experience of the Acid Rain Program

Increasing competition in the utility industry creates incentives for utilities to implement least-cost options, and can be a expected to be a major factor to encourage utilities to start trading. The GAO notes this trend is reinforced by PUC practice to accommodate competition by requiring utilities to conduct least-cost planning. It warns, however, that "utilities are still likely to be reluctant to trade if the risk of trading remains with the utility and the profits with the ratepayer."[169]

Lessons for an Emissions Cap and Allowance Trading System for GHGs

Pending competition in the utility industry is not likely to have any direct effect on a fuels model of GHG regulation but would have a significant effect on an industrial model of GHG regulation, as utilities are a central component of that model. Increasing competition is expected to change dramatically the domestic utility industry, including increased competition for customers; the splitting up of transmission and generation utility operating arms; and an increase in the self-generators and merchant-plant independent power producers (IPPs). This will upset the heretofore stable concept of a utility service territory.

A concern expressed about such regulation is that, in the absence of any form of GHG regulatory control, deregulation of utilities is likely to increase coal usage.[170] While this may slightly increase the costs of a GHG regulatory system, it would not exert other effects on its workability.

A negative effect will be the increased complexity that competition will create, as there may be significantly more administrative units involved in the trading system. With an increasing number of IPPs, their emissions may have to be addressed in the their own right,

---

[169] GAO REPORT, *supra* note 2, at 47.

[170] Comments from many intervenors on the Draft Environmental Impact Statement of the FERC Notice of Proposed Rulemaking (Docket No. RM95-8-000) have suggested that the use of cheap but dirty coal units will be encouraged with more liberal transmission access and long distance transmission of electricity under the currently proposed rule by the Federal Energy Regulatory Commission (FERC) Promoting Wholesale Competition Through Open Access Non-Discriminatory Transmission Service by Public Utilities.

rather than being subsumed within the local utilities' emissions cap. The net effect will be to add hundreds or even thousands of additional trading system participants. Also, because new IPPs will have no 1990 baseline, the new entrant problem described above will be more severe.

Another effect will be that each utility's emissions will shift constantly as existing generating facilities are bought and sold, utilities merge and split apart, and units are re-started or re-powered based on prevailing fuel prices. Utility holding companies will want as much flexibility as possible to balance rising and declining emissions among their individual operating companies, but this will make structuring an emissions tracking and trading system more difficult.

A significant positive effect will be that the decreasing significance of PUC rules, and an increased emphasis on cost reduction is expected to make utilities more receptive to allowance trading when it is in their economic interest, overcoming some of the barriers to trading. Another advantage of a more integrated utility system is that weather-related fluctuations in year to year utility and IPP emissions likely will be moderated, making a trading system easier to predict and execute. This will be because utilities facing excess capacity for a variety of potential reasons will be more able to sell any excess power due to favorable weather conditions on the open market.

Increased competition and deregulation could also significantly boost the profitability of capturing methane emissions, resulting in greater reductions. A severe practical problem with methane capture from animal waste ponds and landfills is that utilities are not receptive to purchasing small amounts of power from these sources, reducing the price incentive for such capture. However, increased competition and the rising role of IPPs is likely to increase the number of sources willing to purchase methane-generated electricity from these sources.[171]

5. International Trading Aspects

The Experience of the Acid Rain Program

Title IV allows SO_2 allowances to be exported, but does not permit regulated sources to import SO_2 allowances from other countries to achieve compliance. While Title IV does not restrict the sale of SO_2 allowances, foreign entities currently have no incentive to do so. Thus, SO_2 allowances can be exported, but there is no incentive for foreigners to purchase them. As for imports, regulated sources must hold SO_2 allowances issued by the EPA to cover all of their SO_2 emissions, so SO_2 allowances issued by another country cannot be used to achieve compliance.

At present international trading is a moot issue, since no other country has an SO_2 trading program. However, given that acid rain is a regional concern, trading of SO_2 allowances

[171] Information from Ruminant Livestock Methane Program, EPA and Methane and Utilities Branch, Atmospheric Pollution Prevention Div., EPA (May 1996).

would only make sense from an environmental perspective on a regional scale, i.e., the United States, Canada and Mexico.

Lessons for an Emissions Cap and Allowance Trading System for GHGs

Unlike SO_2, which is a regional environmental problem, there are no environmental reasons to limit trading in greenhouse gas allowances geographically. Greenhouse gases have long atmospheric residence times, so emissions anywhere in the world have the same effect on the climate. In addition, the available studies suggest that significant cost savings of 50 to 80 percent are possible if geographic flexibility in the choice of emissions reduction measures is allowed. This means that there is a large economic incentive to allow international trade in GHG allowances.

International trade could be accommodated in a greenhouse gas allowance trading system in a straightforward manner. Exports of allowances could be allowed without restriction, as is presently the case under Title IV. U.S. sources might also be permitted to use allowances issued by other countries in order to achieve compliance, if such a global regulatory system were established under the FCCC.

Reductions achieved through Joint Implementation projects could be considered credits for this purpose. Absent an international regulatory regime, the U.S. government should retain authority to approve or reject allowances imported from other countries to ensure comparable standards of compliance. Thus permits from countries with lax enforcement of their greenhouse gas emissions regulations could be discounted or rejected altogether. This would provide exporting countries with a strong economic incentive to monitor and enforce domestic compliance.

THE ENVIRONMENTAL LAW INSTITUTE

For a quarter century, the Environmental Law Institute has played a pivotal role in shaping the fields of environmental law, management, and policy domestically and abroad. Today, ELI is an internationally recognized, independent research and education center.

Through its information services, training courses and seminars, research programs, and policy recommendations, the Institute activates a broad constituency of environmental professionals in government, industry, the private bar, public interest groups, and academia. Central to ELI's mission is convening this diverse constituency to work cooperatively in developing effective solutions to pressing environmental problems.

The Institute is governed by a board of directors who represent a balanced mix of leaders within the environmental profession. Support for the Institute comes from individuals, foundations, goverment, corporations, law firms, and othehr sources.

ENVIRONMENTAL
LAW • INSTITUTE®

1616 P Street, N.W., Suite 200
Washington, D.C. 20036
Telephone: (202) 939-3800
Fax: (202) 939-3868
E-mail: law@eli.org • Web site: www.eli.org