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An International Market for Transferable Gas Emission Permits to Promote Climate Change

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INTRODUCTION

The atmosphere maintains the balance of the global ecosystem by regulating the temperature of the earth's surface and protecting it from damaging ultraviolet radiation. Current scientific evidence indicates not only that there has been a deterioration of the ozone layer, the atmospheric stratum that provides protection against ultraviolet radiation and regulates much of the surface temperature, but also that the build-up of greenhouse gas concentrations may cause a progressive increase in global temperature with significant potential ecological, economic and social effects.[1] Current estimates suggest that a doubling of carbon dioxide levels in the next 50 to 100 years could increase average global temperatures by 1.5 to 4.5 degrees centigrade.[2] This increase in global temperature, often termed "global warming" or the "greenhouse effect," is thought to be related to the release into the atmosphere of certain trace gases which have heat-trapping qualities, and which, in high concentrations in the atmosphere, cause the heat radiating from the earth to be ad-

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1. *See generally* William D. Nordhaus, *Economic Approaches to Greenhouse Warming, in* GLOBAL WARMING: ECONOMIC POLICY RESPONSES 39-46 (Rudiger Dornbusch & James M. Poterba eds., 1991).

2. *See id.* at 37. It is important to note that although climate simulation models may vary, they have resulted in similar predictions. *See, e.g.*, NATIONAL ACAD. SCI., POLICY IMPLICATIONS OF GREENHOUSE WARMING 19 (1991) [hereinafter NATIONAL ACAD. SCI., POL'Y IMPLICATIONS] (regarding the temperature range of possible warming in response to an increase in carbon dioxide emissions).

sorbed and retained.[3] Many of these trace gases are also associated with ozone deterioration.[4] This strong interrelationship between the greenhouse effect and the depletion of the ozone layer suggests that when examining policies aimed at mitigating global climate change, the regulation of substances that deplete the ozone layer should also be considered.

The atmospheric trace gases predominantly associated with the greenhouse effect are carbon dioxide (CO_2), chlorofluorocarbons (CFCs), nitrous oxide (N_20) and methane.[5] Although CO_2 is a less effective greenhouse gas, the sheer volume of emissions, and hence atmospheric concentrations, make it the single most important contributor to global warming. Recent evidence suggests CO_2 emissions are responsible for fifty percent of the potential greenhouse effect.[6] CO_2 emissions are predominantly the result of the combustion of fossil fuels. The question of curbing CO_2 emission is, therefore, particularly contentious, given the high level of dependence on fossil fuels in electricity generation, industrial processes and transportation in the developed world. The top ranking countries in terms of total and per capita emissions from 1960 to 1988 were the United States, the former Soviet Union and China.[7]

Before the developed world can contribute effectively to major reductions in CO_2 emissions, it needs to assess the economic consequences of global warming, and compare these to the significant costs associated with reducing fossil fuel use, while simultaneously adopting alternative energy technologies. There is little evidence to date that the developed world will have the necessary political will to institute such widespread changes to halt global warming, particularly in light of the uncertainty surrounding the economic costs associated with global climate change.

Many developing nations are reluctant to commit to emission controls that may retard their industrial growth. Furthermore, be-

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3. *Cf.* NAT'L ACAD. SCI., POL'Y IMPLICATIONS, *supra* note 2, at 91.

4. *See id.*

5. *See* Andrew R. Solow, *Is There a Global Warming Problem?*, *in* GLOBAL WARMING: ECONOMIC POLICY RESPONSES, *supra* note 1, at 8.

6. *See* MERETE HEGGELUND, EMISSION PERMIT TRADING: A POLICY TOOL TO REDUCE THE ATMOSPHERIC CONCENTRATION OF GREENHOUSE GASES 7 (Canadian Energy Res. Inst. Study No. 36, Jan. 1991).

7. *See* NAT'L ACAD. SCI., POL'Y IMPLICATIONS, *supra* note 2, at 9.

cause they believe that developed nations are largely responsible for the problem, such developing nations feel that the developed nations should fund action to reduce greenhouse gas emissions.[8] Global warming, however, is not solely the result of the industrial practices of the developed nations. Increases in CO_2, N_2O and methane concentrations in the atmosphere are also consequences of deforestation and agricultural practices in the developing world.[9] Population growth also places increasing demands on production of goods and services, energy and transportation.[10] Both India and China have significant greenhouse gas emission levels, indicating that there is a strong correlation between population size, the process of industrialization, and greenhouse gas emissions.[11] As nations become more industrialized and population growth continues unabated in many developing nations, the problem of greenhouse gas emissions will continue to escalate if no emission controls are implemented.

The fact that the extent, time, and period of global warming are unpredictable creates a great deal of uncertainty about the possible economic consequences of the greenhouse effect.[12] These economic consequences, along with the social, environmental and political ramifications, need to be understood, or at the very least, assumed, before a cost-benefit analysis can be undertaken on measures proposed to combat climate change, including the use of international trade in carbon emission entitlements. While there have been some simulation models constructed in an attempt to assess the economic consequences of global warming and alternative policy initiatives to mitigate, accommodate or prevent further global warming, these are

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8. *See* T.C. Schelling, *Economic Responses to Global Warming: Prospects for Cooperative Approaches*, *in* GLOBAL WARMING: ECONOMIC POLICY RESPONSES, *supra* note 1, at 218-19.

9. *See* Edward B. Barbier et al., *Technological Substitution Options for Controlling Greenhouse Gas Emissions*, *in* GLOBAL WARMING: ECONOMIC POLICY RESPONSES, *supra* note 1, at 109-10; Solow, *supra* note 5, at 9-10.

10. *See* Schelling, *supra* note 8, at 22.

11. *See* NAT'L ACAD. OF SCI., POL'Y IMPLICATIONS, *supra* note 2, at 9.

12. *See generally United Nations General Assembly, Report of the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change on the Work of the Second Part of its Fifth Session*, U.N. Intergovernmental Negotiating Comm. for a Framework Convention on Climate Change, 5th Sess., U.N. Doc. A/AC.237/18 (Part II) (1992).

not necessarily predictive of the global, national or regional costs that may be incurred. As most of the studies to date have been fragmentary, at best, no general conclusions on the potential economic impact of global warming either in the United States or abroad are possible at this time.[13]

The climate is the product of a complex interaction of variables. This makes forecasting the impact of climate change particularly difficult. Some of the projected effects of global warming include dramatic changes in ecosystems, a rise in sea levels, polar ice cap warming, changes in rainfall patterns and water supply, and significant changes in the availability of arable land.[14] Although the economic consequences are unclear, a cost-benefit analysis clearly must be undertaken to assess possible intervention strategies to mitigate or abate the progress of global warming.

Traditional cost-benefit analyses may not only be difficult to achieve given the level of uncertainty, but also may be incompatible with the notion of sustainable development. Because we typically prefer to receive benefits now rather than in the future, the interests of future generations are often discounted. Future outcomes of greenhouse gas emissions need to be assigned a value, and the investment made in reducing these emission levels needs to be assessed. This investment should then be compared to the return on alternative investments, like alternative mitigation techniques that may be made or deferred, perhaps for investment in adaptive technologies, once the results of global warming are felt. Determining the most cost-effective strategy will be difficult in these circumstances. This is also a part of a larger problem, namely the valuation of non-market costs and benefits associated with global climate change and the various policy options that may be considered. Some of the economic models that have been developed to generate estimates of the costs of global climate change are examined later in this paper.[15]

The success of the Montreal Protocol[16] in limiting production and

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13. *See* Nordhaus, *supra* note 1, at 44.

14. *See* Hirofumi Uzawa, *Global Warming Initiatives: The Pacific Rim, in* GLOBAL WARMING: ECONOMIC POLICY RESPONSES, *supra* note 1, at 275.

15. *See* discussion *infra* Part III.A.

16. *See* Montreal Protocol on Substances that Deplete the Ozone Layer, Sept. 16, 1987, 26 I.L.M. 1541 (entered into force Jan. 1, 1989)

consumption of ozone-depleting substances has fueled hopes that the international community may be able to implement an effective international agreement to address the issue of greenhouse gas emissions and their implications for global climate change. A treaty, modeled on the Montreal Protocol, could be as successful in dealing with the problem of global warming. The principal difference, however, between regulating the reduction in CFC and halon use and regulating the reduction of all greenhouse gas emissions is one of cost. One of the chief reasons the Montreal Protocol has been effectively implemented is the availability of alternative, ozone-friendly, technologies.[17] In contrast, limiting greenhouse gases emissions could prove costly in both absolute and relative terms. Preliminary cost-benefit ratios (comparing the cost of abatement with projected benefits of abatement) suggest there is a considerable difference between the costs and benefits associated with ozone depletion, when compared with global warming.[18] Whereas projected benefits from freezing CFC levels were 162 times greater than costs, benefits from a ten percent reduction in greenhouse gas emissions produced benefits only 7.4 times that of the costs.[19] This difference is probably due to the high cost associated with reducing greenhouse gas emissions, as well as the uncertainty over the projected benefits of undertaking these types of abatement efforts. The question of monetary valuation of environmental benefits also remains problematic.

This paper deals with two interrelated concerns over the atmosphere: (1) the depletion of the ozone layer due to CFCs and other ozone-depleting substances; and (2) global climate change issues arising out of the presence of greenhouse gases in the atmosphere. The paper considers the structural, economic and policy considerations surrounding the establishment of international economic in-

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[hereinafter Montreal Protocol]. The Montreal Protocol is discussed in greater detail *infra* Part III.B.

17. *See* Barbier et al., *supra* note 9, at 147-55.

18. *See* LYNNE M. JURGIELEWICZ, GLOBAL ENVIRONMENTAL CHANGE AND INTERNATIONAL LAW PROSPECTS FOR PROGRESS IN THE LEGAL ORDER 209 (1996).

19. *See* Scott Barrett, *Economic Analysis of International Agreements: Lessons for Global Warming Treaty, in* RESPONDING TO CLIMATE CHANGE: SELECTED ECONOMIC ISSUES 134 (OECD, Paris, 1991).

struments, specifically tradable emission permits. These permits would be designed to mitigate against the damage caused by ozone depletion and global climate change and to meet the environmental goals of greenhouse gas emission reductions. Part I of this Article introduces the political and economic debate surrounding the use of economic instruments to promote climate change. Part II outlines the current international legal regime for protecting the atmosphere. Part III then examines, in greater detail, the principles of environmental economic damage resulting from global warming and the use of economic instruments to promote economic and environmental goals. Finally, Parts IV and V examine the practical application of a tradable emission permit scheme in the current international context, and the key issues that surround the possible use of economic instruments to secure climate change under international law.

I. BACKGROUND

Evaluating the possible introduction of tradable emission permits to promote climate change requires an understanding of some of the microeconomic tools of analysis most frequently utilized to conduct an economic analysis of legal structure and law. The study of the interaction between law and economics has emerged as a discipline in its own right, seeking to explain the impact of legal institutions and rules in economic terms.[20] Any evaluation of international economic instruments to promote environmental goals involves, at least to some extent, identifying the economic consequences of current legal rules and explaining the possible economic impact of introducing an alternative structure like the development of an international tradable emission permit scheme.[21] This paper builds upon an economic evaluation of environmental policy and proposes that international economic instruments may be a successful policy tool that is consistent with both the demands for economic efficiency and meeting environmental targets. Therefore, it is important to outline some of the key economic concepts involved before proceeding with

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20. *See generally* RICHARD A. POSNER, ECONOMIC ANALYSIS OF LAW (1991).

21. *See, e.g.*, JURGIELEWICZ, *supra* note 18, at 137-41.

this evaluation. Before proceeding with this evaluation, it is, therefore, important to outline some of the key economic concepts involved. Section A of Part I examines the atmosphere in economic terms, the concept of atmospheric pollution as an externality and the use of economic instruments, in both a domestic and international context, to correct market imbalances created as a result of these externalities. Section B highlights the current scientific and economic uncertainty surrounding global climate change.

A. *The Economics of the Environment*

1. Defining the Atmosphere: Global Commons and Public Goods

Protecting the atmosphere involves protecting an integral part of what is termed the "global commons," which is, in a loose sense, "owned" by all mankind in common.[22] The problem with protecting the global commons is in part a result of the fact that there are no private property rights attached to it. As Aristotle notes, "[W]hat is common to the greatest number has the least care bestowed upon it. Everyone thinks chiefly of his own, hardly at all of common interests."[23] The atmosphere is not "ownable" in a private property sense, at least not within the confines of current legal systems, by any one individual, firm or nation state. It may, however, be polluted or chemically altered by the harmful actions of individuals, firms, and by extension, nations. The source of pollution or harm may be hundreds of miles from the site where the damage is recognized or the cost associated with the damage is incurred.[24] Of increasing concern is not only the transboundary effects of air pollution, but also the global effects of activities causing depletion of the ozone layer and global cli-

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22. *See generally* Garrett Hardin, *The Tragedy of the Commons*, 162 SCI. 1243 (1968).

23. ARISTOTLE'S POLITICS AND POETICS 27 (Benjamin Jowett & Thomas Twining trans., Viking Press, 1957).

24. *See, e.g.*, D.H. Cole, *Cleaning Up Krakow: Poland's Ecological Crisis and the Political Economy of International Environmental Assistance*, 2 COLO. J. INT'L ENVTL. L. & POL'Y 205, 232 (1991).

mate change.[25] Multilateral cooperation is even more vital for ozone depletion and global warming because harmful emissions regardless of origin have the same impact on the global climate. Thus atmospheric concentrations, particularly where greenhouse gases are concerned, are essentially uniformly dispersed throughout the atmosphere.[26] Given the dynamic nature of the effects of global warming over time, however, it is even more difficult to predict the costs that may be incurred in the future as a result of ozone depletion, global warming, or the efforts undertaken to halt these processes.

In economic terms, the atmosphere also exhibits all the necessary attributes of a public good. Its consumption by one individual does not deplete it to the extent that another individual cannot consume it, although the quality of that consumption may be affected. A public good is also something that cannot be supplied to one person without being supplied to the public at large. Thus, the benefits of clean air, climate stability and protection from harmful ultraviolet (UV) radiation cannot be enjoyed by one individual or nation to the exclusion of others.[27] As a corollary, damage and ultimately the costs of air pollution, global warming and increased UV radiation are not incurred by only one individual or nation; they are borne by the public at large. Imposing a price on a public good is, therefore, very difficult. While the price may inhibit one individual's consumption or satisfaction, this does not influence the level of consumption or satisfaction of other individuals.[28] Typically, private firms will not engage in supplying or trading in public goods because they can neither exclude non-paying beneficiaries nor derive sufficient profit to justify investment, unless paid by the government to supply those goods.[29] Hence, the supply of public goods is normally provided or subsidized by a government agency.

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25. *See* J. William Futrell, *International Environmental Legal Framework*, SB79 A.L.I.-A.B.A. 1, 6 (1997).

26. *See id.*

27. *Cf.* WILLIAM J. BAUMOL & WALLACE E. OATES, THE THEORY OF ENVIRONMENTAL POLICY 201-05 (1975).

28. *See id.* at 19.

29. *See id.*

2. The Concept of Externality

The damages caused by air pollution, global warming or other human health issues are also externalities of either an individual, firm, or nation's activities. Externalities are in many ways an elusive concept and there are a number of definitions that could be adopted.[30] A simple, and more appropriate, definition for our purposes is that an externality exists where there is a divergence between the private and social cost of an activity such that a firm or individual does not have to take into account the social cost or harm that is a by-product of its activities.[31] That is to say, a firm will decide its level of production without taking into account the social cost in determining its internal costs of production. In this instance there will be production over and above the socially optimal level, which is the appropriate level of production taking into account the social costs. Pollution is the most often cited example of a harmful, or negative, externality.[32] Sulfur, carbon dioxide and CFC emissions would all be classified as externalities, and have been a primary focus of literature discussing the establishment of an emission permit scheme to improve air quality, to mitigate against ozone depletion and to slow the greenhouse effect.[33]

The social costs associated with externalities are invariably borne either by those who are inflicted with the damage or by governments seeking to regulate or compensate against such harm.[34] While quantifying the extent of these social costs is difficult at both a national and international level, undoubtedly pollution (in all its forms) imposes a considerable burden on society.

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30. *See id.* at 14.

31. *See generally* Ronald H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1 (1960).

32. *See, e.g.*, Kyle C. Johnson, *Letting the Free Market Distribute Environmental Resources*, 17 WM. & MARY J. ENVTL. L. 79, 82-83 (1992).

33. *See, e.g.*, Joshua D. Sarnoff, *The Continuing Imperative (But Only from a National Perspective) for Federal Environmental Protection*, 7 DUKE ENVTL. L. & POL'Y F. 225, 273-78 (1997).

34. *See* David A. Westbrook, *Liberal Environmental Jurisprudence*, 27 U.C. DAVIS L. REV. 619, 648-51 (1994).

The theory of externalities suggests that they require a corrective mechanism that the normal market cannot provide because of an asymmetry between the price to consumers, or victims of harm, compared to the price to the producers, or source, of the externality.[35] The presence of externalities results in a suboptimal allocation of resources. Society experiences a level of pollution and a quantum of resources allocated to the emission of harmful substances that is different from that which would be found if firms had to take into account externalities in their production decisions. To remedy this problem, a corrective mechanism must be imposed though, for example, the payment of taxes,[36] the provision of compensation,[37] or the purchase of "pollution rights."[38]

One of the elements of economic uncertainty associated with greenhouse gas emissions is, however, also associated with a lack of data on the possible economic consequences of a "do-nothing" approach, compared with the consequences of undertaking particular forms of action.[39] We have very little empirical evidence upon which to assess the economic impact of introducing a corrective mechanism, and thus must rely, at least in part, on theoretical models to predict the possible consequences of introducing a measure like an emission permit scheme.

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35. *See* David M. Driesen, *The Societal Cost of Environmental Regulation: Beyond Administrative Cost-Benefit Analysis*, 24 ECOLOGY L.Q. 545, 552-53 (1997).

36. *See, e.g.*, Dana Clark & David Downes, *What Price Biodiversity? Economic Incentives and Biodiversity Conservation in the United States*, 11 J. ENVTL. L. & LITIG. 9, 35-36 (1996) (discussing the use of a Pigouvian tax, which is "intended to force actors to internalize costs to exceed marginal private costs").

37. *See, e.g.*, Warren J. Samuels & Nicholas Mercuro, *The Role and Resolution of the Compensation Principle in Society: Part One — The Role*, 1 RESEARCH L. & ECON. 157, 179-81 (1979) (discussing the provision of compensation).

38. *See, e.g.*, J. Yost Conner Jr., Note, *Revisiting Cafe: Market Incentives to a Greater Automobile Efficiency*, 16 VA. ENVTL. L.J. 429, 448 (1997) (discussing the use of pollution rights under the Clean Air Act).

39. *See* JOHN RAWLS, A THEORY OF JUSTICE 66-75 (1971).

3. Options to Correct Market Failure

An understanding of Pareto-optimality — the allocation of resources, rights and duties so as to benefit all affected parties — is necessary in order to effectively consider alternative market correction mechanisms.[40] While economic efficiency looks at production of a given level of output using the least costly combination of inputs, distributive efficiency looks at the allocation of goods and services between consumers and producers.[41] Pareto-optimality or efficiency indicates that an equilibrium has been reached whereby no change in production or allocation of goods and services to consumers could make one consumer better off without detrimentally affecting another.

In order to determine the optimal price of an externality, there needs to be an evaluation of the behavioral conditions and incentives under which producers and consumers will operate. The mechanism that an economist favors is a price system to ensure an efficient allocation of resources. The price that will be reached in a perfectly competitive market will be the point at which the buyer and seller will agree to bargain. A Pareto-optimal price will exist at the point at which any change in price, which obviously will result in either an increase or decrease in the supply of the externality, will benefit one individual only at the expense of another.[42] The assumption is made that firms will seek to maximize profit while individuals will seek to maximize their utility levels.

The theory behind utilizing economic, as opposed to purely regulatory, instruments to promote environmental change is premised on a belief that firms will act to maximize profits, and in the face of rising costs of pollution, will decrease activities that result in pollution.[43] Purely regulatory instruments have traditionally involved establishing standards, development plans and other forms of pollution control. An economic instrument utilizes the market mechanism to achieve similar goals. This distinction is in many ways artificial, as governments will usually incorporate a

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40. *See id.* at 67.
41. *See id.* at 67-68.
42. *See* BAUMOL & OATES, *supra* note 27, at 15.
43. *See id.* at 25.

mix of policy approaches including market incentives to meet objectives and standards. Under Pareto-optimal conditions, emissions of harmful substances would occur only up until the marginal cost to emitters of emitting one more unit of pollution is equal to the marginal damage resulting from that emission. The concept of Pareto-optimality must also be viewed in the broader context of sustainable development, which takes into account not only present, but also future needs and the potential effect of activities on the ability of future generations to consume goods and services.

The traditional economic approach to the problem of externalities has been to recommend the imposition of a tax on the producer or source of the externality that equals the marginal social damage incurred.[44] This tax, known as a Pigouvian tax, effectively internalizes the external cost and aligns the incentives, and hence behavior, of the firm to those affected by the externality.[45] The principal criticism of this approach is that the lack of information available on the marginal cost function of the firm and society's marginal social damage function makes it very difficult to accurately set a tax at the appropriate level.[46] This approach also assumes that there is a linear relationship between damage and emission levels, in other words, as emissions increase, damage levels increase at a corresponding rate, and when emissions decrease damage will be reduced in direct proportional terms. This may or may not be the case depending on the nature of the pollutant and its effects. It is possible that there is a threshold beyond which damage occurs exponentially from increases in emissions, and only reductions that take overall emissions beyond that threshold will have a positive impact of reducing damage. In light of this uncertainty the choice of regulatory and economic instruments potentially will have different economic consequences. The nature of these consequences will depend on the elasticity of the cost and damage functions, indicating whether a small change in emission levels has a large impact on the damage caused to society.

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44. *See id.* at 24-26.
45. *See id.* at 26-27.
46. *See id.* at 30-32.

A tax or similar levy is, however, attractive to many national governments in their pursuit of environmental objectives, as it generates revenues that may be applied to further environmental measures.[47] A tax may also have distributional consequences and may be used as an instrument of government policy to reallocate resources. Using taxation or other government charges is likely to be inefficient, given a government's likely insufficient knowledge of any firm's internal costs of production and the value society has placed on various elements associated with the use of public goods. It is possible, however, that the imposition of a uniform charge per unit of emission will reach a cost-efficient solution as polluters seek to minimize the marginal costs associated with emitting to equal the uniform charge.[48]

A number of countries, including Sweden, Finland and the Netherlands, have unilaterally imposed carbon taxes.[49] There have also been a number of proposals in the United States to adopt similar fiscal measures.[50] One of the main objections to adopting a carbon tax in the United States is its perceived regressivity and the potential for adverse consequences for lower income households, for whom expenditures on heating fuel, electricity and gasoline make up a significant portion of disposable income.[51] In addition, to counteract the regressive nature of a carbon tax, transfer payments, compensation or other measures may need to be taken. Furthermore, the macroeconomic effects, in terms of market inefficiency, unemployment and possible trade distortions, through the introduction of imports that are produced in countries with lower production costs as a result of no carbon tax, are of concern. An international tax would be difficult to impose and would require management by some form of supra-national agency.[52] This would raise the issue of rev-

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47. *See id.* at 26-27.

48. *See id.* at 31.

49. *See* James M. Poterba, *Tax Policy to Combat Global Warming: On Designing a Carbon Tax*, *in* GLOBAL WARMING: ECONOMIC POLICY RESPONSES, *supra* note 1, at 71, 73.

50. *See id.* at 74.

51. *See id.* at 77.

52. *Cf. V. Institutional Arrangements*, 104 HARV. L. REV. 1580, 1590-91 (1991).

enue sharing and it would probably be difficult to obtain national participation in such a scheme. Similar difficulties are present when attempting to negotiate a multilateral agreement to harmonize national laws in order to impose a carbon tax.

As an alternative to direct regulatory control, economists have also examined the prospect of establishing markets in environmental or pollution commodities to rectify the problems resulting from the presence of externalities. The Coasian approach is to treat the failure of the market system to deal with the presence of externalities as a failure to adequately define property rights.[53] Coase's argument is that polluters and victims will be able to negotiate an efficient solution to the problem of externalities, even in the absence of rules of law.[54] The preconditions, however, are that only negligible transaction costs be involved in the negotiation process, that the market be perfectly competitive, that private transferable property rights be well defined, and that individuals seek to maximize their utility.[55]

A common criticism of the Coase theory is that it makes unrealistic assumptions. For example, the Coase theory assumes transaction costs are zero, which even Coase, himself, insists is unrealistic.[56] The problem with pollution externalities is that there are usually a large number of participants affected and/or large numbers of polluters involved. This renders direct negotiation difficult, thereby precluding a Coasian approach whereby polluters and those affected directly bargain to reach an optimal solution to the problem of externality. An alternative is, therefore, to design a system whereby direct negotiation occurs within an institutional framework for the negotiation process in the trading of emission permits.

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53. *See* Coase, *supra* note 31, at 19.

54. *See id.* at 16.

55. *See id.* at 15.

56. *See* Bryan Bachner, *Regulating Pollution in the People's Republic of China: An Analysis of the Enforcement of Environmental Law*, 7 COLO. J. INT'L ENVTL. L. & POL'Y 373, 395 (1996); *see also* EJAN MACKAAY, ECONOMICS OF INFORMATION AND LAW 49, 57 (1982) (summarizing some of the criticisms of the Coase Theorem).

4. The International Context

Utilizing economic instruments to implement environmental policy in an international context raises some additional issues, although many of these are not unique to the international sphere. The first of these issues involves differentiating between what can be achieved through unilateral action, regional (i.e. bilateral or trilateral) cooperative action and global international cooperation. A tradable emission permit scheme is only going to be attractive to members of the global community if it can achieve benefits or reduce costs beyond what could have been achieved by a simple bilateral agreement or cooperative action. If we were to look at two countries, each with a utility function representing the combination of emission reductions and benefits which that country is willing to accept, then we must examine the area in which both parties can act in cooperation for mutual benefit.

Nash equilibrium models explore strategic behavior of firms in oligopolistic situations.[57] Arguably the international market for emitters of greenhouse gases operates as an oligopoly, with some key countries being responsible for a large proportion of the emissions produced. This means that the Nash equilibrium models may be able to illustrate the strategic behavior that may occur in these circumstances.[58] A non-cooperative Nash equilibrium will be achieved when each government considers its neighbors or other principal emitting countries' levels of emission reductions and then adopts its own best strategy to maximize its emissions, to the point at which the marginal costs of emissions are equal to the national environmental benefits achieved.

Under a cooperative Nash equilibrium model, countries will seek to maximize their benefits from cooperation and will set production/emission targets at levels that will maximize the benefits for all parties who have cooperated.[59] Nations will negotiate with one another to achieve this point only in circumstances

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57. *See* Mark Kelman, *Could Lawyers Stop Recissions? Speculations on Law and Macroeconomics*, 45 STAN. L. REV. 1215, 1263 n.16 (1993).

58. *See generally* GER KLAASSEN, ACID RAIN AND ENVIRONMENTAL DEGRADATION: THE ECONOMICS OF EMISSION TRADING 66-75 (1996).

59. *See id.* at 68.

where cooperation yields greater benefits than non-cooperation. A fully cooperative solution would involve nations acting to maximize global benefits from emission reductions. The viability of instituting an international tradable emission permit scheme will depend on whether such a scheme can offer even greater benefits than under a cooperative Nash scenario. The fully cooperative model can be achieved through a tradable emission scheme, as trading can allow for exchanges to occur recognizing that some countries have a greater emission reduction burden, and hence incur costs, than others. Compensation, in the form of ownership of permits which may be traded for value, is therefore given to these countries, while the global community reaps the maximum level of environmental benefits that can be achieved given technological constraints.

B. *Scientific and Economic Uncertainty*

Some of the scientific and economic uncertainty surrounding global climate change has already been discussed.[60] By contrast, however, considerable scientific agreement has been reached over the effects of ozone depletion, which probably helped solidify international action to halt the production and use of ozone-depleting substances.[61] The first scientific evidence of the existence and ramifications of ozone depletion came with the publication of Molina and Sherwood's findings in 1974.[62] This report explained that CFCs broke down in the upper stratosphere, releasing chlorine that caused a deterioration in the ozone layer.[63] Subsequently, the United Nations Environment Programme (UNEP), through various working groups, began to formulate an international response to the problem of ozone depletion.[64] At this time, manufacturers and consumers of CFCs were concerned that there was still too much scientific uncertainty over the exis-

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60. *See* discussion *supra* notes 12-15 and accompanying text.

61. *See* ROSALIND TWUM-BARIMA & LAURA B. CAMPBELL, U.N. ENV'T PROG., PROTECTING THE OZONE LAYER THROUGH TRADE MEASURES: RECONCILING THE TRADE PROVISIONS OF THE MONTREAL PROTOCOL AND THE RULES OF THE GATT 6-8 (1994).

62. *See id.*

63. *See id.*

64. *See id.* at 11.

tence, extent and rate of possible ozone depletion.[65] They were also concerned about the economic uncertainty over the ramifications of ozone depletion and the development of alternative technologies to be able decide on future CFC production and consumption.[66]

Prior to international agreement, a number of countries had already taken unilateral action to regulate substances which may affect the ozone layer, for example, the United States' introduction of the Clean Air Act of 1977.[67] Regulations were introduced into the United States in March 1978 to phase out CFC use, and similar steps were taken in Canada, Norway, Sweden, West Germany, the Netherlands and the European Community.[68] There was, however, a significant divergence in standards. While the United States' CFC production levels decreased to levels which met only domestic demand, the European Community became a major supplier of CFCs to the growing market in the developing nations.[69]

The 1978 U.S. ban on CFCs decreased emissions originating from the U.S., but was insufficient to stem the growth in emissions from industrializing nations.[70] There was increasing concern that this could overwhelm any reduction in ozone-depleting substances in the United States and European Community (UNEP).[71] Unilateral action also exposed U.S. companies to competitive disadvantage as other nations quickly moved to fill the gap brought about by the United States' preventive actions. Hence, multilateral action was required to prevent a negative trade impact on those countries which had taken unilateral action and to prevent the benefits of the reduction in emission from being eroded by increasing consumption in the developing world.

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65. *See id.* at 8.
66. *See id.*
67. 42 U.S.C. § 7401 (1997).
68. TWUM-BARIMA & CAMPBELL, *supra* note 61, at 9.
69. *See id.* at 9-10.
70. *See id.* at 10.
71. *See id.*

II. THE CURRENT INTERNATIONAL LEGAL REGIME FOR PROTECTING THE ENVIRONMENT

In response to the recognition that the threat of ozone depletion needed to be dealt with on an international level, several steps were taken. This Part discusses the responses of the international community. Specifically, Section A of Part II examines the 1985 Vienna Convention, which was designed to facilitate international cooperation in the area of research on the depletion of the ozone layer. Section B outlines the key provisions of the Montreal Protocol and its subsequent amendments that regulate international production and consumption of ozone-depleting substances. Finally, Section C discusses the Framework Convention on Climate Change (including the Kyoto Protocol), while Section D provides a brief summary of some of the other international conventions regarding the atmosphere.

A. *The 1985 Vienna Convention*

In the 1985 Vienna Convention, the participants created a framework to formalize the process of international cooperation to undertake research on ozone depletion, and to protect against activities that threaten the ozone layer.[72] The convention does not outline any specific emission targets or goals. Instead it simply lists CFCs in an annex with other gases and substances thought to have the potential to modify the chemical and physical properties of the ozone layer.[73] This convention requires the parties to take appropriate measures to protect human health and environment from adverse effects of ozone depletion, and it establishes a framework for a future protocol to control ozone-modifying substances.[74] It is also the principal international mechanism for promoting research and harmonization of laws on reducing the emissions of harmful ozone-depleting substances.[75] The Montreal Protocol, which is discussed below, is the

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72. Vienna Convention for the Protection of the Ozone Layer, March 22, 1985, T.I.A.S. No. 11,097, 26 I.L.M. 1516 [hereinafter Vienna Convention].

73. *See id.* Annex 1, § 4, 26 I.L.M. at 1538.

74. *See id.* art. 2, at 1529-30.

75. *See id.* art. 2, §§ 2(a)-(b), at 1530.

primary instrument for ensuring that these objectives are met and that specific emission targets are implemented.[76]

The organizational structure under the Vienna Convention involves the establishment of a Secretariat ("The Ozone Secretariat") which is responsible for initiating and convening meetings of the parties, receiving and distributing data on parties' consumption of substances that deplete the ozone layer, and monitoring the implementation of the Montreal Protocol.[77] The Ozone Secretariat is also responsible for advising the Executive Committee of the Multilateral Fund on whether parties are eligible to receive assistance under Article 10 of the Montreal Protocol.[78]

B. *The Montreal Protocol and Subsequent Amendments*

The Montreal Protocol was signed in September 1987 by representatives of virtually all the countries that were significant producers and consumers of ozone-depleting substances.[79] These countries agreed that the protocol would enter into force on the first of January 1989 only if a minimum of eleven countries, "representing two thirds of the 1986 estimated global consumption of the controlled substances," had ratified it.[80] Currently more than 150 countries, including the European Union, representing over ninety-five percent of the world's consumption of ozone-depleting substances are parties to the Protocol.[81]

The key aspects of the Montreal Protocol include:

(1) restrictions on production and consumption of ozone-depleting substances;[82]

(2) transfer of production;[83]

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76. *See generally* Montreal Protocol, *supra* note 16.

77. *See* Vienna Convention, *supra* note 72, art. 7, at 1532.

78. *See id.*

79. *See Multinational Pact Aims to Protect Ozone Layer*, CHI. TRIB., Sept. 17, 1987, at 6.

80. Montreal Protocol, *supra* note 16, at 1559-60.

81. *See* Denise Grady, *Asthma Sprays to be Modified*, N.Y. TIMES, Apr. 23, 1997 at C8.

82. *See* Montreal Protocol, *supra* note 16, art. 2, §§ 1-4, at 1552-53.

83. *See id.* art. 2, §§ 5-7, at 1553.

(3) restriction on exports and imports of ozone-depleting substances with non-parties to the Protocol;[84]

(4) special obligations for developing nations;[85] and

(5) the establishment of a Multilateral Fund to assist in providing financial and technical assistance, including the transfer of technologies, to developing nations.[86]

These aspects will be dealt with in turn and will include a discussion of amendments to these requirements to impose stricter emission controls that followed the meetings in London and Copenhagen. One of the strengths of the Montreal Protocol has been its ability to adapt to changes in scientific evidence, to impose stricter controls in response to evidence, of ozone layer deterioration. Although a great many countries had already unilaterally accepted greater reductions in consumption of controlled substances prior to the amendments made to the Protocol, the Protocol itself was very responsive to change. This has prompted a good deal of optimism that other international environmental agreements will be responsive and flexible enough to adapt to further changes in scientific knowledge.

1. Restrictions on Production and Consumption of Ozone-Depleting Substances

The scheme established under the Montreal Protocol requires the parties to reduce both the consumption and production of a specified group of CFCs and halons, which are outlined in Group I and II respectively in Annex A to the Protocol ("controlled substances").[87] Reductions mandated by the Protocol are expressed in terms of percentages of calculated national levels (or benchmarks).[88] Until it was amended, the Montreal Protocol required parties to freeze production and consumption of controlled substances at 1986 levels and outlined a timetable for fu-

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84. *See id.* art. 4, at 1554-55.

85. *See id.* art. 5, at 1555-56.

86. *See id.* art. 5, § 3, at 1556.

87. *See id.* art. 1, § 4, art. 2, §§ 1-4, & Annex A, at 1551, 1552-53, 1561.

88. *See id.* art. 2, §§ 1-4, at 1552-53.

ture reductions to be made.[89] The Protocol specifies, however, that future adjustments to already-specified controlled substances would be considered binding on parties.[90] The Protocol has to be formally amended, by a two-thirds majority of the parties, if further chemicals are to be added as controlled substances.[91]

Whether the purpose of the Protocol was to control production or consumption levels is a contentious issue. While imposing controls on production alone may be easier, as there are probably more limited numbers of producers compared to consumers, there may be a disparity in effect between producers, depending on their size and capability to accommodate emission controls. Small producers may be dealt with inequitably if controls are based on current or historical production levels, and greater power will be given to the larger producers if production levels are capped. Those countries that depend on imports have also argued that they would be starved of substances to meet domestic demand.[92] In recognition of these concerns and the possibility of discouraging countries from participating, the Montreal Protocol limited consumption levels by aggregating each party's level of production and imports of controlled substances and subtracting from this levels of exports.[93] The Protocol simultaneously recognizes the need to meet domestic demands in a transitional period and allows sufficient incentives for smaller producers or smaller producing nations to move into alternative technologies.

The first meeting of the parties to the Montreal Protocol took place in Helsinki in 1989.[94] Although agreement was reached that CFCs should be phased out by the year 2000 and that halons should be phased out as soon as possible, no amendments to the obligations under the Protocol were made.[95]

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89. *See id.*

90. *Id.* art. 2, § 11, at 1554.

91. *Id.* art. 10, at 1554.

92. *See* TWUM-BARIMA & CAMPBELL, *supra* note 61, at 15.

93. *See* Montreal Protocol, *supra* note 16, at 1553. The Protocol, however, allowed for the subtraction of exports in calculating consumption level until January 1, 1993.

94. Helsinki Declaration on the Protection of the Ozone Layer, May 2, 1989, 28 I.L.M. 1335.

95. *See id.*

Amendments were, however, adopted at the London meeting in 1990.[96] These changes can probably be attributed to reports that the hole in the ozone layer over Antarctica was larger than originally anticipated.[97] Specifically, at the London meeting it was agreed that CFC use would be phased out by the year 2000.[98] To achieve this the parties agreed that CFCs would be cut by fifty percent by 1995 and eighty-five percent by 1997, with additional time for phaseout by developing countries.[99] Furthermore, the use of halons would also be phased out by 2000 by freezing consumption levels to 1986 levels by 1992, followed by a fifty percent reduction by 1995.[100] The reductions, however, were applied to non-essential production, but postponed defining "essential" uses until a later date.[101] Methyl chloroform and additional CFCs were also added to the list of ozone-depleting substances.[102]

The fourth meeting of the parties to the Montreal Protocol, held in Copenhagen in 1992, resulted in further adjustments to the Protocol to restrict the production and consumption of ozone-depleting substances.[103] At this time the phaseout of controlled substances was already ahead of schedule, and the costs were already much lower than originally anticipated.[104] The report of the Scientific Assessment Panel was released during these negotiations and strongly indicated that there were greater ozone holes and higher levels of UV-B radiation than had been

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96. Montreal Protocol Parties: Adjustments and Amendments to the Montreal Protocol on Substances that Deplete the Ozone Layer, June 29, 1990, STATE DEP'T NO. 91-68, 30 I.L.M. 537, 547-8 [hereinafter London Amendments].

97. *See* Thomas H. Maugh III, *Ozone Depletion Far Worse Than Expected Long Awaited Study of Loss in Protective Layer Raises Key Health and Environmental Concerns*, L.A. TIMES, Mar. 16, 1988, at 1.

98. *See* London Amendments, *supra* note 96, ¶ 5, at 540.

99. *See id.* ¶ 3-4, at 539.

100. *See id.* at 540-41.

101. *See id.* ¶ 4, at 541.

102. *See id.* at 552-53.

103. United Nations: Adjustments and Amendments to the Montreal Protocol on Substances that Deplete the Ozone Layer, Nov. 23-25, 1992, S. TREATY DOC. NO. 103-9, 32 I.L.M. 874 [hereinafter Copenhagen Amendments].

104. *See* TWUM-BARIMA & CAMPBELL, *supra* note 61, at 33.

predicted.[105] The findings of the Environmental Effects Assessment Panel (the "EEAP"), which cited evidence of harm to the marine ecosystem and food chain, was similarly disconcerting.[106] The report stated that particular emission reductions would be economically feasible, although there were no adjustments for products with controlled substances as components.[107] This decision was made because of the difficulty in assessing whether or not a product has been made utilizing a controlled substance.[108] The adjustments provided for included a 75% reduction in production and consumption of CFCs by 1994, with a total phaseout by 1996.[109] Halons were also mandated to be phased out by 1994, and carbon tetrachloride and methyl chloroform by 1996.[110]

2. Transfer of Production Levels

Under article 2(5) of the Montreal Protocol, production limits may be transferred between parties "for the purposes of industrial rationalization" so long as the general production limits specified under the protocol are not exceeded.[111]

At the London meeting, article 5 was replaced with a provision encouraging broader trade production limits.[112] The amended article 5 enables parties to trade in a portion of a nation's calculated level of production, provided that total combined levels of production for any group of controlled substances does not exceed the total production limits for the group set out in the Protocol.[113]

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105. *See id.* at 34.

106. *See id.*

107. *See id.*; *see also* Montreal Protocol, *supra* note 16, art. 1, § 4, at 1551.

108. *See id.*

109. Copenhagen Amendments, *supra* note 103, at 876.

110. *See id.*

111. Montreal Protocol, *supra* note 16, at 1552.

112. *See* London Amendments, *supra* note 96, at 546-48.

113. *See id.*

3. Export and Import Restrictions

Under article 4 of the Montreal Protocol, restrictions are also imposed on trade with non-parties of the Protocol to ensure that emission reductions are not undermined and to prevent a competitive advantage being obtained by non-party states.[114] Article 4 prohibits the export and import of controlled substances with any non-party state, and provides that within five years of the Protocol's entry into force the parties would consider banning or restricting trade in products that are produced with controlled substances.[115] The London meeting amendments extended this provision to cover controlled substances, listed in annex B to the Protocol, as well as controlled substances listed in annex A.[116] A procedure for restricting the import and export of products containing controlled substances was also laid out.[117]

4. Special Obligations for Developing Nations

In recognition of the fact that they need to have an extended time period in which to meet these reductions, developing nations receive special treatment under article 5 of the Protocol, to facilitate compliance.[118] To ensure that the domestic demands in these developing countries may be met, article 5 of the Protocol provides for a grace period for the transition to ozone-friendly technology to occur.[119] Where the per capita consumption in a state is less than 0.3 kilograms, the grace period is ten years.[120] Although developing nations may continue to consume controlled substances within this period, their consumption is not allowed to exceed 0.3 kilograms.[121]

It was recognized throughout the negotiations, however, that although developing nations' per capita consumption was only a fraction of that in the industrialized nations, their domestic re-

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114. *See* Montreal Protocol, *supra* note 16, at 1554-55.
115. *See id.*
116. *See* London Amendments, *supra* note 96, at 546.
117. *See id.*
118. *See* Montreal Protocol, *supra* note 16, at 1555-56.
119. *See id.*
120. *See id.*
121. *See id.*

quirements were growing, and if unabated, their emission levels would increase alongside population growth and moves to industrialize.[122] Hence, it was very important that developing nations be given an incentive to abide by the Protocol. Otherwise, multilateral action would be undermined if developing nations continued production and consumption of ozone-depleting substances.

5. Multilateral Fund

The availability of alternative technologies has been critical to the success of the Montreal Protocol, as the possibility of substituting ozone-safe technology provided the necessary incentive for industry to phase out CFCs and halons and lower the compliance costs of the protocol's obligations.[123] The turning point probably came with DuPont's decision in 1988 to phase out production of CFCs.[124] As the world's largest producer of CFCs, DuPont's decision was a significant step in accepting that it was now technically feasible to use alternatives to CFCs. By 1991 the Technology and Assessment Panel established under the Montreal Protocol declared that the innovation to replace CFCs had been successful, and that it was technically feasible to phase out CFCs and halons by 1995-97.[125]

The concern in developing nations over the potential costs of converting their production facilities to ozone-friendly technologies and acquiring the technology to assist this process is reflected in the technology transfer and multilateral fund provisions of the Montreal Protocol.[126] By 1989, it was disconcerting to

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122. *See, e.g., Report of the Fourth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer*, Nov. 25, 1992, *available in* 1992 WL 675170 ([*Report of the Implementation Committee*:]

> [T]he Committee has noted with some concern that there was a trend of increased consumption of controlled substances, particularly halons, by some Parties operating under Article 5. Two other problems noted by the Committee were the pattern of late reporting by many Parties and the problem of getting accurate population data.).

123. *See* JURGIELEWICZ, *supra* note 18, at 173.

124. *See id.*

125. *See id.*

126. *See id.* at 174.

note that only fourteen developing countries had become party to the Protocol.[127] If developing nations were not going to participate fully to combat ozone depletion, then it was entirely possible that emission reductions would be undermined and that production facilities would be established in non-party states. To prevent this from occurring, the parties agreed at the London meeting to establish a Multilateral Fund to assist "eligible parties" by providing financial and technical aid, including technology transfer, to assist them in meeting the targets under the Protocol.[128] Between $340-500 million was committed for 1994-96 to this Fund.[129] However, the much wider issue of disparity between the industrialized and developing worlds and the implications for development with increased environmental protection still remains contentious.

6. Non-Compliance Issues

The Montreal Protocol provides three kinds of economic incentives to encourage compliance: (a) entry into force requirements; (b) control on trade with non-parties; and (c) technology transfer and research benefits.[130] The Montreal Protocol directly links trade with environmental controls, and in doing so, demonstrates not only the profound link between the two, but also the importance of utilizing trade-based control measures to ensure compliance. Under article 16, at least eleven countries representing two-thirds of global consumption of controlled substances must ratify the proposal before it enters into force.[131] Under article 8 of the Montreal Protocol, an implementation committee is established to consider and report on submissions made to the Secretariat about the possible non-compliance by parties to the

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127. *See* Bing Ling, *Developing Countries and Ozone Layer Protection: Issues, Principals and Implications*, 6 TUL. ENVTL. L. J. 91, 97 n.34 (1992).

128. *See* JURGIELEWICZ, *supra* note 18, at 169-70.

129. *See id.* at 169.

130. *See* Carol A. Petsonk, *The Role of the United Nations Environment Programme (UNEP) in the Development of International Environment Law*, 5 AM. U. J. INT'L L. & POL'Y 351, 367-72 (1990).

131. *See* Montreal Protocol, *supra* note 16, art. 16, § 1, at 1559; Petsonk, *supra* note 130, at 370.

Protocol.[132] The Secretariat must also be provided with statistics on production, in order to monitor compliance with the Protocol.[133] Although the investigatory and dispute resolution provisions are limited, if negotiation, mediation or conciliation fails, the dispute can be submitted to the International Court of Justice.[134]

C. *The Framework Convention on Climate Change*

Both the Vienna Convention[135] and the Montreal Protocol[136] regulate production and consumption of controlled substances that in addition to being ozone-depleting, are also greenhouse gases and contribute to the "greenhouse effect." The Montreal Protocol, however, only deals with certain classes of substances that are known to have ozone-depleting effects.[137] Therefore, it provides only an indirect and incremental effect on the emissions of greenhouse gases. A comprehensive and multilateral greenhouse gas emission regime is still required. Despite its shortcomings, the Framework Convention on Climate Change ("FCCC"),[138] signed in Rio De Janeiro in June 1992, is the first crucial step in establishing such a regime. Attention is now being focused on the institutional structure that may be established under this framework, including the possibility of implementing a system of tradable carbon emission entitlements.[139] The recommendations of the United Nations Conference on Trade and Development ("UNCTAD")[140] offer a useful framework for evaluat-

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132. *See* Montreal Protocol, *supra* note 16, art. 8, at 1556; Petsonk, *supra* note 130, at 379.

133. *See* Montreal Protocol, *supra* note 16, art. 7, at 1556.

134. *See* Vienna Convention, supra note 72, art. 11, at 1533-34; *see also* Jennifer S. Bales, *Transnational Responsibility and Recourse for Ozone Depletion*, 19 B.C. INT'L & COMP. L. REV. 259, 264 (1996).

135. Vienna Convention, *supra* note 72.

136. Montreal Protocol, *supra* note 16.

137. *See id.* pmbl., art. 1, § 4 & Annex A, at 1550-51, 1561.

138. Framework Convention on Climate Change, May 9, 1992, UN Doc. A/AC.237/18, 31 I.L.M. 849 [hereinafter FCCC].

139. *See id.*

140. *See generally* UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT (UNCTAD), COMBATING GLOBAL WARMING: POSSIBLE RULES, REGULATIONS AND ADMINISTRATIVE ARRANGEMENTS FOR A GLOBAL MARKET

ing the possible implementation of such a system, and is evaluated in Part IV of this paper.

While this Convention establishes some key principles to address global warming, it is deficient in many respects and should only be regarded as the first step in what will undoubtedly be a long and involved process of formulating a specific, cost-effective and efficient response to greenhouse gas emissions.

The FCCC's objective is to promote the stabilization of greenhouse gas concentrations at levels that would prevent serious interference with the world's climate system.[141] This objective is not translated, however, into specific emission targets or levels. In article 3, the FCCC merely outlines some further principles and, in article 4, broad commitments, which are not readily adopted into positive policy initiatives.[142] Article 3 recognizes three important principles: intergenerational interests, sustainable development, the precautionary principle, and the need to have special requirements for developing nations.[143] The first two of these principles are clearly interrelated, and as previously discussed, difficult to place within a traditional cost-benefit analysis of particular policy options. The United States asked that cost-effectiveness be included within the principles established, but this proposal met with considerable opposition.[144] Nevertheless, the precautionary principle is expressed in terms of measures that should be cost-effective so as to ensure global benefits at the lowest possible costs. While only a guide for policy response, it recognizes that consideration must also be made of the economic consequences of measures to prevent or mitigate against global climate change.

Article 4 of the FCCC purports to lay down the various commitments to which the parties have agreed.[145] In practical terms, however, these commitments are neither targets nor a timetable

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IN CO_2 EMISSION ENTITLEMENT, U.N. Doc. UNCTAD/GID/8, U.N. Sales No. E.95.II.D.4 (1994) [hereinafter UNCTAD, COMBATING GLOBAL WARMING].

141. *See* FCCC, *supra* note 138, art. 2, 31 I.L.M. at 854.

142. *See id.* arts. 3, 4, at 854-59.

143. *See id.* art. 3, at 854-55.

144. *See* Daniel Bodensky, *The United States Framework Convention on Climate Change: A Commentary*, 18 YALE J. INT'L L. 451, 453-60, 475-81, 492-96, 499-509, 511-24, 526-27, 554-58 (1993).

145. *See* FCCC, *supra* note 138, art. 4, at 855-59.

for the implementation of specific emission reductions. The parties are asked to prepare national inventories on greenhouse gas emissions and take action to remove them, and formulate and implement national programs to address the sources of greenhouse gas emissions.[146] Developed nations are also asked to commit themselves to taking special measures to limit emissions of greenhouse gases and enhance the capacity of their sinks and reservoirs for the stabilization of such gases.[147] They are also required to accord financial support to developing nations who are parties to the Convention to enable them to comply with the terms of the Convention.[148] How these broad commitments are to be translated into practice remains to be seen.

Article 4(2) purports to set targets for emission levels to return, by the year 2000, to "earlier levels" of carbon dioxide and other greenhouse gases not controlled by the Montreal Protocol.[149] Needless to say, the uncertainty of what these "earlier" levels are to be makes these so-called commitments impossible to implement. At the first conference of the parties to the FCCC, held in March-April 1995, a proposed protocol was submitted to reduce CO_2 emissions to 1990 levels by the year 2000.[150] The United States opposed this,[151] although under the Kyoto Protocol[152] the United States has now agreed to a seven percent reduction in 1990 levels of carbon dioxide emissions by 2012.[153] The majority of developed nations agreed to a five percent reduction, while the European Union committed to an eight percent reduction in emissions.[154] Under the United States' Climate Action Plan, unveiled in October 1993, the administration had relied on voluntary industry action to reduce greenhouse gas emissions.[155]

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146. *See id.* at 855.
147. *See id.* at 856.
148. *See id.* at 858-59.
149. *See id.* at 856-57.
150. *See id.*
151. *See* Bodensky, *supra* note 144, at 514.
152. Conference of the Parties to the Framework Convention on Climate Change: Kyoto Protocol, Dec. 10, 1997, 37 I.L.M. 22 [hereinafter Kyoto Protocol].
153. *See id.* art 3, at 33.
154. *See id.*
155. *See* Glenn Wiser, *Joint Implementation: Incentives for Private Sec-*

One of the key elements of the FCCC, at least as far as this paper is concerned, is the joint implementation provisions under article 4(2).[156] This provision may be a possible precursor to a tradable emission permit scheme. Proponents of the convention are now closely examining the possible use of tradable emission permits and other economic instruments to curb global warming.[157] The FCCC is, to a great extent, an evolutionary stage in the process, so there should be considerable opportunity for evaluating a system for utilizing international economic instruments to achieve global warming objectives.

Under article 4(2)(a), the possibility for a transborder approach to emission reductions is anticipated by what is termed joint implementation.[158] This provision allows countries to obtain credits for reductions in emissions which can be transferred to another country to assist it in complying with its emission entitlements.[159] The provision applies to all those countries listed in annex 1 to the Convention which have accepted the goal of stabilizing greenhouse gas emissions at 1990 levels by the year 2000.[160] Unfortunately, it does not appear that many of the countries who are party to the FCCC will be able to meet expected emission reductions to 1990 levels without severe economic consequences, making compliance unlikely.[161] Although the Kyoto Protocol marks a significant step forward in achieving emission reductions, it still remains to be seen whether developed nations will comply with the targets established. Despite the agreement reached in Kyoto, the Protocol has yet to enter into force or be ratified by the United States Congress. The opportunity for joint implementation, however, could provide the ideal platform for establishing a tradable emission permit scheme.

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tion Mitigation of Global Climate Change, 9 GEO. INT'L ENVTL. L. REV. 747, 748 (1997).

156. *See* FCCC, *supra* note 138, art. 4, § 2, 131 I.L.M. at 856.

157. *See* Adam L. Aronson, *From "Cooperator's Loss" to Cooperative Gain: Negotiating Greenhouse Gas Abatement*, 102 YALE L.J. 2143, 2143-44 (1993).

158. *See* FCCC, *supra* note 138, at 856.

159. *See id.* at 856-57.

160. *See id.* art. 4, § 2(a) & Annex I, at 856, 872.

161. *See, e.g.*, Aronson, *supra* note 157, at 2154-55.

A "Clean Development Mechanism" is established under the Kyoto Protocol to enable developed nations to finance emission reduction projects in developing countries.[162] This extension of "joint implementation" could provide the platform for establishing a tradable emission permit scheme. Article 6 of the Protocol specifically allows parties to engage in trading of emission reduction units.[163] Agreement on how an emission trading scheme would be undertaken has yet to be reached, however. The Clinton administration has indicated that it supports the introduction of emission trading to meet its carbon dioxide emission reduction targets.[164] One concern over the United States draft plan on implementing emissions trading is that the initial allocation could favor Russia and other members of the former Soviet Union as a result of economic decline in these countries. This could lead to a transfer of considerable wealth should Russia trade its allocation to other developed nations, most notably the United States, which is likely to be a purchaser of such permits in the event that trading is initiated.[165]

Unlike the issue of ozone depletion, which will affect every country equally, the impact of global warming will be felt differently across the globe, and the fact that some countries may be less affected than others raises the specter that these countries will be reluctant to commit to strict emission controls in the absence of any foreseeable economic harm. Halting global warming must be viewed as a long term objective, given that there is not enough scientific evidence to indicate what degree of emission reductions will lessen the greenhouse effect. It is still unknown whether emission reductions at this stage can reverse the global warming process. Nevertheless, the United States has reiterated its commitment to taking steps to ensure that all countries adopt measures to reduce greenhouse gas emission levels and to seek market based solutions that are flexible and cost-effective.[166]

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162. *See* Kyoto Protocol, *supra* note 152, art. 12.

163. *See id.* art. 6.

164. *See* John J. Fialka, *Breathing Easy: Clear Skies are Goal as Pollution is Turned into a Commodity*, WALL ST. J., Oct. 3, 1997, at A1.

165. *See id.*

166. *See* Richard L. Berke, *Clinton Declares New U.S. Policies for Environment*, N.Y. TIMES, Apr. 22, 1993, at A1.

D. *Other International Requirements Affecting the Atmosphere*

The possible use of tradable emission permits must also be viewed within the greater sphere of international protection of the atmosphere. In addition to the Montreal Protocol and FCCC, atmospheric pollution is also regulated by the provisions of the Convention on Long Range Transboundary Air Pollution[167] and the Convention on Transboundary Shipments of Hazardous Wastes (Basel Convention).[168] The latter convention will affect the traffic in ozone-depleting substances and possibly other atmospheric pollutants and chemical compounds that affect the atmosphere.[169] According to a note issued by the Technical Working Group of the Basel Convention, controlled substances would be regarded as hazardous waste and, thus, are subject to restrictions on transboundary movements of hazardous wastes as defined under article 1.[170] These substances are subject to article 5.4 of the Convention, which bans exports and imports of hazardous wastes unless separate agreement has been reached.[171]

Many European nations are also subject to restrictions on emissions of sulfur, nitrous oxides and volatile organic compounds that affect the atmosphere, pursuant to a number of protocols under the Convention on Long Range Transboundary Air Pollution, which came into force in 1983.[172] The United States, Canada and Mexico are bound under the North American Free Trade Agreement (NAFTA) to take environmental considerations into account, and under the side agreement on the environment, to potentially take much greater action against air pollu-

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167. Convention on Long Range Transboundary Air Pollution, Nov. 13, 1979, T.I.A.S. No. 10541, 18 I.L.M. 1442.

168. Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, Mar. 22, 1989, U.N. Doc. UNEP/WG.190/4, 28 I.L.M. 649, 657 [hereinafter Basel Convention].

169. *See id.* at 658.

170. *See Basel Convention on the Control of the Transboundary Movements of Hazardous Wastes and Their Disposal*, 1994 BIANNUAL BULL. ENVTL. L. (UNEP) 15.

171. Basel Convention, *supra* note 168, at 662.

172. *See* Convention on Long Range Transboundary Air Pollution, *supra* note 167.

tion.[173] NAFTA also recognizes that in the event of a conflict with international environmental agreements such as the Montreal Protocol, these agreements, not NAFTA, will prevail.[174]

In addition to international agreements, countries are also obligated under general customary law to prevent transboundary pollution.[175] The precautionary principle is, however, predicated on a cause and effect analysis which may be impractical in many instances of atmospheric damage, particularly when looking at global climate change.

International environmental obligations cannot be viewed in isolation from international trade. The premise of this paper is, in many ways, that trade and free market exchange are key components to establishing a successful international response to global warming. The Montreal Protocol demonstrates the potential success that accompanies the integration of environmental goals and trade. The General Agreement on Tariffs and Trade[176] and the agreements reached following the Uruguay Round of negotiations[177] do not directly deal with many of the crucial questions on how environmental measures are to be treated in terms of their potential effects on international trade. While there is recognition that environmental measures may be exempt from the non-tariff trade barrier provisions where they are necessary to protect human, animal or plant life or health, or which involve the conservation of exhaustible natural resources, there is no clear guidance from the World Trade Organization over which obligations (trade or environment) will prevail in any given circumstance or where there is a conflict.

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173. North American Free Trade Agreement, Sept. 11, 1992, *available in* 1992 WL 721882, *14-15 (N.A.F.T.A.).

174. North American Free Trade Implementation Act, *available in* 1993 WL 561124, *2 (N.A.F.T.A.).

175. *See, e.g.*, Trail Smelter Case (U.S. v. Can.), 3 R.I.A.A. 1905 (1941).

176. General Agreement on Tariffs and Trade, Oct. 30, 1947, 61 Stat. A-11, 55 U.N.T.S. 194.

177. *See* Final Act Embodying the Results of the Uruguay Round of Multilateral Trade Negotiations, Apr. 15, 1994, 1 LEGAL INSTRUMENTS: RESULTS OF THE URUGUAY ROUND, 33 I.L.M. 1125 (1994).

III. The Principles of Environmental Economics and Their Application in the International Sphere

To determine the practicality of tradable emission permits to combat global warming, it is necessary to examine the latter in greater detail. Section A of Part III briefly describes some of the current estimates of the economic damage that may result from global warming. Section B then deals with the use of economic instruments to mitigate against the effects of global warming. Finally, Section C specifically examines the theory and application of a tradable emission permit scheme as a possible means of promoting international environmental goals.

A. *Estimates of Economic Damage Resulting from Global Warming*

While it is beyond the scope of this paper to go into detail on the simulation models that have been developed to assess the potential economic consequences of global warming, a summary of the disparate results that have been produced helps place the issue of a cost-effective policy action in perspective. One of the dilemmas facing policy makers is that the economic costs associated with global warming may indeed be less than the projected costs of mitigation and that the benefits of reducing greenhouse gas emissions may not outweigh the costs associated with reducing reliance on fossil fuels. The simulation models that have been developed to date have reached very different conclusions on the level of damage that may be incurred, the costs associated with mitigation and the levels of emission reductions that should be made.[178] The differences in these results are due, in part, to differing assumptions as to the appropriate discount rate to apply to future harm from global warming, as to the risk of harm in the future and on the projected benefits that may accrue from particular emission reductions.[179] Total damage estimates for the United States accompanying a doubling in CO_2 levels range from around $61.6 billion in the medium term to $335.7 billion in the very long term (50-100 years).[180] Simulation models have used per-

178. *See* Aronson, *supra* note 157, at 2149-74.

179. *See id.*

180. *See* William R. Cline, The Economics of Global Warming 131 (Inst. Int'l Econ., 1992).

centages of GDP estimates, and these hypothesize that the economic costs of carbon emission limits could constitute between one and three percent of world GDP with, in national GDP terms, China potentially incurring the greatest losses (from eight to ten percent of GDP).[181] None of these models has appropriately incorporated potential rates of technical change in response to the required reduction in carbon emissions (and hence reliance on fossil fuels).

B. *The Use of Economic Instruments to Promote Economic and Environmental Goals*

The Montreal Protocol provides a conceptual framework for the international trade in emission permits. The FCCC has also prompted closer examination of the possible use of tradable emission permits to mitigate the effects of global warming due to emissions of greenhouse gases. The Organization for Economic Cooperation and Development ("OECD") and UNCTAD are both evaluating the practical implications of using a tradable gas emission permit scheme.[182] The prime motivation at domestic and international levels for utilizing such a scheme is the belief that it can achieve a level of greenhouse gas emission reduction at the least economic cost. Traditionally, the approach at both a domestic and international level has been to deal with the problem of emission and air pollution through arbitrary standards enforced by a regulatory agency which monitors and controls the conduct of firms and individuals.[183] One possible advantage of a tradable emission permit system is that it is by and large self-operating. However, an organizational structure is required to oversee its operation (particularly at an international level) and to establish emission levels and initial permit allocation.

When deciding whether to pursue a global policy of reduction or elimination of greenhouse gas emissions, parties must choose

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181. *See id.* at 340.

182. *See* Hourcade & Baron, *Tradable Permits, in* ORGANIZATION FOR ECON. COOPERATION & DEV., INTERNATIONAL ECONOMIC INSTRUMENTS AND CLIMATE CHANGE 21 (OECD 1993); *infra* Part V.A.

183. *See* HEGGELUND, *supra* note 6, at 34 tbl.2.1, 35-38 (comparing direct enforcement with market incentive policies).

between relying on unilateral action or free riding on the system. Unilateral action presumes that international cooperation will ultimately follow and that countries may free ride on the reductions in greenhouse gas emissions.[184] Global warming ultimately may affect all nations in the long-term, and some countries have been willing to undertake unilateral emission reductions, thus making the free-rider problem potentially less important in practice than in theory.[185]

It may be, however, that for some nations there exists a situation of "cooperator's loss." Cooperator's loss is a term that refers to a situation where the total benefits of cooperation outweigh the total benefits of non-cooperation, but for one of the players total non-cooperation remains a more attractive alternative than total cooperation.[186] This may very well exist for nations such as the United States that are heavily reliant on fossil fuels and who may benefit more from not cooperating in reducing total emission levels given the large costs involved in substituting alternative energy sources. Countries like the United States may also be less affected by global warming, or at least better able to respond and adapt to the possible consequences of global warming.[187]

There is evidence, however, that some countries, particularly island nations, will be more significantly affected, and that there may be considerable regional variations in the impact felt from global warming.[188] As a result, countries predicting that they will be less affected by global warming will undertake a cost-benefit analysis and decide that it is more cost-effective to wait and rectify the problems associated with global warming than to incur costs now to prevent those problems. The finding of the National Academy of Sciences in its 1991 report is illustrative. According to the report, "[p]eople in the United States will have no more difficulty adapting to such future changes [in the pro-

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184. *Cf.* CLINE, *supra* note 180, at 325-32 (discussing the free rider problem).

185. *See id.* at 328.

186. *See* Aronson, *supra* note 157, at 2151.

187. *Cf. id.* at 2159-60.

188. *Cf.* Samuel Preatt Menefer, *"Half Season": The Impact of Sea Level Rise on International Law and Policy*, 9 UCLA J. ENVTL. L. & POL'Y 175, 178 (1991).

jected rate of climate change] than to the most severe conditions of the past, including the dust bowl."[189] This report suggested that the rate of technological change and capital investment in research and development was such that adaptation was a more cost-effective solution than implementing abatement measures. Still, there remains such uncertainty on the ramifications of global warming and its economic consequences that it is probably ill-advised to make such findings at this stage. Nevertheless, it reveals the very real attitude of "wait and see" rather than acting on uncertain and imperfect scientific evidence at a time when the economic consequences of undertaking a particular form of action are far from clear.

In addition to these concerns, there is still the issue of resolving developing countries' participation in an international effort to curb global warming. Although the developed world accounts for approximately seventy percent of global carbon dioxide emissions,[190] there are indications that countries such as China will become increasingly more reliant on fossil fuels as population and economic growth continues.[191] Oil-producing nations will also be affected by any global move to cut fossil fuel and associated carbon dioxide emission levels.

International cooperation is far more likely to occur when countries perceive that the marginal benefits of abatement (that is the benefit of reducing one more unit of emission) will rise sharply as emissions increase. This will, perhaps, provide the necessary incentive for change. This is probably best illustrated by the success of the Montreal Protocol, where the perceived benefits of reducing ozone depletion were clear and immediate. While it is clear that where externalities are present each country will have an incentive to reduce its own damage, there will be an incentive to act jointly only where it is clear that more damage reduction will result from international cooperation than from unilateral action. In the absence of international cooperation, each country will act to meet its own costs of abatement and re-

189. NATIONAL ACAD. SCI., POL'Y IMPLICATIONS, *supra* note 2, at 47.
190. *See id.*
191. *See id.* at 65.

duce emissions to the point where the marginal cost of abatement equals the marginal benefits from abatement.

The slope of both the marginal benefit and marginal cost curves will dictate whether international cooperation provides significant gains over unilateral action. The problem with assessing policy action to halt global warming is that the benefits are not yet quantifiable, even though it is probably clear that international action is required, because greenhouse gases are dispersed uniformly throughout the atmosphere. As a result, unilateral reductions, unless they constitute a significant percentage of global emissions, may not result in expected benefits if other countries continue or indeed increase their emissions.

C. *Tradable Emission Permits: Theory and Application*

A theoretical assessment of a tradable emission permit system requires a number of assumptions and an examination of the market mechanism that should operate, given these assumptions, to produce an environmentally and economically efficient result. A basic assumption is that we can identify an appropriate overall (national/bilateral/multinational) emission level which may then be divided into units and traded between producers. The level of pollution/emission is thus determined by the distribution of existing permits among those who actually use them, and in theory, those holding the permits unused in order to preserve air quality. The theory of tradable emission permits creates a market for emission as externalities, and grants a quasi property right to the commons by granting what is, in effect, a license to pollute.[192]

Distribution of the benefits from emission permit trading depends on the gap between the marginal costs associated with activities that produce emissions.[193] There probably will be a tendency for prices to fluctuate as firms modify their behavior and their purchases of tradable emission permits in response to changing marginal cost structures and the availability of alternative technologies.[194] The bargaining power of individual emitters

192. *See* HEGGELUND, *supra* note 6, at xiv, xvi, 19-32.
193. *See id.* at 22-26, 24 figs.2.1 & 2.2.
194. *See id.* at 25.

should not be underestimated, and if there is significant market power or barriers to trade, there may be a reduction in the efficiency with which the market for tradable emission permits operates.[195]

Some of the key conditions for a successful tradable emission permit system are:

(1) Sufficiently large numbers of emitters in the trading market to ensure that it is competitive and that emitters cannot engage in strategic behavior or manipulation of the market in terms of wither allocation, distribution or price of permits;[196]

(2) Divergence between emitters in the costs of complying with the overall emission levels;[197]

(3) Minimal restrictions placed on the transferability of permits, enabling the market to achieve the lowest cost of compliance outcome;[198]

(4) Uniformly mixed pollutants rather than specific emissions that only cause damage in specific areas and for a specific time period;[199]

(5) No auctioning of permits as an initial allocative mechanism which otherwise may lead to increased costs to emitters and negate the cost savings which may accompany the proper operation of the tradable emission permit system;[200] and

(6) Free allocation of permits, which provides an incentive to trade, but is also an instrument of wealth transfer.[201]

A tradable emission permit system may also have advantages in that, unlike a tax, no regulatory body has to assess the appropriate tax rate in circumstances where there is both scientific and economic uncertainty.[202] A tradable emission permit system may have the flexibility to accommodate changes in economic growth, inflation and changes in technology, and it will also pro-

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195. *See, e.g., id.* at 30-31 (non-competitive behavior).
196. *See id.* at xv.
197. *See id.*
198. *See id.*
199. *See id.*
200. *See id.*
201. *See id.* at xvi.
202. *See id.* at 41-43.

vide an incentive for innovative technology development.[203] There is, however, no direct control imposed by the tradable emission permit system, unlike a tax, and so it may be less responsive as a mechanism for controlling emission activities.

IV. Practical Application and Implications of a Tradable Emission Permit Scheme

To ensure a successful implementation, several aspects of any proposed permit trading system should be examined and clarified. Section A of Part IV provides an overview of experiences to date, both in the United States and abroad, with the use of tradable emission permits. Section B expands upon these experiences to highlight some of the key issues involved in establishing a tradable emission permit scheme.

A. *Experience to Date in the Use of Tradable Emission Permits*

Experiences in the United States suggest that a tradable emission permit system can be an effective means of achieving environmental change.[204] Several issues need to be addressed, however, to ensure a successful implementation. These include the determination of baseline and emission reduction levels which define the emission units available, because where there is uncertainty there is less incentive for emitters to participate in the system. In addition, the transaction costs associated with trading should be carefully assessed, as well as the extent to which trading is restricted as a result of these costs. Such restrictions may have a significant impact on the success of the system, as they may hinder the competitiveness of the market.

The United States has used tradable emission permit systems to minimize levels of air pollution.[205] It is also evaluating the use of a tradable emission permit system to meet obligations under the FCCC to reduce carbon dioxide emissions. The United States already has an emissions trading system in place to meet obligations under the Montreal Protocol, with respect to CFC produc-

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203. *See id.*
204. *See id.* at xvii-xviii.
205. *See id.* at 53.

tion and consumption.[206]

The most successful examples of trading appear to have been under the Lead Trading Program for concentrations of lead in gasoline.[207] This program was instituted in 1985 and terminated in 1987.[208] Estimates suggest a savings of around $228 million occurred through the utilization of the Lead Trading Program.[209] The success of this program reflects the unrestricted competition which was present and the large percentage of participation by the refineries in the United States. A less successful example of utilizing tradable permits is the Fox River tradable discharge permit scheme.[210] Because it was hindered by a small number of participants and a narrowly defined market area, only one trade occurred in six years of operation and the projected cost savings were never realized.[211]

For a number of years, the United States Environmental Protection Agency (EPA) has operated a system of emission trading in sulfur dioxide, carbon dioxide, nitrous oxide, ozone and lead.[212] The system is a combination of marketable permits and direct control measures. Some disagreement exists, however, concerning the success of these programs, but the number of trades that took place was lower than expected.[213] Such results may have been due to restrictions imposed on trading, as well as the uncertainty over the value of the rights issued to participants.

The CFC and halon tradable permit system was implemented to meet the requirements under the Montreal Protocol.[214] In 1990, in order to combat acid rain, trading in sulfur and nitrous oxide emissions was commenced as part of a program under the Clean Air Act.[215] Initial estimates suggest that the introduction of trading in sulfur dioxide emission permits has led to a thirty per-

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206. *See* HEGGELUND, *supra* note 6, at 58-59.
207. *See id.* at 52.
208. *See* Hourcade & Baron, *supra* note 182, at 21.
209. *See* HEGGELUND, *supra* note 6, at 52.
210. *See id.* at 51-52.
211. *See id.* at 52.
212. *See* KLAASSEN, *supra* note 58, at 131.
213. *See id.* at 134.
214. *See id.* at 141.
215. *See id.* at 145.

cent drop in the level of sulfur dioxide emissions since trading was imlemented in 1995.[216] Estimates on the value of the world-wide market in carbon dioxide emission permits range from $10 to $20 billion.[217]

Many of the European nations have also been experimenting with the use of tradable permits to promote environmental goals. Denmark, Germany and the Netherlands have all introduced forms of permit/quota schemes, but these systems have not been full trading schemes.[218] The Second Sulfur Protocol may provide an opportunity to introduce such a scheme, however, and Europe will probably look to the American experience for guidance in this field.[219]

B. *The Key Issues*

1. Establishing Target Emissions

The lack of agreement on target emission reductions clearly presents a significant obstacle to implementing any form of emission permit trading. Ideally, targets and timetables for future targets should be specified at the optimal level, given current information on the foreseeable consequences and costs of particular levels of greenhouse gas emissions.[220] It is highly unlikely, given the current uncertainties, that an optimal level of greenhouse gas emissions can be agreed upon in both developed and developing nations in the near future, despite the advances made in Kyoto. The initial targets are important for any tradable emission permit scheme because they will be used as the benchmark for the initial allocation of permits and any subsequent reissues that may be made. The difficulty with implementing a reduction of emission levels over time is that the projected goals must be specific enough to enable a reallocation or a reduction in the number of permits available. Such goals must, however, be balanced against the economic benefits of having a trading sys-

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216. *See* Fialka, *supra* note 164.

217. *See id.*

218. *See* KLAASSEN, *supra* note 58, at 157-66.

219. For a discussion of the Second Sulfur Protocol, see *id.* at 274-76.

220. *See* HEGGELUND, *supra* note 6, at 20-22.

tem which involves property rights of value that may be traded. Experience in the United States suggests that if permits are subject to uncertainty in terms of future reductions/reallocations, and hence changes in value, trade is unlikely to occur.[221]

Any proposal for the implementation of a tradable emission permit scheme is contingent on the ability of the global community to reach an agreement on baseline and target emission levels. Given the range of sources of greenhouse gas emissions, the impact of emission reductions will be affected by a number of economic sectors. If uncertainty exists or inappropriate levels are set, the economic and social benefits of trading will not ultimately be achieved. The absence of any previous regime to regulate greenhouse gas emissions means there is no baseline from which international trading may operate. Not only must the international community reach agreement concerning emission levels, but, in addition, those levels must be monitored effectively to ensure that compliance can be enforced.

2. Allocation of Permits

The allocation of emission permits is undoubtedly one of the most contentious issues because the initial allocation will constitute a transfer or distribution of wealth with significant consequences in terms of possible gains from trade, as well as market concentration implications. Allocation could occur in a number of ways. For example, some schemes would require a fee or price, while others would be initially distributed free of charge. A free distribution may be based on a per capita, historical production, GDP or current emission levels. Allocation based on historical production levels for emissions will favor developed nations, particularly the United States. Allocation based on GDP is also biased against developing countries while population levels would favor some countries such as China and India over smaller countries which may nevertheless be reliant on greenhouse gas emitting technology. Favoring those countries with high population growth does not sit easily with current notions of sustainable development.[222]

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221. *See id.* at xvii.

222. *See* CLINE, *supra* note 180, at 353.

Allocation by auction to the highest bidder necessarily allows those firms or governments who can pay the most to successfully bid for permits. Even an allocation at a specified price may hamper the possibility of efficient trading, because there is no mechanism to prevent purchasing to be made which renders an initial allocation incompatible with future emission requirements.

Many of these proposed allocative mechanisms would be unacceptable both to the developed and developing nations. The difficulty therefore lies in making an equitable allocation that will also provide a sound basis for economic trading to occur. Countries which are large emitters of greenhouse gases must be given the opportunity to minimize their costs and shift to cleaner technologies, and developing nations must be able to tradeoff industrialization with the benefits of reduced emission levels, and hence must not be denied the opportunity to benefit from trade in emission permits.

3. Parameters of Trading

Experience in the United States suggests that it is important for trade to be as competitive and free as possible.[223] The imposition of strict requirements on when trade may occur will defeat the purpose of having an emission permit system, which is to enable market forces to produce the optimal and efficient result. One of the criticisms of regulatory approaches is that they lock industries into a current emission regime when further reductions would be possible, provided there was sufficient economic incentive.[224] To place undue restrictions on trade would similarly lock industries into a current technological mindset, without giving the incentive to reduce costs and shift to alternative technologies guided by the profit- maximizing objective.

4. Intranational and International Trading of Permits

Instituting a tradable emission scheme can occur at two levels within the international context: at a national level, to meet international obligations, and at an international level, to meet in-

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223. *See supra* Part IV.A.

224. *Cf.* HEGGELUND, *supra* note 6, at 71.

ternational targets. The level at which the trading system is to operate must, therefore, be addressed. Governments are clearly the relevant parties to international agreements, and would therefore take primary responsibility for establishing and successfully implementing a permit trade system. The difficulties with developing an appropriate institutional framework for international trading cannot be underestimated. While some countries, such as the United States, are well-equipped to undertake national trading to meet international emission requirements, many less developed nations do not have the legal, political or financial structure available to make trading feasible at a national level. As outlined below, proposed international trading depends upon the ability of the international community to agree upon a supranational body to oversee trading and to monitor enforcement. How this would interact with domestic laws and enable free trade between firms operating under very different legal regimes remains to be seen. National governments may also have the necessary flexibility to be sensitive to local conditions affecting trade.

V. DEVELOPING A TRADABLE EMISSION SCHEME UNDER THE FRAMEWORK CONVENTION FOR CLIMATE CHANGE

Instituting an emission permit scheme within the current international environment is undoubtedly a difficult task. The United States and other significant emitters of greenhouse gases seem reluctant to provide the global leadership that is required to implement the required large-scale emission reductions.[225] There is also such a degree of uncertainty over the effects of global warming and the administrative practicability of utilizing economic instruments in the international sphere that it is hard to determine a feasible course of international action. The benefits, however, of utilizing an emission permit scheme suggest that it is an appropriate mechanism for introducing cost-effective emission controls.[226] Section A of Part V specifically addresses the recommendations made by UNCTAD concerning possible implementation of a tradable emission permit scheme built upon the joint imple-

225. *See* discussion *supra* Introduction.
226. *See* discussion *supra* Part III.

mentation provisions contained within the Framework Convention of Climate Change. Section B examines the possible use of these joint implementation provisions as a springboard for an international tradable emission permit scheme focused on reducing greenhouse gas emissions.

A. *UNCTAD Recommendations*

The UNCTAD has devised a three-stage process for the possible implementation of a tradable program in CO_2 entitlements.[227] This builds upon the FCCC joint implementation provisions[228] and possibly offers a working model worth considering. The first stage is the joint implementation stage to meet the emission reductions that parties have already committed to (at least in theory) in the FCCC and the Kyoto Protocol.[229] UNCTAD recommends that nations be allowed to satisfy their emission reduction requirements by a combination of domestic emission reductions and international offsets against other countries that emit greenhouse gases, to ensure that global emission targets are met.[230]

The second stage in the process would introduce further reductions in emissions over time, with each state receiving a number of certified entitlements equivalent to their 1990 emission levels.[231] Trading between emission sources can then take place. In the third stage, the Culmination Stage, entitlement trading would be expanded in three ways.[232] More countries would opt in, and therefore, both the number of participants and the number of trades would increased.[233] Furthermore, the coverage of greenhouse gas sources would expand to include not only CO_2, but all greenhouse gases.[234] The UNCTAD report highlights some of the key challenges involved in introducing such a three-phase system: (1) leadership is

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227. *See* UNCTAD, COMBATING GLOBAL WARMING, *supra* note 140, at 9-60.

228. *See id.* at 3.

229. *See id.* at 9.

230. *See id.*

231. *See id.* at 10.

232. *See id.* at 11.

233. *See id.*

234. *See id.*

needed at all stages from the principal emitting nations,[235] and (2) strategies must be developed to resolve the tensions between market efficiency and environmental protection.[236] The report cites the need to adequately monitor[237] and enforce emission reductions,[238] and to have sufficient infrastructure to encourage trading activity.[239] The committee recommends that obligations to meet emission reductions should be placed upon national governments, rather than firms.[240] This would overcome many of the difficulties within international law in regulating the actions of firms and individuals. Hence, the primary responsibility for fulfilling international obligations would rest with the participating nations. UNCTAD also recommends that the bulk of the administration and monitoring occur at a national level, as the information is more readily available.[241] The report concludes that a fully operational international trading program that relies not on participating nations' policies but on pure competitive trade between emission sources is probably not feasible at this time.[242] As this Article has indicated, competitive trade is the optimal solution and perhaps one that should not be so easily discounted, although the difficulties in instituting such a scheme are readily apparent.

B. *Joint Implementation as a Springboard for a Tradable Emission Scheme*

As indicated by the UNCTAD recommendations, joint implementation may provide the ideal opportunity to examine and develop the market architecture necessary for a tradable emission permit scheme.[243] While this is by no means an easy feat, the precedent set by the Montreal Protocol offers hope that a system

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235. liSee id. at 53.

236. *See id.* at 54.

237. *See id.* at 6-7, 21-35.

238. *See id.* at 7, 21-49.

239. *See id.* at 63-101.

240. *See id.* at 44-46.

241. *See id.* at 14-15 (discussing administrative certification), 32-34 (discussing monitoring).

242. *See id.* at 51-52.

243. *See generally* UNCTAD, COMBATING GLOBAL WARMING, *supra* note 140.

could eventually be designed to facilitate the trade in "environmental commodities."[244] Joint implementation is, however, only in its formative stages, and there remain a number of issues and concerns that have yet to be reconciled. Joint implementation allows countries with high costs of pollution abatement to invest in abatement measures in a country which has lower costs and to receive credit for the resulting emission reductions[245] or other environmental benefit. Both the Montreal Protocol and the FCCC have set precedents in terms of the application of joint implementation and provide a potential foundation for global partnerships (ideally both between governments and firms) to achieve environmental change and sustainable development.[246] Whether significant cost savings can occur through joint implementation depends on the marginal costs of abatement for the participants involved. There are concerns, however, that these costs may not be sufficiently known and that transaction costs associated with joint implementation projects will be high.

The lack of experience with joint implementation makes it difficult to assess its national and global economic and environmental impacts or whether it can be the formative stage for a tradable emission program. It is commonly perceived that joint implementation will involve the developed world trading off their own obligations against subsidizing projects in the developing world.[247] Greenpeace, for example, criticizes joint implementation as merely an attempt by developed countries to obtain emission credits as a means of evading their own obligations.[248] As a result, Greenpeace recommends that joint implementation be allowed but that no credits be issued to the donor country.[249] Just as allocation of permits is the crux of the problem in imple-

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244. *See generally* ONNO KUIK ET AL., JOINT IMPLEMENTATION TO CURB CLIMATE CHANGE: LEGAL AND ECONOMIC ASPECTS 8 (1994).

245. David Pearce, *Joint Implementation: A General Overview, in* THE FEASIBILITY OF JOINT IMPLEMENTATION 27 (Catrinus J. Jepma ed., 1995).

246. *See id.*

247. *See* Bill Hare & Arjetle Stevens, *Joint Implementation: A Critical Approach, in* THE FEASIBILITY OF JOINT IMPLEMENTATION, *supra* note 245, at 81.

248. *See id.*

249. *See id.*

menting a tradable emission permit scheme, obtaining or receiving credit is the crux of the problem with joint implementation.[250]

The issue of banking emission credits against future polluting activity also remains controversial. It is unlikely that nations will participate if no benefits are accorded to them, and joint implementation offers an ideal opportunity for projects to be conducted in countries which could not otherwise afford to conduct them. Many host nations may, however, be reluctant to relinquish their sovereignty over resources, and joint implementation may become part of a greater concern over inequities in trade and the regulation of foreign investment.

Despite the concerns that have been raised, joint implementation projects have already been commenced. The first agreement was reached between Norway, Poland and Mexico through the Global Environment Facility.[251] Norway has agreed to utilize the revenues generated from its carbon tax to provide financing for carbon-reducing projects in Mexico and Poland.[252]

CONCLUSION

Joint implementation potentially provides an opportunity to develop the market infrastructure necessary for an international market in tradable emission permits, and possibly other environmental commodities. While it is beyond the scope of this article to examine joint implementation in any detail, it is important to note that this sets the precedent for national, and potentially private, involvement in reducing global greenhouse gas emissions. It may be a foundation for discussions on the difficult issue of allocation of permits and parameters of trade for a future emission scheme. Based on past experience, any tradable emission scheme, whether in emission credits or emission permits, needs to be as competitive as possible, to enable the optimal situation to be achieved. Of course, this must be balanced against the environmental imperatives of the time. The principal difficulty will be convincing the international community that market forces,

250. *See* KUIK ET AL., *supra* note 244, at 40-45.
251. *See* Pearce, *supra* note 245, at 20.
252. *See id.*

rather than regulation, should prevail. Obviously, regulation is required on some key issues, such as establishing baseline and emission reduction targets, because the market cannot operate without the key environmental parameters being established. These are difficult but not insurmountable hurdles. The Kyoto Protocol opens up the possibility that a viable international trading scheme could be implemented. The most difficult hurdle to overcome will be the political lethargy, in both the developed and developing worlds, to adopt global measures to combat climate change.