PART ONE

RESHAPING ATTITUDES

The Need to Rethink the Basis for Global Environmental Action

How we think about international environmental issues and the international political system may be as important as what we think about them. Some of the greatest barriers to achieving international environmental agreements are the mind-sets and cultural divides between nations.

It is striking how often negotiators talk past one another because each is arguing from a different set of principles. For example, in the climate negotiations, the United States bases its position on economic efficiency, and the consequences for existing economic interests. Oil exporting countries do not care so much about economic efficiency, but share the American concern of protecting their present industrial base despite its destructive consequences. The U.S. position is not dissimilar to that of many developing countries that argue that protecting the climate must come secondarily to their economic development. Their disagreement is, however, most often cloaked in the banner of equity. The equity principle is often invoked to argue that developing countries deserve to receive special consideration because of their low per capita incomes that can only be bolstered through a process that unfortunately may require further damage to the commons. Some in the South argue further that they deserve reparations from the North for damage already inflicted on the commons. The North in general is unwilling to admit the destructiveness of its pattern of consumption, and still believes that a few technological fixes will suffice to bring the economic and ecological systems into alignment. The third side of the negotiation is informed by the sustainability principle often advocated by some European nations. As is demonstrated here for climate change, strict adherence to any one of these single principles results in wildly different obligations for each country.

The several strategies outlined in this section offer alternatives for reconciling these three different sets of principles. Reconsidering what we mean by *the commons* and the *common heritage of mankind* could recast environmental negotiations along a new set of common principles. It may be more effective to give regional groups of nations primary control over specific aspects of the commons, but their efforts must be linked through larger global agreements. Or perhaps in the case of a true global commons such as the climate system, the responsibility might be taken on primarily by those most responsible for threatening it, with other nations playing more of a watchdog role, with a differentiated set of mitigation obligations.

It is clear that the benefits derived from protecting the commons are not always seen as sufficient to motivate countries to act, in part because of the high level of distrust that exists among them. History weighs heavily on the present. The accumulated anger of the South towards the North for colonialism spills over like an ideological force of nature. It is argued here that such a reaction is counterproductive to the substantive goals of many developing countries. The same might be said of American insistence that efficient markets be the solution to every problem, even when they are not applicable. The fact is that there is some merit to each of the principles that are implicitly used by differing factions, and elements of each must be incorporated into agreements in order for them to be effective. It is essential that all parties see solutions as fair and equitable, both within the present generation, and for future ones.

No political leader can be successful if he or she does not provide for the future of their people. In other words, the sustainability mantra of meeting the needs of the present generation without compromising the ability of future generations to meet theirs is not only ethically important, it is politically essential. Finally, since economic resources are limited it is also essential that they be utilized efficiently in restructuring the production system to reduce adverse environmental consequences.

To accomplish these transformations of attitudes will require an explicit recognition that differences in values exist, and that a concerted effort must be made to understand differing perspectives and value systems. Implicit assumptions must be illuminated and not hidden under outdated rhetoric. Both the North and the South need to change their attitude from one of blaming each other to utilizing principles of mutual gains to protect their own interests along with the commons and their common heritage. Perhaps, as suggested here, it will be essential to take a head-on approach in which these differences are discussed openly in a forum designed to get attitudes as well as interests onto the negotiating table.

CHAPTER ONE

DEFINING THE "COMMON HERITAGE OF MANKIND"

Ari Nathan

In 1967 Arvid Pardo, Malta's United Nations Ambassador, made his visionary proposal that the seabed and ocean floor be declared a common heritage of mankind. Since that time, the term Common Heritage of Mankind (CHM) has become increasingly popular within the environmental lexicon. It has been described as "the broadest and most sustained attempt ever to reform and codify a set of global environmental norms" (Vogler, 1996, p. 16, referring to UNCLOS III). Another author has suggested that "the common-heritage-of-mankind principle, [is] now widely recognized as an appropriate regulatory mechanism for the protection of global 'life-support systems' such as the ozone layer and the climate system" (Imber, 1996, p. 139). Yet despite this there has been a lack of clear agreement about how CHM should be defined.[1]

Perhaps the broadest way of thinking about CHM is that it is "the natural resources and vital life-support services that belong to all mankind rather than to any one country" (Porter and Brown, 1996, p. 13). That such resources could in some way be considered jointly owned by all humanity is not a brand new idea. The English philosopher John Stuart Mill suggested that "the Earth itself, its forests and water above and below the surface. These are the inheritance of the human race" (quoted in Cairncross, 1992, p. 6).

However, although this issue was raised by Mill almost 150 years ago, the specific legal rights associated with this inheritance have not as yet been clearly defined. This definitional lag has been explained by Siebert (1995, p. 103):

> The definition of property rights has been a historical process. If we look at human development since Adam and Eve left paradise, the increasing scarcity of resources required the definition of property rights. When land was in ample supply, property titles for land were not necessary. When people competed for the scarce good land, property titles became relevant. Similarly, water once was a free good, but today property titles for water are well accepted.

That property rights associated with CHM might evolve was recognized by Mill, who suggested that "air, for example, though the most absolute of necessaries, bears no price in the market because it can be obtained gratuitously . . . It is possible to imagine circumstances in which air would be a part of wealth. If from any revolution in nature the atmosphere became too scanty for the consumption, air might acquire a very high marketable value" (quoted in Hite and others, 1972, p. 15).

Why Is It Necessary to Define CHM?

There is growing evidence that CHM is an evolving concept. Concepts which are based on normative principles, or soft laws, are often the foundation for specific multilateral agreements and/or laws because international law is "developed . . . by reference to general principles" (Birnie quoted in Susskind, 1994, p. 30). They can also "be hardened by later international practice. [And]soft-law instruments have also served as forerunners of subsequent treaty law . . . or as a mandate for new mechanisms of intergovernmental cooperation" (Sand, 1991, p. 253). Even more specifically, "Soft law may be turned into binding international law in two ways: Principles included in soft-law agreement may become so widely regarded as the appropriate norms for a problem that they are ultimately absorbed into treaty law; or political pressures may arise from those dissatisfied with spotty adherence to soft-law norms to turn a nonbinding agreement into a binding one" (Porter and Brown, 1996, p. 45).

Normative principles provide an underlying foundation that can be agreed to and to which the parties can refer to resolve (otherwise) contentious issues. They are particularly helpful in the development of environmental agreements because environmental treaties often involve disagreeable sacrifices that no party wishes to make, and simply compromising on the degree of the sacrifice each party makes is often not an effective protective mechanism for the environment. But, with a normative principle to serve as the basis to resolve disagreements in the formation of the agreement, compromises are likely to be more compatible with the general environmental goals of the agreement.

For CHM to effectively move from a concept based on soft law to actual hard law requires that it be clearly defined. Hard laws need to be enforceable, which means they must be specific enough to be understood. It has, for example, been pointed out by Susskind (1992) that the Basel Convention on the Transboundary Shipment of Hazardous Waste avoids the politically difficult task of defining key terms. While this lack of specificity made it possible for reluctant countries to sign, it also undermines the chances of successful implementation. For instance, the agreement calls for the disposal of hazardous waste in an "environmentally sound manner." It does not, however, say what this means (Susskind, 1992a, p. 67). Additionally, before a concept such as CHM could explicitly become the basis for multilateral agreements, those states potentially adversely impacted by the agreement may require that it be clearly defined.

Multilateral agreements to protect the environment (and hence normative principles on which such agreements can be based) are needed because "global environmental systems cannot either be annexed by states or be left *res nullis* (without the protection of the law), for they would then be liable to destruction by unregulated exploitation—Hardin's 'tragedy of the commons' " (Imber, 1996, p. 139). The globalization of the tragedy of the commons is a function of "national efforts to maintain not only control over all decisions within their geopolitical borders but autonomy over actions that affect common areas and resources as well" (Susskind, 1994, p. 21). Without clear and objective international standards, the environment will continue to be abused because individuals and nations are also less likely to acknowledge the harm of their own actions. This means that the need for "locating those political values that can ascribe meaning to global political life, and can provide grounds for selecting practical solutions to insoluble philosophical problems" (Dryer, 1996, p. 36) is particularly acute.[2]

Different Definitions of CHM

A review of the relevant literature reveals three distinct definitions of CHM, each based on a different normative principle. Which principle one uses to define CHM may be a function of the perception one has of the overriding need(s) which could be met if CHM becomes an accepted concept in global environmental regimes. But how one defines CHM will create quite different results when trying to quantitatively outline relative obligations under a potential agreement.

The first normative principle used to define CHM builds on the notion that there should be a fair and egalitarian distribution of common resources (FAIR). In other words, all people should benefit from resources that are not exclusively owned by any single nation. In accordance with FAIR, "developing-country officials as well as NGOs began to demand in the early 1990s that industrialized countries reduce their share of what they call 'environmental space'—the use of the earth's limited natural resources and environmental services—and permit developing countries to use more of that environmental space in order to raise their living standards" (Porter and Brown, 1991, p. 112).

However, developing countries are not necessarily proponents of FAIR. It was fear of FAIR that led Malaysia and India to object to the application of principles of global responsibility for forest management because they saw this as an attempt "to establish the legal principle that forests are 'global commons' or part of the 'common heritage of mankind,' thus giving industrialized countries some right to interfere in the management of the tropical forest countries' resources" (Porter and Brown, 1991, p. 126). FAIR may also be seen as a primary motivating factor in the Second World Climate Conference's declaration that "in order to stabilize atmospheric conditions of greenhouse gases while allowing for growth in emissions from developing countries, industrialized countries must implement reductions even greater than those required, on average, for the globe as a whole" (Paterson, 1991, p. 66).[3]

The second normative principle on which the definition of CHM could be based is the idea of stewardship or intergenerational sustainability (SUSTAIN). SUSTAIN is an explicit component of Edith Brown Weiss's "Declaration of Planetary Rights and Obligations to Future Generations" which lays out principles of intergenerational equity. SUSTAIN also underlies the "Bill of Rights for Future Generations" which Jacques Cousteau proposed and which has been signed by millions of people. It stands for the idea that future generations have a right to an *uncontaminated* and undamaged Earth and that present generations are responsible for protecting that right. The proposed "Declaration of the Right to Nature Conservation, Environmental Protection and Sustainable Development," which was produced by the Bruntland Commission, relies on SUSTAIN in its call for nations to "conserve and use the environment and natural resources for the benefit of present and future generations . . . prevent or abate any transboundary environmental interference which could cause or causes significant harm . . . provide compensation for the harm caused" (Susskind, 1994, pp. 176–179). Together these documents lay out "principles of intergenerational equity" (Susskind, 1994, p. 108) with the underlying view being that each future generation is entitled to receive an undamaged earth and that therefore each present generation has an obligation to prevent harm to it.

The third normative principle that can define CHM hinges on the idea that harm to the planet should be avoided or reduced by the most economical, efficient, and functional (ECON) means possible.[4] This is the view that locates the problem of sustainability within the context of a global economy of mutually interdependent actors. They regard nature as a commodity that can be subject to property rights, and believe that market mechanisms create the most efficient use of resources. Sustainable development policies can be pursued through the creation of economic incentives to retard, stop, or reverse the process of environmental degradation (Williams, 1996, p. 53).

A rationale behind ECON is that "clear rights of ownership for natural resources may sometimes improve the way they are managed. If ownership of environmental assets is clearly established, then polluters and the polluted will be able to bargain over a reasonable price for allowing pollution to take place" (Cairncross, 1992, p. 10).[5] The application of economics to environmentalism "seems odd to many environmentalists. The very idea that values can be attached to natural beauty is an affront to those who think that it is beyond price" (Cairncross, 1992, p. 7). How much odder then to go a step further and consider economic analysis as an actual normative principle. However, one of the fundamental principles underlying neoclassical economics[6] is that it provides the mechanism for the maximization of happiness (for contemporary humans at least). While one may not feel that the maximization of happiness (or utility) is the best of all normative principles, it is hard to deny[7] that it is reasonable to consider it as a potential normative principle. A cost-benefit analysis is the primary method used to determine how ECON best maximizes utility.

To summarize, FAIR, SUSTAIN, and ECON appear to represent three possible, and very different, ways in which CHM can be defined. While one might argue that CHM should encompass all three definitions, analyzing each separately produces very different results, which suggests the difficulty in amalgamating them. To illustrate how this is so it is useful to examine the application of each definition to a specific environmental issue; in this chapter, the introduction of greenhouse gases (GHG)[8] into the atmosphere.

A Bunch of Hot (and Dirty) Air

The fact that there is *some* relationship between GHG and climate change is relatively straightforward and agreed upon. During the day the sun transfers to the earth heat energy that is radiated back into space as infrared energy. Some of this infrared energy radiation is absorbed by GHG in the atmosphere. Naturally (that is, non-technologically) produced CO_2 and water vapor were the two primary GHG prior to the beginning of the industrial revolution.

Since 1800 the increases in GHG have included the doubling of methane, the introduction of synthetic CFCs (which are also infamous as ozone depletors), and an increase in atmospheric CO_2 of over 25 percent (Baarschers, 1996, p. 127). Although much of this discussion focuses on emissions, it is the total quantity of GHG in the atmosphere that creates the greenhouse effect. Of the different GHG, CO_2 is the most important one because it has by far the largest effect on climate change given its quantity, infrared absorption capacity, and life span. Since 1960 alone global concentration of CO_2 has increased from 316 parts per million (ppm) to 350 ppm.[9] Approximately 80 percent of the CO_2 increase is from the use of fossil fuels (particularly car exhaust and electric power production) with the remaining increase coming primarily from the burning of tropical rain forests and the production of cement (Rathjens, 1991, p. 157).

Although there is consensus within the scientific community that global warming is occurring and that it is linked to increased atmospheric concentrations of GHG, "it is very difficult to calculate the potential enhancement of the greenhouse effect by atmospheric pollution . . . the magnitude of the effect is still unknown" (Baarschars, 1996, p. 127). However, it is speculated that "this warming could shift storm track patterns and significantly diminish soil moisture levels in major grain-producing areas, such as China, the United States, and the (former) Soviet Union. Thermal expansion of the oceans and some melting of sea ice could raise the average sea level, flooding most of low-lying Bangladesh. Worse, nonlinear or unexpected changes in the climate system might occur" (Chandler, 1990, p. 1). Moreover, "whole ecological systems could be destroyed or transformed, especially with the destruction of wetlands, estuaries, and barrier islands. The possibility of dramatic changes in ocean currents . . . could have catastrophic effects on fisheries and local climates" (Rathjens, 1991, p. 167).

It is helpful to think of air pollution as a resource use, since air is a resource which pollution adversely affects. Such a perspective "interprets nature and the environment as a scarce resource . . . Consequently, environmental disruption and environmental use are by nature allocation problems" (Siebert, 1995, p. xiii). In this view, consideration of air pollution becomes an issue "of competing uses and is, therefore, a question of scarcity. Thus using the environment presents itself as an allocation problem" (Siebert, 1995, p. 18). This problem is assisted by the use of cost/benefit analysis, but such analysis is not easy,[10] as "the problem of measuring the demand for nonmarket goods, such as environmental amenities, is doubly difficult. In the case of marketable goods the economists can observe the quantities purchased at given prices and apply statistical techniques to get some estimate of demand. But since there are no explicit markets for clean air, clean water and many other types of environmental amenities, there are no prices of quantities to observe" (Hite, 1972, p. 40).

In addition to the problems associated with costing global warming, there are two "major and fundamental problems in trying to 'do something' about the GHG problem . . . the uncertainty as to the magnitude and seriousness of climate change . . . and the time scales of concern" (Rathjens, 1991, p. 171). The time problem associated with analyzing the impact of GHG has two components.

First, the time scale for effects of GHG is large (relative to the type of cause-effect relationships which usually result in policy decisions in human affairs). The global system of oceans acts as a heat sink that by itself can delay climate response by "a decade or two. More important is the fact that the effects of GHG buildup will be cumulative over a time scale measured in centuries. This follows because . . . with the exception of methane and ozone, the other important greenhouse gases have lives in the range of 50–175 years" (Rathjens, 1991, pp. 177–178).

The second time-scale problem is the moral and economic issue of how to properly discount. Essentially time discounting is the application of a number per time-unit through which the value of money in the future is converted to the value of money in the present. When one is dealing in the scale of centuries (as one is forced to do when analyzing the impact of global warming) the discount rate used can lead to vast differences in the value assigned to harms and benefits. In fact, a primary difference in the analysis of two of the leading scholars on the issue of the harms and benefits associated with GHG (Nordhaus and Cline) is a function of the different discount rates they use.[11]

Different Definitions, Different Results

If one construes CHM to refer literally to an inheritance, three primary variable factors can be applied to each definition. To put it in other words, there are three questions which one would ask about any inheritance. First is the question of entitlement: Who, or what, is the entity that is the beneficiary of the inheritance? The second question is the nature of the inheritance: What is being inherited? In reference to air pollution emission controls this would be translated into the amounts of emissions one considers as being the inheritance. Finally, there is the question of the value of the inheritance—what is the inheritance worth?[12] Each of the three different definitions of CHM will lead to different answers to these questions.[13] Although this chapter addresses all of these questions for each of the definitions it needs to be clear that the actual numbers used are estimates. However, the point is not the specific numbers generated but the general relationship between the different results. Almost all of the data considered here is for 1992 with the exceptions of the population rankings and the data used in the generation of the Nordhaus Optimum percentage reduction.

Who Inherits?

With regard to the issue of entitlement there are three reasonable possibilities. Perhaps the most obvious "possible basis for allocating quotas is simply population.

Here, the notion is the ultimate equality-oriented rule: one person, one emissions vote. This basis has the merit of equity" (Cline, 1992, p. 353). From this perspective, all mankind would be treated equally with regard to entitlement to the CHM. This perspective would be consistent with FAIR.

One could also assume that each nation receives one equal share. This position is based on the neo-realist analysis that "the world is composed primarily of sovereign states, which can be treated as unitary actors" (Paterson, 1996, p. 62). In fact, it is nations, not individuals, NGOs, or other actors, who enter into treaties. Such a perspective would be compatible with the SUSTAIN definition of CHM because nations are the organizations with the best capacity for representing their future citizens[14] and it is nations which make treaties and vote in the United Nations General Assembly (on the basis of one nation, one vote).

Next, one could blend population and nationhood.[15] For example, if each nation was ranked according to its population then China (with 1,165,800,000 people in 1992) would receive 167 shares (the approximate number of nations in 1992) and Iceland (with 300,000 people in 1992) would receive ten shares. Note that if only population were used then China's share would be approximately 3,900 times greater than Iceland's share and if only nationhood were used then they would have the same share. Taking into consideration both population and statehood might be an appropriate and acceptable compromise. This would be consistent with the ECON definition of CHM because its potential acceptability makes it more functional by recognizing the mutual interdependence of states.

What Is Inherited?

The second question to answer is what specifically is the inheritance. To rephrase it, which range of emissions do we consider to be subject to the inheritance? This is vitally important as "different schemes for defining the trading baseline have different consequences" (Tietenberg, 1991, p. 212). One might consider three levels—each of which relates most directly to one of the three possible definitions of CHM.

If CHM is based on the FAIR perspective then all emissions over zero should be considered to be subject to the inheritance because it should be equitably and fully distributed regardless of the amount of GHG emitted.

However, if one is defining CHM in accordance with the SUSTAIN view then one is only concerned with emissions above the level that the ecosystem can naturally process. All emissions up to this level (that is, all emissions of CO_2 that trees and plants convert through photosynthesis) would not be considered as a part of the CHM because under SUSTAIN it is acceptable for any party to emit up to such a level. It is estimated that 1.67 billion tons (bt) of carbon are annually processed by terrestrial ecosystems (although there is some partitioning of such processing and the figure will change as emissions levels change). Therefore, any emission above 1.67 bt per year would become part of the CHM inheritance to be shared if SUSTAIN is used.

If one ascribes to an ECON definition of CHM then the level of emissions subject to the inheritance can be determined by what one could refer to as the "Nordhaus Optimum" (Nordhaus, 1994). This is essentially the amount of carbon emissions that is economically efficient to produce because it is the point where the social marginal benefit of reducing pollution equals the social marginal cost of reducing it. This Optimum is an attempt to balance the costs of emissions controls against the benefits of emissions controls (discounted over time of course). The general idea is that it would not make economic sense to spend one trillion dollars on carbon emission reductions if the total discounted benefit[16] (which in this case would be the savings which would result from not having the costs associated with the climate change created by GHG) of doing so would only be one billion dollars. The United States is following this general reasoning in its current push for an international joint implementation technology transfer program whereby nations such as the United States in which it would cost (for example) $100 to reduce carbon output by one ton will offer assistance to nations such as China where it would (for example) cost only $10 to reduce carbon output by one ton.[17]

The Nordhaus Optimum includes CO_2 and CFCs for 1995 but one can still compare its projected value for 1995 and the projected uncontrolled emission for 1995 to generate a Nordhaus Optimum of 8.8 percent lower than uncontrolled discharge (Nordhaus, 1994, p. 88). Applying this to the global carbon figures for 1992 (6,098.7 million tons) produces a rough figure of 5,562 million tons. The difference between the global carbon discharge and the Nordhaus Optimum is 536.7 million tons, the amount of carbon to which an ECON perspective will apply free market principles in order to ensure that this excess carbon is paid for.

The Nordhaus Optimum is consistent with the ECON perspective of the CHM for a variety of reasons. It is based on an economic model and in fact the economic logic behind it seems consistent with the paradigm of economic efficiency currently dominant in much of the world. It generates a higher number than either FAIR (zero) or SUSTAIN (1.67 billion tons) which means that a smaller amount of pollution must be paid for. While this may seem like a cynically appeasement-oriented reason it is unlikely that nations using more than their share (however that is defined) of the CHM are going to accept financial responsibility for the large monetary obligations to which either the FAIR or SUSTAIN perspective would lead. Finally, with improvements in emissions reductions technology (to which the tradable discharge system discussed *infra* would contribute) the Nordhaus Optimum could also drop over time.

What Is It Worth?

The third question one would ask regarding any inheritance is value. In the case of atmospheric emissions this translates into the issue of what method is used to determine how much the "polluter should pay." In keeping with the analytic framework established here, there are three possible ways of determining the value of the right to pollute, each of which is consistent with one of the different definitions of CHM.

If one believes that the purpose of CHM is to help ensure that there is a fair and egalitarian distribution of common benefits (that is, FAIR) then the focus would be on the benefits of polluting. In other words, one would look only to the economic advantage that polluters receive by virtue of their polluting (ignoring the potential damage atmospheric pollution could create) and seek to distribute that advantage in accordance with FAIR distribution principles. In determining what the benefits of being able to pollute are, one can look to projected estimates of the costs to the economy if carbon emissions were reduced.[18] Such "estimates vary a lot . . . this is because of different research approaches, different assumptions, data, and the like. But it also reflects the inherent difficulty and uncertainty of doing studies that try to extrapolate well into the future" (Field, 1994, p. 437).

In reviewing a number of studies in this area one author estimated that "at the most summary level, then, a carbon reduction of x percent will require a reduction of GNP by 0.04x percent, caused by an energy reduction of 0.5x percent in combination with an output elasticity of energy of 0.08x" (Cline, 1992, p. 191). Since the FAIR perspective considers all emissions as part of the inheritance this would mean that *x* in the equation would be 100 and therefore the value of being able to emit carbon domestically is 4 percent of GNP. Making a leap from gross domestic product to gross world product (GWP) one reaches a figure of $21,850,000,000,000 for 1992 and the value of being able to emit carbon could therefore be estimated at $1,024,000,000,000.

The next perspective from which to define CHM is SUSTAIN. In determining the value of the inheritance, SUSTAIN suggests that one look to the harm caused[19] and apply what is known as the *polluter-pays* or *full-cost* rule. The polluter-pays rule is based on the idea that a party has a "property rights claim . . . equal to the damage caused" (Susskind, 1994, p. 89). The full-cost rule is a variation that states, "all users of environmental resources should pay their full cost. Those using the environment as a waste repository, for example, would be presumed responsible . . . for restoring environmental resources damaged beyond some *de minimus* amount and for compensating for damage caused . . . This principle is based on the presumption that humanity has a right to a reasonably safe and healthy environment. Since this right has been held in common for the stratosphere . . . it has been involuntarily surrendered on a first come, first served basis without compensation" (Tietenberg, 1991, p. 213).

There are two ways of applying the damage component of SUSTAIN to CHM—either pay for the damage caused or for the restoration of the environment. The difference between these two types of costs is illustrated by the example of strip mining on a piece of land originally worth, for instance, \$10,000 which is now only worth \$2,500 and which could be restored to its original condition for \$20,000. In this case the compensation could be construed as payment of \$7,500 to the owner of the land or as paying \$20,000 to restore the land to its original condition.[20] It would be compatible with SUSTAIN for the value of the inheritance to be the cost of processing GHG such that they have no greenhouse effect. Alternatively, the SUSTAIN analysis of CHM could focus on compensation for the damage created by GHG provided such damage is considered to include harm to the future in addition to that of the present.[21]

In discussions of the damage which a doubling of atmospheric CO_2 will produce Nordhaus suggests that it would be 1.33 percent of GWP per year (Nordhaus, 1994, p. 55) with Cline agreeing that it would be between 1 and 2 percent of GWP per year[22] (Cline, 1992, p. 132). It is also estimated that "even if all man-made emissions were to stop virtually immediately . . . the equilibrium amount of warming already committed amounts to about 1.7°C. Moreover, the IPCC estimates that even if an aggressive program of 'accelerated policies' were adopted by the year 2100 ultimate warming of a central value of 2.4°C seems almost inevitable" (Cline, 1992, p. 35). Making the, perhaps overly optimistic,[23] assumption that total atmospheric CO_2 will be held at double the current levels, we may, not unreasonably, assign a damage[24] inheritance factor valued under a SUSTAIN perspective (based on the amount of CO_2 each nation emits) at 1.33 percent of GWP.

Cline has also analyzed CO_2 emission abatement costs (Cline, 1992, p. 229). He concludes that reductions in CO_2 emissions of between 20 percent and 90 percent from the 1990 level would, by the year 2025, range from zero cost (because a 20 percent abatement could be achieved by increasing energy efficiency with current technologies which would create savings in costs of energy use) to 3.2 percent of GWP (Cline, 1992, p. 229). The reduction from the 1991 level of emissions of 6.19 bt to the 1.67 bt which can be naturally processed would be a reduction of over 100 percent from the current baseline of emissions. This reduction would require a consistent annual commitment of over 3 percent of GWP. Combining the damage factor and the abatement factor, one can produce a (very) rough damage/abatement factor of 2.2 percent of GWP.

Next, we can ask what is the economic, efficient, and functional method of determining the value of the inheritance. The ECON approach is to let the market make the determination through a transferable discharge permit system. Such a system creates a new type of property right which consists of a "permit to emit pollutants. Each permit entitles its holder to emit one unit (pound, ton, however the permit is calibrated) of the waste material specified in the right . . . These discharge permits are transferable; they can be bought and sold among anybody allowed to participate in the permit market, at whatever price is agreed upon by the participants themselves" (Field, 1994, p. 248).[25]

The United States has been using the transferable discharge permit system for a number of years. It was particularly successful "in 1985 when it gave oil refineries two years in which to cut the allowable lead content of gas. Refineries received quotas of lead, which they could trade with each other. The effect was to let them phase in the cut in lead at their own pace. Half of all the refineries took part in trading . . . The EPA's attempts since 1974 to allow companies to trade air-pollution permits have been less successful" (Cairncross, 1992, p. 102).

An international transferable discharge permit system is especially attractive. Such a system "[would promote] cost effectiveness . . . because those sources that can reduce their emissions most cheaply choose to do so, selling the resulting emission reduction credits to others . . . the mandated improvements are achieved more quickly with trading and with less litigation . . . [such a system would] facilitate a more cost effective allocation among nations, but it would leave the valuation of these transfers to what is now a global market place . . . [and] would facilitate the movement of credits from those countries with the capacity to create them most cheaply to those countries faced by very high costs of additional control" (Tietenberg, 1991, pp. 210–220).

As Cline (1992, p. 351) has described it, "if a country has a quota allocation that is small relative to its demand, its firms will bid to purchase quotas from other countries. Other countries will sell a portion of their quotas to the point where the marginal cost of cutting back a ton of carbon emissions at home equals the price of a ton 'exported' through the sale of an emissions permit. International abatement will thus be pursued at minimum cost, in a manner similar to the outcome under taxation and in contrast to the result with a rigid, non-tradable quota system . . . tradable permits *minimize* overall abatement cost by allocating the cutbacks to the countries where marginal costs of emissions reductions are the lowest."

This is why Cairncross (1992, p. 105) has noted that "America is eager to extend the idea of tradable permits into a completely new field: that of international environmental agreements. In particular, it wants an international trading system for greenhouse gases as part of a deal to tackle global warming."[26] As discussed above, the United States is advocating a joint implementation technology transfer program which would be based on similar goals but would not require as extensive a multilateral agreement as an international trading permits regime would.

Any transferable discharge permit system must have an upper allowable limit of emissions. Although one could simply set the limit at the Nordhaus Optimum and prohibit any emissions above this limit, this is unlikely to be agreed upon since it would require large reductions in emissions. However, whatever number is internationally agreed upon, perhaps in accordance with the Convention on Climate Change (and there is a possibility that this could be a "return to 'earlier' emission levels by 2000" (Susskind, 1994, p. 174)), it could serve as the upper limit for determining the acceptable levels of emissions. It would therefore be possible to have discharge permits distributed to nations in proportion to their actual carbon emissions[27] (their projected emissions multiplied by the percent ratio of the Nordhaus Optimum to total carbon discharges) up to the Optimum, and then have an additional set of discharge permits distributed in accordance with the "blend" system proposed above.

For the purpose of this analysis we can look to an Optimum of 91.2 percent of Nordhaus's projection of 1995 uncontrolled levels (Nordhaus, 1994, p. 88) and consider the 536.7 million tons (6,098.7 mt × .088) as being subject to the transferable discharge permit system. Because the value of discharge permits would be unknown until one actually instituted the system, one is forced to use the next best thing, the estimated amount of a carbon tax which would reduce carbon emissions by 20 percent; $40 per ton, for this analysis (Cline, 1992, p. 369).

We can now calculate the actual numbers to quantitatively compare the differences among using a FAIR, SUSTAIN, or ECON perspective to define CHM (see Table 1.1). Perhaps not surprisingly, quite different results are obtained with the different perspectives. For example, FAIR leads to China being owed over $135 billion; SUSTAIN results in China owing close to $91 billion; and ECON indicates that China would have to purchase over $2 billion worth of discharge permits to be able to continue to emit carbon at the same rate (although if it could make a 20 percent reduction in emissions it would have over $3 billion worth of discharge permits to sell). Under FAIR Indonesia receives $32 billion and under ECON it should earn over $70 billion but under SUSTAIN it is liable for only $5 billion. Under FAIR Mexico receives over $4 billion; under SUSTAIN it owes over $10 billion; and under ECON it owes $81 billion. Somalia, however, receives money under all three perspectives—almost $2 billion with FAIR, over $1 billion with SUSTAIN, and close to $125 million with ECON.[28] What these extreme differences suggest is that if CHM is to continue to evolve from a soft law into a hard law, making the leap from a general normative principle vaguely referred to in the preambles of environmental treaties to a methodology used to determine specific commitments, then we need to know what CHM means.

TABLE 1.1

1	2	3	4	5	6	7	8	9
Country	**Pop (mil)/% total**	**C emil/% total**	**Ent-FAIR**	**(ent-act)/ FAIR val(mil)**	**Ent-SUS**	**SUS val (mil)**	**Ent-ECON**	**ECON val(mil)**
China	1165.8/25.15	728.4/11.94	1533.8	805.4/$135,226.70	10	−$91,236.80	664.3 + 6.23	−$2308.40
United States	225.6/5.51	1332.6/21.85	336	−996.6/−$167,329.10	10	−$167,970.20	1215.3 + 6.23	−$4442.80
Indonesia	184.5/4.0	50.4/0.83	243.9	193.5/$32,488.70	10	−$5,130.80	46.0 + 6.17	$70.80
Brazil	150.8/3.25	59.3/0.97	198.2	138.9/$23,321.30	10	−$6,261.10	54.1 + 6.17	$38.80
Mexico	87.7/1.9	90.9/1.5	115.9	25.0/$4,197.50	10	−$10,274.30	82.9 + 5.96	−$81.60
Gemlany	80.6/1.74	239.8/3.93	106.1	−133.7/−$22,448.20	10	−$29,184.60	218.7 + 5.90	−$608.00
S. Africa	41.7/0.9	79.2/1.3	54.9	−24.3/−$4,078.00	10	−$8,788.40	72.2 + 5.36	−$65.60
Saudi Arabia	16.1/0.35	60.2/0.99	21.3	−38.9/−$6,561.30	10	−$6,375.40	54.9 + 4.06	−$49.60
Somalia	8.3/0.18	0.004/0.00007	11	11.0/$1,846.20	10	$1,270.00	0.00365 + 1.34	$118.00
Bhutan	0.7/0.015	0.036/0.0006	0.91	0.8/$146.70	10	$1,265.40	0.0328 + 1.34	$53.50
Solomon Islands	0.4/0.0086	0.044/0.0007	0.52	0.48/$79.90	10	$1,264.40	0.04 + 0.421	$16.70
Iceland	0.3/0.0065	0.49/0.008	0.4	−0.09/−$15.10	10	$1,198.30	0.0447 + 0.383	−$0.06

[1] States chosen to give a wide range in terms of population, geographic location, state of development and Carbon emissions.
[2] Populations are for 1992 from "Information Please Almanac/1993" (Houghton-Mifflin: 128–9). Numbers are in millions.
[3] Carbon output is for 1992 from "World Resources/ 1996–1997" (World Resources Institute: 326–7). Carbon Dioxide emission figures (in millions of metric tons) are derived by multiplying CO_2 emissions by the weight of CO_2/weight of C or 44 / 12 = 0.273. Total worldwide Carbon Dioxide emissions of 22,339.408 mt are therefore multiplied by 0.273 to give a worldwide Carbon emission figure of 6098.7 mt.
[4] Percentage of world population × the total Carbon emitted worldwide (for FAIR).
[5] Gross World Product ("GWP") = $25,600,000,000,000 for 1992 (from "Information Please Almanac/1993," Houghton-Mifflin: 128). A Carbon reduction of y% requires GWP reduction of 0.04y%; $25,600,000,000,000 × 0.04 = $1,024,000,000,000. $1,024,000,000,000/6,098.7 mt C = $167.9 ton (for FAIR).
[6] Amount of Carbon that the environment can annually process = 1670 mt ("Climate Change of 1995, Second Assessment Report of the Intergovernmental Panel on Climate Change": 457). Entitlement = l670mt/167 states = l0mt/nation (for SUSTAIN).
[7] GWP = $25,600,000,000,000. Damage/abatement (D/A) factor = 2.2% of GWP to reduce Carbon emissions from 6098.7 mt to 1670 mt; $563,200,000,000 for reduction of emissions of 4428.7 mt = $127/ton for D/A. (Entitlement-Actual emissions) × $127/ton (for SUSTAIN).
[8] Entitlement = (91.2% of Actual emissions: the NO) + (State Share based on relative population [1 − 167/based on 1982 ranking]) × (536.7 mt the difference between Actual emissions and the NO)/(14,028: the total of all State shares) (for ECON).
[9] Value = Entitlement − Actual emissions × $40/ton (for ECON).

Meanwhile, Back in the Real World . . .

The natural question at this point would be whether multilateral environmental agreements are actually based on definitions of CHM and, if so, on which definitions. Two environmental agreements of the last two decades particularly well known for the strength of their respective normative foundations are the Law of the Sea Convention which was reached at the Third United Nations Conference on the Law of the Sea (UNCLOS III) and the Montreal Protocol (to the Vienna Convention for the Protection of the Ozone Layer) on Substances that Deplete the Ozone Layer (Montreal Protocol).

At UNCLOS III, agreement was reached "that the minerals of the international area of the sea bed belonged to 'mankind' as a whole; they were not just free for anyone to take without payment in any manner they chose" (Ogley, 1996, p. 160). Discussions were initiated for "the creation of a regime to govern sea-bed mining in the interests of mankind" (Ogley, 1996, p. 158). UNCLOS III was to guarantee that "all rights in resources [outside national EEZs] are vested in mankind as a whole . . . " (Part XI, Section 2, Article 137.2). It looks like FAIR is the normative principle at work here with a goal of making an equitable distribution of resource benefits.

The SUSTAIN definition of CHM seems to be the basis for the Montreal Protocol which is to "protect the ozone layer by taking precautionary measures to control equitably total global emissions of substances which deplete it" (Preamble to Protocol). The protection of the ozone layer is, of course, necessary in order to reduce the amount of ultraviolet radiation reaching the earth's surface and damaging life. The Montreal Protocol seems to be based firmly on the SUSTAIN value of protecting the planet for present and future generations. It has been cited as a regime which could "actually reverse in future decades the damage to the ozone layer which has occurred since the 1960s" (Porter and Brown, 1991, p. 77).

A closer look at the formation of UNCLOS III and the Montreal Protocol suggests that the enunciated normative principles may not tell the whole story. It has been argued that at UNCLOS III the ultimate outcome was dictated "by the rich, potential sea-bed-mining states" (Ogley, 1996, p. 168) leading to an agreement in which the attempt to create a regime "in the interests of mankind was futile" (Ogley, 1996, p. 168). Below the surface of UNCLOS III the economics of ocean resources utilization were at least as influential as the FAIR normative value.

Furthermore, the momentum for the Montreal Protocol did not develop until the chemical industry had announced cost-effective alternatives to CFCs and thus "the imposition of severe economic constraints on use by any of the largest countries could well have made sense, even aside from the question of ozone damage and actions by other nations" (Rathjens, 1991, p. 186). In other words, CFC reduction was not agreed on until there were economic incentives to do so. While SUSTAIN values may have been important, underlying economic factors also played a major role in the development of the Montreal Protocol.

This suggests that even those environmental agreements that at first appear to be based on discrete definitions of CHM are often the product of a blend of definitions. However, this is generally unacknowledged and not explicitly considered in the formation of agreements. There are a number of reasons why this non-recognition could have a negative effect on environmental regimes and why having clear definition(s) would be appropriate. Lack of a clear definition means that in the formation of the agreement there are no agreed-upon general normative principles to which the parties can turn for guidance in developing specific language. Parties may also be less likely to enter into an agreement if they are uncertain as to what exactly they are getting into.

Explicit recognition of the different definitions of CHM force different analyses to be undertaken and considered. More than one analysis can lead to a fuller and more comprehensive understanding of the issue. Multiple analyses can also create additional potentials for tradeoffs between the parties involved (linkage) that facilitate creative win-win situations.

Once an environmental regime has been developed, clear underlying normative principles can make enforcement easier by clarifying otherwise ambiguous language. Having explicit principles underlying an environmental regime may also make it easier to extend and expand the regime since the parties know and agree on what the regime is really about and, perhaps even more importantly, because such an expansion would have moral strength.

It might be valuable to have an international agreement to determine exactly what the definition of CHM is. However, the result of such an agreement would probably *not* be that CHM means FAIR (or SUSTAIN or ECON). Rather, one might expect a definition that combined and blended all three values and would sound something like, "the Common Heritage of Mankind means that the costs and benefits of resource use should be equitably distributed taking into consideration the needs of future generations, factors unique to each nation involved (including but not limited to population), and the economic impact of any agreement on the resource use."

Such a definition may not be overly helpful but, given the vast differences implied by the different definitions, it would be a surprise if a more narrow one could be agreed upon.

However, it would be both possible and useful to

1. Have a clear understanding that there are different reasonable definitions of CHM,
2. Explicitly and transparently consider how each definition could lead to a different agreement, and

3. Openly and quantitatively agree on the blend of definitions—recognizing that different definitions should have different relative weights in the development of regimes targeted for different types of environmental harms.

This would require an interdisciplinary approach to the formation of environmental agreements.

An institutional mechanism would have to be developed which could efficiently, effectively, and credibly make all of the different analyses while respecting the fact that any numbers generated are not necessarily what will be required in the final agreement but are only a component to be used in making the agreement. Numbers under all three definitions of CHM (if CHM is considered an appropriate concept to be used in the environmental regime) could be generated in a manner similar to that attempted in this paper. Then the parties to the agreement would have to agree on the relative contribution that each definition of CHM should have for that particular regime.

The type of harm targeted by a specific environmental agreement is relevant to the weighting of the contributions of the different definitions of CHM. Where the targeted harm is the potential for irreversible loss of critical natural capital (such as the extinction of a species) then the SUSTAIN definition should be considered the most important. However, if the resource being protected is regenerative (such as commercial fisheries) then ECON should be given the most relative weight. Finally, when the resource is neither regenerative nor critical (such as manganese nodules—there are alternative ways to get the same minerals) then FAIR is most appropriate.

Having the numbers (and their monetary implications) associated with each definition will undoubtedly affect how the parties wish to have the different definitions weighted. However, with an accepted metaprinciple on how to relatively compare the normative principles if the parties agree on the purpose of the agreement then they should be able to agree on the weighting of the definitions. Having all of the normative principles involved in an environmental regime openly and transparently on the table means that any agreement reached will be an accurate and true reflection of the interests and intentions of the parties involved.

Notes

1. A similar definitional need has arisen with regard to what is *rigor* (Lele, 1991, p. 607).
2. The need for specific solutions grounded on agreed-upon normative values is especially relevant in the case of an issue such as global warming because "some of the largest contributors to the problem would likely judge the direct benefits, if any, not commensurate with the costs to them, and most of those likely to reach the opposite conclusion on the

cost-benefit issue would have little leverage to induce accession by the major actors" (Rathjens, 1991, p. 177). The ability to effectuate agreement on this issue could also be hampered by the fact that there is differential harm from global warming postulated for different regions. However, for the purpose of developing normative principles this is irrelevant as we are essentially assuming that a Rawlsian veil of ignorance exists regarding each nation's emissions and susceptibility to harm from global warming (Rawls, 1971).

3. It is worth noting that this is unlikely to stabilize the global climate given the "unpleasant fact of inertia in climate change. Scientific estimates suggest that the stock of greenhouse gases in the atmosphere will lead to significant climate change even if we take stringent steps to reduce emissions" (Nordhaus, 1994, p. 189) and even "to stabilize the global concentrations of carbon dioxide . . . would not reduce the warming to which earlier emissions have already committed the earth" (Porter and Brown, 1991, p. 93).
4. It might be noted that these three definitional approaches to CHM closely parallel attempts to define sustainable development. For example, the World Resources Institute points out that "in an attempt to make the concept of sustainable development more specific, some authors . . . stress using renewable natural resources in a manner that does not eliminate or degrade them or otherwise diminish their 'renewable' usefulness for future generations. Some economic definitions of sustainable development have also focused on optimal resource management by concentrating on maximizing the net benefits of economic development, subject to maintaining the services and quality of natural resources." But many authors argue that the issue is the quality of growth and how its benefits are distributed.
5. However, this author then goes on to suggest that establishing ownership principles over some resources, including the atmosphere, "is too difficult; the number of polluters and of those affected by pollution is too great for bargaining to be practical" (World Resources Institute, 1993, p. 2).
6. However, neoclassical economics, sometimes disparagingly referred to as frontier economics, is criticized for suggesting a sense of unlimited resources and an infinite supply of sinks for waste disposal (Porter and Brown, 1996, p. 23).
7. Although a very strong and engaging argument has been made by Sagoff that "efficiency has no normative claim or moral worth" (Sagoff, 1988, p. 107).
8. I will focus specifically on CO_2 because "Carbon Dioxide . . . will continue to cause the largest share of human-induced radiative forcing, that is, the retention of heat that can lead to atmospheric increases" (Chandler, 1990, p. 2) and because it is even more problematic to try and calculate the costs and benefits of non-CO_2 GAG than it is for CO_2.
9. Also note that figures in this paper related to CO_2 emissions refer to tons of Carbon, even though CO_2 is used. To actually get the true weight of CO_2 one would multiply by the factor of 3.66 or 44/12 since Oxygen has an atomic weight of 16 and Carbon has an atomic weight of 12.
10. Another problem in applying cost-benefit analysis to the environment is the consumer surplus issue. People can easily be "confused by the fact that important goods like air and water are free or inexpensive . . . because they do not understand that the equilibrium price of a good does not measure its importance to people . . . the equilibrium price of diamonds (per ounce) exceeds the equilibrium price of clean water (per ounce). Consumer surplus for water [i.e., the benefit to a consumer of being able to buy a good at the equilibrium price as opposed to being unable to buy it at all], however, is much larger than the consumer surplus for diamonds; in that sense, water is more valuable" (Stockman, 1996, p. 234). Or, as it has been more eloquently

put, "the labor of nature is paid, not because she does much, but because she does little. In proportion as she becomes niggardly in her gifts, she exacts a greater price for her work. Where she is munificently beneficent she always works gratis" (D. Ricardo quoted in Siebert, 1995). Such issues are associated with all environmental problems but GAGs add their own unique conundrums because climate change is "the prototype of the global commons issue. All nations are affected by the earth's climate system, and broad international cooperation is required to mitigate the threat of global warming" (Porter and Brown, 1991, p. 92).

11. Nordhaus claims that "no issue has raised more concern and confusion than the question of the appropriate discounting of the future" (Nordhaus, 1994, p. 122).
12. Actually there is another question to ask about an inheritance—who died? I am assuming that the decedent, that is, the entity responsible for making payments in accordance with the inheritance, is the nation where the emissions are taking place. Although the emitters are most probably corporations and individuals, such emissions are being done under the laws and control of nations and it is up to them to be responsible for same.
13. It is perhaps not surprising that there are different quantitative methods of interpreting CHM. As one commentator has cautioned with regard to discussing global constraints related to the environment, "We should not expect to discover a single, universally applicable formula" (Ogley, 1996, p. 167).
14. Since the total monetary value of the entitlements under SUSTAIN is negative, such monies could be paid to an internal organization with the responsibility to reduce the effects of GHG (though nations with a positive entitlement could receive it and be responsible for their own damage/abatement activities).
15. Of course, there are other ways of considering entitlement. For example, Cline (1992, p. 353) suggests that a nation's GDP could be a potential basis for a quota allocation. This approach acts to partially "grandfather-in" existing CO_2 emissions since they are generally correlated with national GDPs. Alternatively, one could use an entitlement scale similar to the "global assessment scale laid down by the U.N. General Assembly, which rates countries according to a combination of economic, geographic and demographic criteria" (Sand, 1991, p. 235). However, for simplicity's sake discussion is limited to those possibilities that seem most clearly related to the different definitions of CHM postulated herein.
16. Admittedly benefit is calculated in an economic sense and does not include other factors such as spiritual, aesthetic, or moral benefits in emissions reductions.
17. Conversation with Undersecretary of State for Global Affairs, Tim Wirth, on April 7, 1997.
18. It should be noted that this is not the same as the cost of creating CO_2 abatement measures but instead is the loss to the economy that would result after abatements are made. It is, in other words, the overall benefit received by an economy by virtue of being able to emit CO_2. The fact that the overall economy benefits from CO_2 emissions also lends support to the idea that it is appropriate for a nation to be the decedent, that is, the entity who is responsible for making payments in accordance with the inheritance.
19. The harm component of the SUSTAIN value has a (relatively, for environmental issues) long historical tradition in environmental treaties and laws. This international version of the "Golden Rule" acquired some global credibility during the Pax Britannica of the 1800s in which "the view that you should not seek your advantage by causing detriment to other peoples became generally the accepted policy of the [British] empire"(Collis, 1946). For example, since the creation of the Rhine Commission in 1815, international river commissions have developed more than 2,000 treaties regulating rights to shared waters (Imber, 1996, p. 141) and the only principle that has emerged from all these treaties is that

countries should "avoid harming downstream states" (Porter and Brown, 1991, p. 157). The passage of the National Environmental Policy Act of 1969 by the United States was also a clear affirmation of this principle as it directed U.S. federal agencies to support international cooperation in "anticipating and preventing a decline in the quality of mankind's world environment" (Porter and Brown, 1991, p. 24). But it was the first U.N. Conference on the Human Environment held in Stockholm in 1972 during which this principle was most clearly and specifically articulated. Principle 21 of the Stockholm Declaration states that nations have "the responsibility to ensure that activities within their jurisdiction and control did not cause damage to the environment of other States or of other areas beyond the limits of national jurisdiction." These areas beyond the limits of national jurisdiction are, in other words, "the global commons, such as the atmosphere and the oceans" (Humphreys, 1996, p. 216).

20. One might argue that under SUSTAIN the company would pay for the cleanup, under ECON the land would be bought for $10,000, and under FAIR the company would pay the owner based on the profits made by the mining.
21. One proposal has been made which would incorporate both damage and abatement costs in a surprising way; "an international fund [would] be established to which the polluting country would pay according to its assessment of the damages and the victimized land would pay according to its assessment of the costs of abatement . . . The funds collected from the two parties would then be redistributed to them for implementation of the environmental protection measures" (Siebert, 1995, p. 195). The goal of this would be to reduce the infomation asymmetries that encourage there to be an exaggeration of harms and costs of abatement.
22. Cline also points out that "as a general rule one would expect the economic size of damage from global warming to rise more than linearly with the magnitude of the warming. The costs of 10°C warming in the very long term could thus be far more than four times the costs of the 2.5°C benchmark warming for a doubling of carbon dioxide-equivalent" (p. 72).
23. Progress on the Convention on Climate Control, and particularly the Clinton Administration's 1993 Earth Day Message in which the policy of stabilizing GHG at 1990 levels was proposed (Nordhaus, 1994, p. 80), suggests that such an agreement may be possible.
24. Even though the damage to the GDP may not take place for some years, when it does it will be occurring on an ongoing basis. So if, for example, CO_2 doubles in ten years and maintains that level thereafter one would be responsible for the cost of damage in the year 2005 in 1995, for $2006 billion in 1996, etc. Although this does not properly discount the value of the damage, one may, very roughly, assume that the discount factor may be balanced by the damage caused between each of the first ten years and their later counterparts.
25. The theoretical underpinning for the TDP system is the Coase theorem which states that if exclusive property rights to the environment are defined and transferable with no transaction costs then a bargaining solution among different users of the environment will result in a Pareto-optimal allocation of the environmental resource which is independent of the initial allocation of property rights (Siebert, 1995, p. 99). However, the exact Pareto-optimal allocation one ends up with will be a function of the initial allocation of property rights which is why "the very first step of the program is one of potentially great controversy: what formula to use to make the original distribution of emission rights" (Field, 1994, p. 253). In whatever method the original allocative system is agreed upon, the closer one comes to a perfect Coase market the better the system will operate.

26. If such an internal TDP system could effectively be established one can imagine that "under such a system, Japan (which would find it expensive to reduce its output of gases) might buy permits from Poland (which would find it inexpensive, as long as it had the cash that a permit sale would bring in). Or Britain's National Power might reforest a stretch of Brazil with trees that would mop up carbon dioxide in exchange for being able to build another coal-fired power station . . . best of all, a company in America making refrigerators might set up a subsidiary in India to make refrigerators there too . . . thus a system of tradable permits could, in theory, give companies with energy-efficient technologies a big incentive to transfer their technologies to less efficient countries in the third world and Eastern Europe" (Cairncross, 1992, p. 171).
27. This is a limited grandfathering-in of current emissions. Although it is somewhat disadvantageous to developing countries to the extent they do emit CO_2 they may be able to make more effective reductions than developed countries ultimately giving them a positive monetary entitlement.
28. If the results are too financially onerous for developing nations one might track back 10–25 years and cumulatively make a determination of past emissions behavior which could reduce the emissions share used by developing nations relative to developed nations even further.