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Equitable Carbon Revenue Distribution Under an International Emissions Trading Regime

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Equitable Carbon Revenue Distribution Under an International Emissions Trading Regime

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1. Introduction

When people hear about 'global warming' or the Kyoto Protocol, many think of a topic of boundless uncertainty and political controversy. One reason for this reaction is the current U.S. administration's statement that 'Kyoto is dead' and impossible to implement in the United States. As the largest greenhouse polluter in the world, the U.S. is indeed vital to any meaningful attempt to address the certain threat of climate change.[1] Yet climate change will not go away simply because the Bush Administration refuses to sign one particular international accord. Scientists believe with high certainty that the impacts of current greenhouse gas emissions have started but may not be completely felt for 100 years or more.[2]

The long-term nature of the climate problem requires fundamental, long-term changes in how economies produce goods and services, particularly reductions in the amount of fossil-fuel energy they use. One of the most likely policies to encourage this transition is a system of overlapping national and international emissions permits. The Kyoto Protocol would set up such a system, but even if this Protocol fails, the movement toward a global emissions market is likely to continue for several reasons. First, all major polluting countries apart from the U.S. have endorsed the aims and the mechanisms of Kyoto. Second, several countries have already implemented domestic emissions-trading systems like that proposed in Kyoto, and the entire European Union is planning to start one in 2005. Third, many large corporations – including the major European oil companies – have endorsed the mechanisms of the Kyoto Protocol, and some have initiated their own emissions trading systems. Finally, the idea of trading has strong American support – the U.S. lobbied tenaciously for the inclusion of a flexible, market-based structure in the now-controversial Kyoto Protocol.

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The world therefore will likely see the emergence of multiple linked markets for greenhouse gas emissions permits over the next five to ten years. These permits will be assets that have an economic value and provide economic benefits. Allocating these assets equitably, both across and within countries, could simultaneously advance environmental protection and reduce poverty. However, as in any contest over the distribution of wealth, entrenched interests will ensure that increased equity will not happen spontaneously.

In this paper, we discuss a wide range of institutional structures that could help bring equitable benefits from this atmospheric asset distribution. First we review the arguments for creating tradable permits. Then we discuss the implications of the international allocation of emissions permits, and how a country with an agreed emissions cap can decide to distribute permits within its borders. Finally, we review some potential obstacles to equitable asset distribution, and discuss steps that communities, foundations, governments, and non-governmental organizations (NGOs) might take to advance a sustainable and progressive solution to atmospheric emissions.

2. From Sink to Asset: Approaches to Managing Carbon Storage

2.1 Alternative approaches to reducing environmental damage

Several policy mechanisms exist for reducing the free-ridership and overexploitation associated with open-access resources. For example, a government with highly structured legal systems and a powerful enforcement capability might be able to pass legislation or decree that the common resource shall be shared according to a certain formula set to ensure that the total exploitation is not at a level that threatens the viability of the resource. Examples include the mandatory automobile fuel economy standards in the United States, and the maximum automobile emission allowances implemented in California under the 'Smog Check' program. This approach, often called the 'command-and-control' or 'regulatory' approach, is attractive in its simplicity, but in a diverse economy with differing costs of abatement, it can lead to large disparities in the cost of compliance.

As an alternative to the regulatory approach, the government could set a price for the resource and then allow producers to decide on their own how much of the resource to consume. This price can be set directly as a tax (for example, \$5 per ton CO_2 emitted), or indirectly via a 'cap-and-trade' system in which the government sets a total emission limit and then allows firms and individuals to buy and sell permits to emit up to this cap (Weitzman 1974). These methods – taxes, permits, or a hybrid[3] of the two – have the potential to reduce the total cost of meeting environmental targets, since those polluters for whom abatement is cheaper than buying a permit (or paying the pollution tax) cut emissions, while those for whom abatement is more expensive pay to continue polluting.

In addition to reducing total cost of compliance, these market-based methods have other economic and environmental advantages. First, because firms who surpass the requirements that would have been set by regulation ('overcomply') are able to benefit financially, there are stronger incentives to invest in pollution-control technology. In the long run, this helps push technological changes that further reduce the cost of compliance. Second, these schemes establish the principle that the *polluter pays* for the use of 'environmental sinks' – in contrast to regulatory approaches in which the discharge of wastes into the air or water bodies is free as long as it remains within prescribed guidelines. This raises the question of who will receive these payments, or in other words, how is ownerships of environmental sinks to be shared? Depending on how this questions is answered, market-based methods to pollution reduction could be a powerful tool for distributional equity, as well as for economic efficiency.

2.2 International emissions permits

Recent international policies to regulate global atmospheric resources the have taken the form of permit systems. In effect, these define property rights for portions of the commons and assign (or sell) those rights to emitters. Because the atmosphere provides continuous benefits in the form of pollution abatement services, it can be thought of as an economic asset that yields dividends to the planet's people and organisms. This asset has an enormous value, as these services are necessary for life. Though some estimates have been made for the value of nature's services (de

Groot 1994; Vitousek 1997; Daily 1997), setting precise values is impossible. Given the complex nature of the earth system, our inability to reach complete scientific understanding of it, and our inability to predict future human and biospheric needs, we can never know precisely how much the atmosphere is 'worth'.

Nevertheless, policies to convert one aspect of the atmosphere – its ability to absorb carbon – from an open-access resource to a legally recognized and monetized asset will move its price closer to its fundamental value (at the least, from zero to positive). For this to happen, governments must elaborate a legal system of tradable emissions rights and distribute the permits to the entities that will trade them. The most contentious question in developing such a system is precisely this allocation of emissions rights. Until now everybody has had free access to the atmospheric pie, so cutting and distributing it is going to lead inevitably to some argument about who 'deserves' a bigger slice.

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This problem is sometimes cast as a question of whether to allocate permits on the basis of what countries or industries have emitted in the recent past. This method, often called 'grandfathering,' is politically convenient in that large incumbent polluters essentially can continue with business as usual. However, it also rewards inefficient resource use and ignores the benefits that have already accrued to users because of their greater use of the common resource. Another perspective maintains that the atmosphere is a common heritage of humankind and should therefore be allocated accordingly. Whether this heritage would include the historical atmospheric debt of industrialized countries is open to debate (Agarwal and Narain 1991; Smith 1991), but at the very least it provides an ethical framework to support an equitable allocation of current and future use rights, as opposed to a purely grandfathered asset giveaway.

3. Expected Characteristics of the International Carbon Market

3.1 State of international law

Despite doubts arising from the breakdown of international negotiations at the Hague and the Bush Administration's declaration of its imminent demise, the Kyoto Protocol seems set to continue as the international community's basis for coordinated action. The EU's 2001 ministerial declaration at Gothenburg, followed by UN meetings in Bonn and Marrakesh, both framed and approved rules governing emissions trading under the Protocol.

Under this structure, developed country governments (called Annex I Parties) must adhere to agreed emission limits for the period 2008–2012.[4] Table 1 presents these the Kyoto targets, alongside emissions data for the years 1990 and 2000. These caps reflect a modified version of grandfathering, with permits allocated approximately according to each country's past emissions. Developing countries do not have targets under the Kyoto Protocol, but they have stated their willingness to consider the adoption of binding targets once the developed countries have begun to reduce their own emissions. The type of eventual allocation of permits among developed and developing countries is still hotly debated.

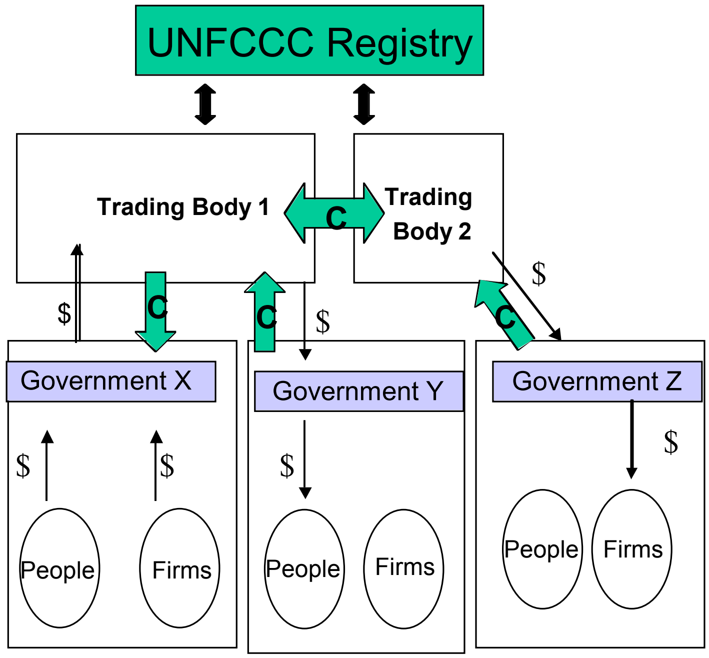
Table 1. Historical Emissions and Kyoto Protocol Targets

Region	**Greenhouse Gas Emissions** *billion tons CO2e/year*		
	1990	2000	KP Target
World	21.81	23.63	na
Developing countries	6.92	9.64	na
Annex I countries	14.90	13.99	13.46
European Union	3.33	3.28	2.76
United States	4.98	5.76	4.55
Non-EU, non-US OECD	1.84	2.20	2.05
Russia and Eastern Europe	4.75	2.74	4.19

Sources: Historical emissions are converted from data compiled by the U.S. Energy Information Administration (2002) and do not include land-use change (LUC) emissions arising, for example, from changes in forest cover. Kyoto targets are based on net emissions reported to the UN Framework Convention on Climate Change Secretariat (2000) and include LUC emissions. Most Annex I countries reported LUC emissions ranging between –10% and 10% of reported energy-related emissions; for Annex I as a whole, LUC amounts to a 10% reduction in energy-related emissions.

Although the Kyoto Protocol has been rejected by the current administration in the United States, markets for greenhouse gas emissions tied to the UN Framework Convention on Climate Change (FCCC) are being introduced. For example, the United Kingdom introduced a voluntary multi-sector trading plan in early 2002, and Denmark has implemented a mandatory program that covers the electricity generation sector (Rosenzweig *et al.* 2002). The European Commission has introduced a proposal for mandatory multi-sector EU-wide emissions trading starting in 2005. Furthermore, despite the official United States stance, one of the leading private-sector contenders for an international carbon exchange was recently established in the Chicago Climate Exchange. If the Kyoto Protocol ultimately enters into force as expected, these governmental systems and trading bodies will be linked to a central registry maintained by the FCCC (see Figure 1).

Figure 1. Schematic Diagram of International Emissions Permit Trade



<u>Note:</u> Gray arrows represent carbon permit flows; thin black arrows represent monetary flows; thick black arrows represent information sharing. Different country governments (represented as X, Y, and Z) can decide how to distribute revenue from domestic auctions or international purchases; in this diagram, Country X has opted for a carbon tax, Country Y has allocated dividends from the sale of permits to its citizens, and Country Z has grandfathered its permits to the private sector ('firms').

3.2 Estimate of international carbon market size

Several methods exist to characterize the total amount of wealth at stake in these allocation processes. The most important consideration for the long-term is how much benefit the global atmosphere provides to humankind by absorbing greenhouse gases. A conservative minimum estimate of the value of this global 'atmospheric scarcity rent' is $100 billion per year.[5]

In the near term, a crude but simple way to get an idea of the expected order of magnitude of this market is to take a short time horizon in which the policy context is relatively clear, and multiply the expected number of permits to be issued by an expected market price. The most pertinent contemporary example is to take the Annex I emissions limits (shown in Table 1 above), excluding the United States because of its stated aim to stand clear of the Kyoto Protocol, and multiply these by an estimated short-term clearing price for carbon.

Modeling studies and historical experience (see Tables 2 and 3) suggest a clearing price somewhere between $3 and $12 per ton of carbon-dioxide equivalent (CO_2e). If we conservatively assume an expected price at the low end of the scale, given U.S. non-participation, we can take $5 per ton of CO_2e as a rough approximation. From Figure 1, we can see that the non-U.S. Annex I countries have permits totaling approximately 9 billion tons of CO_2e per year.[6] Multiplying this by $5/ton, we get a rough estimate of the annual market value of around $45 billion.

Table 2. Summary of Model Estimates of Global Emissions Market Characteristics

Gases covered	Permit price *$/ton CO2 2001*	Quantity traded *Mt CO2*	Trade volume *billion USD 2001*	% CDM	Study
CO2 only	4-15 (10)	1700-3100 (2400)	7-48 (24)	60-64 (62)	Springer 2001
CO2 only	28	1200	17-34	50	UNCTAD 2000
Six-GHG	3-9 (5)	1600-3000 (2300)	10-14 (12)	56-65 (61)	Springer 2001

Note: Springer (2001) and the UN Conference on Trade and Development (2000) reviewed approximately fifteen existing modeling studies of the near-term carbon market. Most of these studies included the United States as a consumer of permits; the estimates most likely represent the upper limit on the prices in an ex-U.S. carbon market. For example, the International Energy Agency (2001) has estimated that U.S. non-participation will reduce international carbon permit prices by 34 to 90 percent. Averages and standard deviations calculated by authors. CDM = Clean Development Mechanism (see text for details).

Table 3. Historical Experience with Carbon Prices

Commodity	Vintage years	Price (US$/tC02e)	Notes
Annex B VER	1991-2007	0.60-1.50	Vintages before first Kyoto Commitment period
Annex B VER	2008-2012	1.65-3.00	First Kyoto Commitment Period
CDM VER	2000-2001	1.15-3.50	
Dutch ERU	2008-2012	4.40-7.99	
Danish Allowance	2001, 2002	2.14-4.17	2002 showed lower peak prices
UK Allowance	2002	5.76-9.36	

Note: VER denotes verified emissions reductions; CDM denotes the Clean Development Mechanism; ERU denotes emission reduction units. Annex B countries are approximately the same as Annex I countries.
Source: Modified from Rosenzweig, Varilek and Janssen (2002).

As an additional indication of the potential size of the market, we can note that private investors and some governments have already implemented a number of carbon reduction projects to generate carbon credits. Table 4 presents a sample of such initiatives. Together these projects represent an investment of over $500 million, which is substantial given that at the time there were no legally binding carbon-reduction requirements in place; companies were engaging in projects primarily to learn the regulatory process and hedge their emissions exposure in anticipation of future regulation.

Table 4. Examples of Projects to Generate Carbon Credits

Investment type	Holdings ($M)	Emphasis	Investors	Regions
Pure Carbon Funds				
World Bank PCF	145	Carbon	Govt, Private	CDM & JI
ERUPT	32	EE, Cogen, RE, Forest	Govt	CEE
Australian GHG Friendly	varies	Landfill Meth, RE, capture, EE	Private	Australia
Private Equity with carbon enhancement				
Dexia-FondElec En Eff & Em Redn Fund	63.9	EE	Multilat, Private	CEE
Ren En & En Eff Fund	65	RE, EE in emerging mkts	Govt, Private	Em Mkt
FondElec Latam Clean En Svcs Fund	25	EE, microgen, RE	Private	Latam
Black Emerald Leasing	?	RE, Fuelcell, biogas	Private	Europe
Planned Forestry Funds & Companies				
Hancock New Forests Australia	200	sust forest	Private	Australia
GMO Renewable Resources	50	sust forest	Private	US, CEE, CDM
COOL	?	carbon & forestry	Private	Latam
Other Planned				
UBS Global Alternative Climate	50	carbon	Private	CDM & JI
Natsource	?	en technology	Private	

Note: EE denotes energy efficiency; RE is renewable energy; CEE is Central and Eastern Europe.
Source: Modified from Bürer (2001).

3.3 International carbon capital transfers

Whatever the total size of the market, not all of the emission permits would be traded across national borders. While we know that countries with high emission abatement costs will be net purchasers of permits, the long-term cross-border financial flows that would result from this asset creation are still unclear. Nevertheless, several studies of have elucidated a possible range of expected international trade. At the low end, Grubb, Vrolijk and Brack (1999), for example, suggest that only about 6% of the total Annex I permits would be traded internationally; this calculation, however, was limited to trading within the Annex I group of countries. For global trading, the results presented in Table 2 indicate a possible range of 1.2-3.1 billion tons (Gt) of CO_2e per year, with a best guess of about 2.4 billion tons per year, equivalent to about 20% of outstanding Kyoto permits.[7] Using our earlier rough estimate of $5/ton as the price, we could thus expect cross-border activity in the range of $8-$10 billion per year. While this is less than the total value of the permits, it is nevertheless substantial.

Under a global permit market UNCTAD estimates that up to $35 billion per year could flow to developing countries and the former Soviet Union.

Developing countries are particularly interested in how much of these cross-border transactions might flow to their jurisdictions. The studies summarized in Table 2 indicate that approximately 55-65% of cross-border trades would involve developing countries through the Clean Development Mechanism (CDM). The CDM is an international institution, established under the Kyoto Protocol, that helps developed countries implement emissions-reduction projects in the developing world. Even though the host countries' emissions are not bound by current international agreements, they are thus able to add credits to developed countries' accounts.

These studies suggest that developing countries could expect to see around half of the cross-border trades, or about \$4-5 billion using our conservative estimates.[8]

Table 5 presents a comparison of some capital flow projections across regions under alternative trading systems, as estimated by UNCTAD (2000). These figures assume U.S. participation, and thus the world will likely see lower dollar volumes in the near future. For trading limited to Annex I, the former Soviet Union could expect to receive up to \$10 billion annually. Under a global permit market – which is unlikely in the near future, but possible, in a decade or two – UNCTAD estimates that up to \$35 billion per year could flow to developing countries and the former Soviet Union. In the most likely near-term case of limited engagement of developing countries through CDM, flows could reach \$20 billion annually. These numbers are equivalent to between 2-20% the current net private capital flow to these countries of about \$150 billion per year.

Table 5. Capital Flow Projections by Region and Mechanism

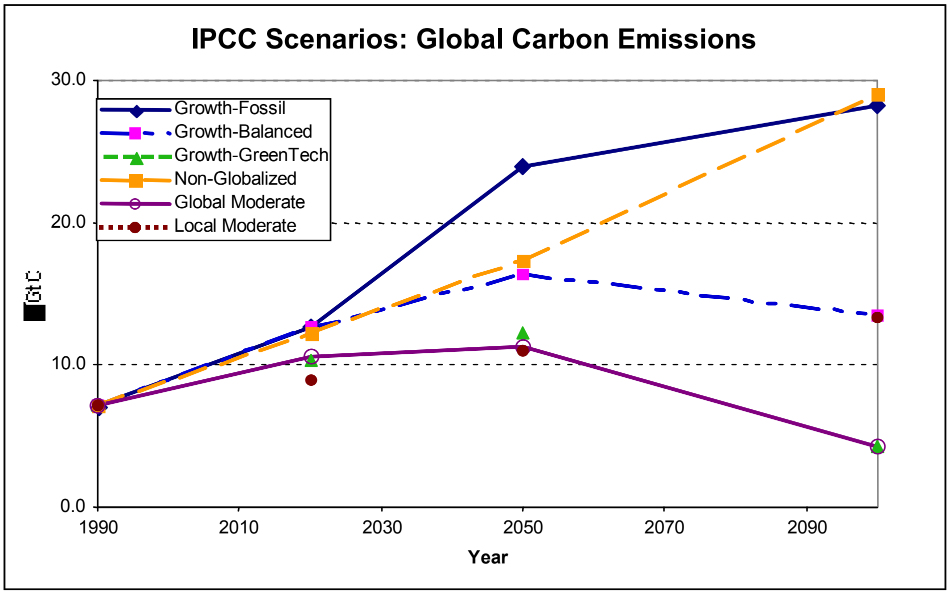
Region	Trading System			
	Annex I & FSU	Global Market	CDM	net FDI
	flows to region in billion USD 2002			
Former Soviet Union	10.5	6.2	5.1	29.1
Asia				
China	na	11.1	9.0	
India	na	2.9	2.4	
Latin Am, Africa, other Non-Annex I	na	4.4	4.4	62.0
Total Market Value	50.1	34.9	20.3	159.0

Note: Annex I and Former Soviet Union (FSU) column refers to trading that is limited to those regions; Global Market column refers to flows expected under a global permit trading system; CDM column refers to expected flows under Kyoto CDM linked to Annex I emissions trading. Net net foreign direct investment (FDI) flows to each region are provided for comparison; for the FSU this figure includes Eastern Europe.
Source: Modified from UNCTAD (2000) and Institute of International Finance (2002).

3.4 Long-term carbon market projections

In the near future, then, carbon permits will be a modest but significant source of revenue for those countries or companies who are able to sell them. Before turning to the design of policies to distribute this revenue, it is important to consider whether this market will increase substantially over time. In the future, the number of permits will need to decrease to address the scientific fundamentals of climate stabilization. To reach a steady state in which human emissions are balanced by natural uptake, emissions will have to decrease by a further 50% to 10 billion tons of CO_2e per year. The associate change in prices and traded quantities will depend on the degree to which the policy-driven permit scarcity is offset by economic ‘decarbonization’ and technological change. These trends are quite difficult to forecast over decadal time scales, and so the debate about long-term climate economics continues.

Figure 2. IPCC Future Scenarios to 2100



Note: Growth-Fossil category plots IPCC scenario A1F1; Growth-balanced=A1B; Growth-GreenTech=A1T; Non-Globalized=A2; Global Moderate=B1; Local Moderate=B2).
Source: Modified from Nakicenovic, Nebojsa and IPCC (2000).

The effect of permit scarcity on the size of the market depends on price elasticity of demand for carbon fuels.[9] For example, if the price elasticity of demand is 0.5, then increasing the price of carbon by 10% would decrease consumption by 5%. In this case, as the number of permits is reduced, demand pushes up the price of carbon mare rapidly than the quantity falls; thus, fewer permits end up generating more total revenue. If the carbon revenues are distributed across the population on an equal per capita basis, as in the Sky Trust system described in the next section, this means that stricter emissions limits will *increase* the carbon dividends for majority of people, thereby generating support for stricter environmental protection.[10] In contrast, in a relatively elastic system (with price elasticity greater than one), a contraction in the number of permits would not be offset by a commensurate rise in carbon prices, and total carbon revenue would fall.

In the short run, the capital infrastructure is inflexible and the elasticity is very low. The problem comes in forecasting this elasticity over the time scale that is meaningful to climate policy, namely the next 10 to 50 years. Indeed, much of the debate about the costs of compliance with Kyoto can be understood as a debate over the rate at which the price elasticity of demand can change (U.S. Department of Energy and Interlaboratory Working Group on Energy-Efficient and Clean-Energy Technologies 2000; Krause 2000). A related question is how this elasticity varies between developed and developing countries. The price elasticity is of particular importance in determining whether an egalitarian distribution of revenues would yield incentives for or against public support of more fossil fuel reductions: if demand is inelastic, bigger cutbacks generate larger dividends for redistribution, and hence political support for the repeated tightening of standards that would be necessary for ultimate stabilization of atmospheric greenhouse gas concentrations.

Given the uncertainty of future paths, it is useful to specify a range of options that span the ‘reasonable’ set of possibilities. The Intergovernmental Panel on Climate Change (IPCC) has conducted such an exercise, producing a set of emissions scenarios under various conceivable global economic development pathways (Nakicenovic and Intergovernmental Panel on Climate Change. Working Group III 2000). Figure 2, which plots six of the main scenarios that span the range of possibilities, shows that carbon emissions can take widely differing paths depending on both government policy and market functioning. The uncertainty is greater the further one projects into the future. In discussing long-term economic impacts, one must therefore remember that these figures may change dramatically and in unpredictable ways over the coming decades.

4. Distribution of Carbon Revenues

In the short term, the annual carbon market turnover will certainly be noticeable, but not particularly large relative to the global economy. Nevertheless, given that the natural earth system can absorb about 10 billion tons of CO_2 per year, states will be legislating into existence a valuable asset. As Victor (2001) has pointed out, the $45 billion annual value calculated above is just an annual dividend from an asset – the actual sink capacity – of much greater value.

Conservatively assuming that this is a risk-free asset, and taking 5% as the long-term risk-free rate, this dividend implies an approximate perpetuity value of $900 billion. Though politicians so far have avoided addressing the long-term ownership of these assets, the next set of international commitments could begin to recognize more equitable ways of assigning ownership to atmospheric carbon rights. In this way, negotiators could start to move carbon income away from arbitrarily chosen historical polluters to a wider and more deliberately chosen set of recipients.
In discussing how potential revenues can be distributed, we need to distinguish between the international allocation of permits and the intra-national allocation of permits. The international allocation derives primarily from the UN-sponsored agreements on climate change, including the Kyoto Protocol; in these agreements, the negotiating groups delineate which parties receive permits to emit and how much each receives. This process exists to partition rights on a global basis, recognizing that the atmosphere is a global resource with global access.
However, each individual country then has to decide how to meet their target under the international regime. Again, countries have the options of mitigating their emissions through direct regulation, or a market-based system of taxes or permits, or a hybrid. While all these approaches will likely be used in some form across the 150 or so countries that are expected ultimately to engage in binding commitments, we will discuss primarily the options for distributing the revenue that would accrue from sales of permits, both internationally to satisfy obligations under the UNFCCC and under domestic permit-trading systems.

4.1 International distribution of carbon revenues.

In principle, permits could be sold directly from one government to another, bought and sold through a supranational entity. Such an entity could merely serve as a market-maker for trades between countries, or if vested with the appropriate authority, it could actually distribute the proceeds from permit sales to the owners of the assets. If one accepts that the atmosphere is owned equally by individual citizens, a supranational trust would distribute carbon revenue to those owners. This would be an international version of the 'Sky Trust' that has been proposed domestically for the United States (Kopp *et al.* 1999; Americans for Equitable Climate Solutions 2000; Barnes and Breslow 2001).

This centralized route has significant logistical and political drawbacks: It would require international administrative institutions to transfer a large amount of funds, raising sovereignty concerns that are unlikely to be placated in the foreseeable future. Moreover, most developed countries would be net 'losers' in financial terms – paying more into the trust than they would receive in dividends – presenting a political obstacle. Thus, while a global trust has theoretical elegance, in the near term the world will almost certainly see a system of internationally negotiated permit rights coupled with domestically defined distribution systems.

The discussion of emissions permits revolves primarily around the *atmosphere's* capacity to hold excess carbon. But carbon can also be absorbed and stored in the *biosphere* – forests and grasslands particularly. While in theory this 'carbon sequestration' is an earth system service that provides benefits to the entire population, in practice the physical boundaries of terrestrial biosphere carbon sinks has meant that they have been viewed primarily as property of individual countries and not part of the international common resource. Thus, under the Kyoto framework, carbon absorbed by a forest in Sweden can be subtracted against industrial emissions from Sweden in figuring out its obligations. This raises many questions of equity, especially if countries are now to be compensated for forest regrowth in the wake of past deforestation (Agarwal and Narain 1991).

4.2 Domestic distribution of carbon revenues

Once a country has an international allocation, it will be able to buy or sell permits as needed. Countries that over-comply with their cap or that host credit-generating projects will be able to generate revenue through the international market for greenhouse gas emissions permits. Furthermore, countries that implement a domestic system of tradable permits or carbon fees will generate revenues at home. It is important to note that individual countries are not *forced* to wait for an international allocation (à la Kyoto) to implement a domestic system: as sovereign states, they can decide on emissions targets unilaterally or in smaller groups.

Regardless of the origin of the international framework, once a country decides to raise carbon prices to control greenhouse gas emissions, it has three broad options for distributing the resulting revenue within its borders:

- Retain in governmental budget

- Distribute to corporations doing business in country
- Distribute to citizens or residents

In the government option, the revenues from carbon taxes or permit sales go to the treasury and become part of the budget. The distributional outcome thereby becomes subject to the political process of the country. The government could decide to tap the carbon revenue for its discretionary budget. Alternatively it could use the revenue to reduce other tax burdens, either targeting specific industries or citizens or as a broad-based tax cut. In the United States, for example, possibilities include social security payroll tax reductions and cuts in corporate income taxes (Phillips 2001; U.S. Congressional Budget Office 2001).

If the country decides to grant permits directly to corporations, as part of a grandfathered allocation, these private entities are able to continue their previous emissions free of charge. This policy effectively grants corporations ownership of the GHG revenue stream. While the government may recoup some of this revenue through taxes or a hybrid permit auction, the remaining revenue accrues to the corporation, and, by extension, to its owners.
The third option is to distribute the benefits directly to the people of the country. This distribution could take two forms:

- A periodic distribution of dividends accruing from the national sale of permits (Barnes 2001).
- A one-time distribution of 'emission endowments' that provide periodic dividends and are assets that can be traded on a secondary market (McKibben and Wilcoxen 1999).

Each of these could be distributed universally with each citizen getting an equal share, or in some other way that might, for example, address economic hardships due to climate change policies or actual climate change. Sky trusts are a universal mechanism for distributing dividends.

Hybrid schemes are possible. For example, the government could retain a fraction of sky-trust revenue to invest in renewable energy research and development and adjustment programs for workers in carbon-intensive industries that are rendered less competitive by having to pay for their environmental externalities.

Multiple national sky trusts would have several attractions. First, the majority of people would be net winners in purely financial terms, receiving more in annual dividends than they would pay in higher carbon prices. This enhances their political viability. Second, low- and middle-income households tend to be net winners, while high-income (and high-consumption) households tend to pay more into the fund then they get back in dividends. The sky trust thus has a progressive impact on income distribution (Barnes and Breslow 2001). Third, multiple national sky trusts would not be dependent on painstakingly developing an international consensus on the procedures and institutions necessary to allocate emission rights internationally. Fourth, they would be compatible with an equitable international allocation that could be negotiated during the second, third, or later commitment periods under the UNFCCC. Fifth, national sky trusts potentially could serve to refine administrative procedures through institutional experimentation and learning. Finally, a system of functioning national sky trusts could serve as a stepping stone to an eventual global sky trust.

5. Perspectives on the distribution options

One can evaluate these alternative carbon asset distribution options from many perspectives. In this section, we briefly discuss four perspectives: ethical, legal, economic, and political.

5.1 Ethical perspectives

The ethical argument has been spelled out extensively by ecological economists, environmental thinkers, political scientists, and legal scholars, among others. The basic idea is simple: that the atmosphere, as a global common resource, should be shared equitably among the people of the world. With this overarching framework, two questions are whether natural debts incurred in the past should be included in this equitable sharing; and whether 'equitable' means equal per capita allocation or should incorporate other economic criteria as well.

The atmosphere, as a global common resource, should be shared equitably among the people of the world.

Within the scholarly debates on ethical perspectives, nobody argues explicitly for grossly unequal distribution of rights to the atmosphere. Some do, however, advance the argument that some element of grandfathering can have theoretical as well as pragmatic benefits. The argument is basically that resources that in the past have been free should not be burdened suddenly with a high cost, as the resource users were operating in a legal and scientific world that did not recognize any limit. Thus their ethical obligation begins from the point of learning and recognition, not from the point of causation.

5.2 Legal perspectives

A related argument has been advance by legal theoreticians. The principal question is whether existing international law provides an adequate foundation for the concept of the atmosphere as the 'Common Heritage' of humankind, or merely a weaker 'Common Concern' of humankind. (Baslar 1998; Arend 1999). Some precedents for the former exist in the treatment of common resources under international environmental law, such as the Antarctic Treaty and Amendments, the UN Convention on the Law of the Sea, and the conventions governing lunar mineral exploitation. Existing legal instruments and decisions do not necessarily imply a universal right to the benefits of the atmosphere, and there is even some disagreement as to whether the atmosphere meets the legal definition of a commons (Buck 1998). Nevertheless, the precedents are encouraging in that the international community has explicitly delineated the common ownership of other shared resources.

5.3 Economic perspectives

One objection to the option of granting permits to corporations free of charge is that not all people are managers or shareholders. Consumers may capture some surplus via the lower prices that firms could charge, but owners could appropriate a large part of this windfall. Furthermore, any surplus passed along the consumers get would not be equally distributed: Those who consume more (typically, high-income households) would reap more than those who consume less (typically, lower-income households). Thus, granting free permits to corporations would probably end up enriching those who already have substantial wealth, without providing much benefit to the 'average' citizen who arguably has an equally legitimate claim to the atmosphere. The sky trust proposal differs from a corporate allocation in three ways:

- First, by allocating an equal share to each person, the sky trust embodies a specific ethical judgment regarding entitlements.
- Second, the sky trust has a *payout ratio* – the fraction of revenues that is returned to shareholders as dividends after other costs are paid – that is extremely high relative to the payout ratio of a typical corporation. Proposed payout ratios in sky trusts vary from 75% to 100%; whereas corporate payout ratios are often less than 10%.[11]
- Third, most sky trust proposals provide for an equal dividend to everybody, without giving individuals the option of either buying or selling their entitlement.

While necessarily initiated through the national legislative process, such a system could be separated from the government.

From an economic perspective, if one could somehow demonstrate that the government can use the revenue more effectively than individuals, then the government should retain the revenue. Defining 'effectiveness' for governments is a difficult task, and given the mixed record of government spending, one must make a strong case for governmental retention of carbon revenues. One area that is particularly compelling, however, is government-sponsored research and development: because private firms often cannot capture the full benefits of innovations, government sponsorship to yield public spillover benefits has been repeatedly vindicated (Duke and Kammen 1999).

Specifically, carbon revenue could be used for investment in developing longer-term approaches for reducing carbon emissions. Currently the United States, for example, arguably under invests in alternative energy research and development. Federal investments in *all* energy research amount to less than 0.4% of U.S. energy revenues, compared to over 12% in many areas of the life-sciences (Kammen and Margolis 1999). Using even a small fraction of the carbon revenue could create more opportunities for the shift to renewable energy, and thus make further reductions in carbon emissions more likely (U.S. Congressional Budget Office 2001; U.S. Department of Energy and Interlaboratory Working Group on Energy-Efficient and Clean-Energy Technologies 2000). In addition, targeting some carbon revenue for governmental-sponsored adjustment assistance could mitigate social problems caused by reduced use of fossil fuels.

5.4 Political perspectives

The political argument over distribution mechanisms will pit strong ethical arguments against entrenched economic interests. One likely compromise is to divide the problem into short and long time horizons. In the short-term, this would allow atmospheric dividends to continue to accrue mainly to those who enjoy them now (mostly corporations based in developed countries) while moving toward a more equitable long-term redistribution of rights (Kinzig and Kammen 1998; Baer *et al.* 2000).

If it is decided that atmospheric carbon revenue should be distributed directly to citizens, the possible pitfalls of distribution mechanisms take on greater importance. Without a strong legal and administrative system, the money may not reach its rightful owners, either because the infrastructure (records, registries, banks, etc.) is not in place to deliver it, or because knowledgeable insiders divert the cash from the intended recipients. In such cases, it is possible that alternative institutional arrangements can achieve a partial distribution of carbon income while maintaining integrity. For example, the Bonn Agreements and Marrakesh Accords to the Framework Convention on Climate Change establish an Adaptation Fund which is to draw funding from a tax on Clean Development Mechanism projects. Decisions adopted at Marrakesh also direct the Global Environmental Facility (GEF) to help fund capacity building and technology transfer in developing countries. Recycling carbon revenue through the Adaptation Fund or earmarked GEF money would redistribute wealth to poorer countries and provide a source of funds for climate-friendly sustainable development.

6. Conclusions

Current trends are hard to extrapolate, but we believe that the politics of atmospheric rights could realign behind a more equitable allocation. To argue that the revenue from higher carbon prices should be distributed directly to citizens, one needs to be demonstrate one or more of the following: (a) the right to share in carbon revenue stems from an ethical argument based on common ownership; (b) the citizens can use the money more effectively than the government; and (c) the political landscape is sufficiently malleable to make this a reality.

Regarding the international allocation of rights, without a strong international norm that prods countries to adopt an egalitarian distributional standard, it is hard to imagine that more than a few industrialized countries would willingly cede the large sums of cash implied in an international allocation scheme based on equal per-capita emissions rights. Longer-term equity is not a pipe dream, and would require a fuller development of an international norm that defines the atmosphere as the common heritage of humankind.

Regarding the allocation of rights and revenues within countries, a system of national sky trusts could provide a means for ensuring that atmospheric scarcity rent flows to the poor as well as the rich. By constructing a legal endowment in the natural asset of the atmosphere, such a system could align environmental protection with wealth creation for the poor. We have noted several administrative and political obstacles to implementing an interlocking system of national sky trusts. Even if this goal proves unattainable in the short term, smaller steps can help move toward this ideal of harmonizing environmental protection and poverty reduction via the definition of natural assets.

Governments have primary, but not exclusive, power over the both international allocation and domestic distribution policies. As a first step, governments should define and defend their own long-term positions on equity questions – for example, by agreeing to the principle of equalizing per-capita emissions rights over time. Such actions can help to build consensus and cooperation for the longer term, and potentially make room for more compromise in the shorter term. NGOs can press domestically for international agreements delineating the principle of universal human ownership of the atmosphere (Schreurs and Economy 1997). This strategy of norm definition has worked well for some other issues as in the international campaign to ban land mines, in which intensive lobbying based upon ethical grounds was able to bolster a new area of international law (Finnemore and Sikkink 1998). Philanthropic foundations with a charter to support equity, human rights, and environmental protection can target this area of climate policy as a long-term goal. Local communities also can participate in the process, in particular by showing their national governments that cutting emissions is not only possible but economically desirable. International and domestic climate change policies that define and allocate rights to emit carbon are already beginning to emerge. By moving toward a more equitable international allocation, and by implementing domestic revenue distribution policies that focus on citizens, government research and development, and adjustment assistance, these policies could simultaneously build wealth for the poor and reduce the risk of overexploiting the atmospheric commons. The result can be both a sustainable and a progressive solution to global climate change.

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Endnotes

[1] Human-caused climate change is a certain threat. Scientists know with high precision the mechanisms for direct warming of the atmosphere due to changes in gas concentrations. The main uncertainties relate to the patterns and timing of its impacts.

[2] Though we refer primarily to the predominant anthropogenic greenhouse gas of carbon dioxide, and often use ‘carbon’ as shorthand, the theoretical concepts developed here can include the non-CO_2 greenhouse gases as well. Accordingly, we adopt the common designation of ‘CO_2-equivalent’, or CO_2e, to refer to greenhouse gases as a whole.

[3] For example, to mitigate the price uncertainty under a cap-and-trade system, the government can set a ceiling for the carbon price by implementing a fixed penalty rate. Denmark is using this type of system for its domestic carbon permit plan.

[4] Annex I is a designation in the UN Framework Convention on Climate Change (FCCC) and reproduced in the Kyoto Protocol as Annex B. Annex I countries are: Australia, Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, U.K., Ukraine, and U.S.A..

[5] Barnes and Breslow (2001) perform a similar calculation for the United States, using a much higher carbon price. Our $100 billion figure uses a carbon price of around $5/ton CO2e, and assumes that this would cut emissions to a near-term target of 21.81 billion tons/year globally.

[6] In the language of the international agreements, the term ‘quantified emission limitation and reduction obligation’ is sometimes used as longhand for ‘permits’.

[7] This figure includes the U.S. permits to be consistent with the models’ assumptions.

[8] Again, the studies in Table 2 assume U.S. participation.

[9] Elasticity is defined as the percentage change in consumption divided by the percentage change in price. Things that are more ‘necessary’, such as basic foods and energy, tend to have lower elasticity than luxury items, which can be more easily foregone if prices rise.

[10] Elasticities are not constant over demand, and would likely become smaller as the quantity of permits decline, enhancing this effect.

[11] A 75% payout ratio results from earmarking 25% of the proceeds for renewable energy R&D, adjustment assistance, and so on.

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