

## CHAPTER 15

# Equity, Greenhouse Gas Emissions, and Global Common Resources

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The core of the climate change problem is as simple as it is daunting: We now know that it will be impossible for the whole world to obtain—or even to approach—the emissions levels of the industrialized countries, without gravely endangering our planetary life support systems. In the United States, emissions average over 5 tons of carbon per person per year;<sup>1</sup> even in more efficient European economies, average emissions exceed 2 tons of carbon yearly. Yet global annual emissions must fall by more than 50 percent—to a third of a ton per person or less—if atmospheric greenhouse gas (GHG) levels are to be stabilized in this century.

Meeting this target would be a big enough problem if it were just a matter of the industrialized nations reducing their emissions by a factor of 5 or 10, and bargaining among themselves about how to share the atmosphere. But this halving of total emissions must take place in a world where more than a billion people live on less than a dollar a day and 30 percent of children under 5 are malnourished.<sup>2</sup> This matters because it is still generally assumed that the solution to poverty is for the poor nations to “develop” along the same path that the rich nations have—for the South to become like the North. But this model depends on increasing energy use and, given current technology, increasing GHG emissions. Thus, if the developing nations follow the energy-technology path of the rich countries, the planet faces the risk of catastrophic climate change.

Since this risk puts a limit on allowable GHG emissions, one can think of that limit as defining the available “environmental space.” And there is simply not enough environmental space for the South to develop the way the North has. Therefore, the particular environmental space at issue here—the atmos-

phere—must be brought under common governance; global rules for its use and allocation must be discussed, decided, and enforced. The UNFCCC and the Kyoto Protocol are steps in this direction.

The structure of the Kyoto Protocol, which establishes binding emissions caps on the developed countries, has made the distribution of those caps a central controversy both in the negotiations and in the ratification debate. Developing countries were explicitly exempted from caps because of their lower historical and current emissions, and because of their agreed need to devote their resources to sustainable development and poverty alleviation.<sup>3</sup> However, U.S. opponents of the Kyoto Protocol have vehemently argued that the protocol is not fair to the United States because developing countries have no caps and bear no costs.

The Clinton Administration did not submit the Kyoto Protocol for ratification and thus avoided this debate over fairness. On taking office, President Bush used the fairness argument as one reason for rejecting the protocol outright. Environmental groups in the U.S. made some effort to counter it, but their strategy seems largely to rely on ratification without the United States and on seeking domestic reductions outside the Kyoto framework. However, the unresolved debate over developing country commitments will continue to focus attention on the fair distribution of emissions rights.

If the Kyoto Protocol enters into force without the United States, caps for developing countries will be crucial to the negotiation of targets for the second commitment period (after 2012). If the protocol doesn't enter into force, the requirement that developing countries limit their emissions probably will be a key bargaining issue in negotiating an alternative agreement. And if the United States wants the developing countries to accept caps, it will have to propose an allocation formula that addresses the developing countries' fundamental concerns over equity. Everyone in the developing world cannot emit at the high rates of the North, but why should developing countries agree to restrictions that bind them to their current, much lower per capita rates or that restrict their economic growth? What is an equitable solution to this dilemma?

There are other important aspects of equity in the climate debate, such as the risks we impose on future generations (intergenerational equity) and liability for the harm that will be caused by climate change we are unable or unwilling to avoid.<sup>4</sup> However, because the question of equitable allocations among countries remains a major—and urgent—unresolved obstacle to an effective global treaty, I focus on the allocation issue in this chapter.

One can view the question of an equitable allocation of emissions rights as a political science problem or as an ethical problem. Much of what has been written about equity in the climate negotiations is relatively traditional political sci-

ence; for example, authors attempt to analyze the rational (economic) interests of the parties and their relative power, and try to predict the outcome of the negotiations. In this framework, the analyst is a neutral observer, and equity (or the perception of inequity) is a possible variable to account for the negotiating outcome.<sup>5</sup> Sometimes authors will go so far as to suggest possible allocation formulas that they believe could be acceptable to all parties; however, the interests and preferences of countries are taken as given.

Alternatively, an ethical analysis looks at the justifications that competing parties offer for their negotiating positions and attempts to critically evaluate them.<sup>6</sup> In this framework, the analyst is a participant, and equity is something to be defined and argued for in order to influence the world. This is how I approach the problem in this chapter.

## **Framing the Problem: Burden Sharing Versus Resource Sharing in the Global Commons**

The climate change problem can be posed as a question of burden sharing or as a question of resource sharing.<sup>7</sup> In the burden-sharing framework, the costs of protecting the atmosphere by reducing emissions to a safe level are a burden that must be shared globally. The costs come from the need to introduce lower-emitting technologies—presumed to be more expensive—and the requirement for reduced consumption. The issue of equitable allocations is usually framed this way;<sup>8</sup> U.S. opposition to the Kyoto Protocol is based on the argument that it imposes an unfair burden.

In this framework, it makes sense to say that the burden should be shared equally unless there are compelling reasons why it shouldn't be. If we accept a principle of equal sacrifice, and we believe that it is a greater sacrifice for a poor person to pay a dollar than it is for a rich person—in economic terms, the declining marginal utility of income—we might define a person's or country's fair share based on ability to pay. Like a progressive tax, this would mean that the wealthy pay a higher proportion of their income than the poor do, but the poor still pay something.

However, focusing on the burden of reductions obscures the question of who has been responsible for, and benefited from, the overuse of the atmosphere. Assessing responsibility requires us to focus on the atmospheric carbon sink as an economic resource, and to account for both its unequal appropriation in the past and its unequal use today. We need to ask who has used the resource, what benefits they have acquired from its use, and what losses will be suffered by those who cannot use as much as they otherwise would have. If the finite size of the available atmospheric space defines the total benefits that can come from its use,

it is necessary to ask whether a person or country has received or will receive a fair share of the benefits. In this way we can meaningfully define overuse and underuse and define a party's obligation on this basis: Parties that have exceeded their share have obligations to parties that will therefore get less. To understand what would be a fair share, it will be necessary to look further at the nature of common resources.

## **The Nature of Common Resources**

From one perspective, any system in which the use of a resource by one party causes harm to another can be viewed as a commons. Those harmed necessarily have a moral stake in the use or conservation of the resource, even if they don't have the ability to exploit it in kind and thus to cause a symmetric harm. However, it is when each party can cause harm to the others that we have a classic commons problem.

In a commons, individuals typically gain much more from their use of the resource than they suffer from the degradation their use causes; thus one can increase one's own well-being by overconsuming and harming the other users. Furthermore, restricting one's own use does not ensure protection against the harms caused by others' use of the resource. In these ways, a common resource establishes a moral community. To protect the resource and to protect themselves, the parties must grant each other the right to a fair share, and accept enforcement of a mutually agreed limit.

I argue that the fundamental principle of fairness in the governance of a commons is equality in decision-making and use, and in particular equality among people, not countries. This cannot be simply asserted or deduced, but rather that must be established through moral reasoning. By drawing on an extended analogy to a hypothetical common resource—in this case, a shared aquifer—and by rebutting common critiques, I will show how the principle of equal rights to common resources can be credibly justified.

Imagine two people—let's call them Nora and Sam—who share an island. Each of them has a well that pumps water from a shared aquifer. Nora discovers how to make a pump that pumps three times as fast, and is able to irrigate more farmland; soon she has a grain surplus, is feeding cattle, and is clearly healthier. Sam meanwhile is able to irrigate a much smaller plot and to feed only a few chickens, and is regularly falling ill. Eventually, however, he discovers how to make his own pump that is as powerful as hers.

Just before he installs his pump, they both find out that the level of the aquifer is starting to fall. Each is aware that the other is using the aquifer and at what rate. They get together and figure out how large the aquifer is and what its

annual recharge rate must be. They know how much each of them has already pumped, and how long it will take to exhaust the remaining stock at the rate they will both soon be able to pump. They know also that if they are forced to immediately reduce to the recharge rate, it will seriously limit their food supplies. They are now forced to decide, whether individually or collectively, how fast to pump the water. Assuming that they decide that they can and must trust one another, what might we expect them to decide is a fair agreement, and why?

It seems likely that they would agree to share the aquifer equally unless one was willing to compensate the other. Nora does not have a good argument to make why Sam should continue to use less and she more; now that they each have a big pump, why shouldn't he be able to use his? Should he agree to remain permanently poorer? It would not make sense for Sam to agree to forever use a smaller share simply because he was using less at the time when the agreement was made.

On the contrary, Sam might point to the wealth Nora accumulated while she was living on an unsustainable share of the water and say that it is not fair for them now to use an exactly equal share. There was a fixed amount of water in the aquifer when they started, and it can only produce a finite amount of wealth before they are both required to learn to live off the sustainable flow; to divide only the remaining part of the aquifer equally would leave him perpetually poorer. Yes, Nora did not know that the level of water that she was pumping was unsustainable, but Sam did not agree to let her become wealthy at his expense. And indeed her wealth is at his expense; what she used, he cannot. He can make a good case that it is fair for him now to use more, or for her to compensate him for using less.

Some might recognize this situation as a version of the prisoner's dilemma and note that there is a noncooperative solution that is equally plausible. Nora or Sam might decide to pump as fast as possible, knowing that their use was unsustainable, but the other probably would do the same, leaving them both worse off. What matters here is that we see the situation of interdependence as necessarily creating a moral community: Each party can harm or be harmed by the other, and depends on the other's cooperation.<sup>9</sup> This, then, is the structure of a common resource: Even if we would like to get more than our fair share of the benefits, we know that it is not ethical for us to do so. Furthermore, absent any other compelling justifications, a fair share is an equal share.

What might constitute a justification for an unequal division of the aquifer? If it rains more on someone's part of the island, we might think it fair for him or her to accept a less than equal share of the aquifer. However, it is important to realize that such an argument for inequality in access to a particular resource is based on an appeal to equal opportunity more generally: No one should be

better or worse off than anyone else simply because of which part of the island he or she happens to live on. In the real world, this principle is not given much weight since (for example) countries with large fossil fuel resources are not expected to give a free share to less fortunate countries. One might argue that fossil fuel reserves *should* be shared as common global resources, but the point here is that because in our hypothetical example the water lies underneath (and is equally accessible to) all parties, there is no way for one individual to physically exclude another from using it, and thus to charge for its use.

In this hypothetical example, I have placed the question of the allocation of the common resource into a very abstract context, as if it were the only resource in question and the only issue of negotiation between the two parties. It is in part through this abstraction that the principle of equality emerges so strongly; there is no possible gain to either party from accepting a less than equal share. However, the real world is much more complicated. For example, it could well be argued that, when there are a large number of unused common resources, each party would accept a principle of “first come, first served.”<sup>10</sup> Allowing one party the right to claim a larger share of certain common resources, in exchange for allowing other parties a similar right to other resources, might be agreed to make everyone better off because it encourages innovation and investment in the development of those resources. This is a major justification for allowing homesteading or the establishment of mining claims or water rights.

However, this condition clearly does not hold in the case of the atmosphere. There have never been any negotiations between all the countries of the world, to say nothing of all the people, concerning general principles of allocation of global common resources. Not, that is, until today. The underusing countries have not agreed to allow the North's overconsumption.

## **An Ethical Analysis of Allocation Principles for Emissions Rights**

This leads us back to the problem with which we started: the need for an international agreement to regulate GHG emissions and the controversy over what an acceptable allocation of rights would be. There is an extensive literature on this part of the equity debate, to which I cannot begin to do justice.<sup>11</sup> I focus on a relatively narrow but crucial aspect: whether the ethical arguments for various allocation principles are convincing. I address the fairness of various principles rather than the likelihood of their being accepted or the ease of implementing them, not because I believe that it is better to be morally righteous than to be

practical but because what a government and its citizens believe is fair is one justification of country's negotiating positions. Especially because of the large role of the United States in the climate negotiations, this is not just an academic matter; the sense of fairness that eventually becomes dominant in the United States may have a significant influence on the future of the negotiations.

I assume in the following discussion that tradeable emissions permits are a plausible and desirable scheme for addressing climate change. There are reasonable arguments against tradeable permits, such as the practical difficulties of implementation and the possible negative impacts of market power (either buyers' or sellers'). Nonetheless, many analysts have concluded that the power of such a scheme to separate efficiency (making the most cost-effective reductions) from equity (determining who will pay for those reductions) makes it the best option for an international agreement.<sup>12</sup> Furthermore, the Kyoto Protocol itself explicitly includes mechanisms for emissions trading. Thus, in the remainder of this section I will assume that however emissions rights are allocated, they may subsequently be traded.

### Why Emissions Rights Can't Be Equal by Country

I will begin by examining two principles that are seldom explicitly advocated but underlie many of the arguments against other principles (such as equal per capita rights). The first of these is the principle that every country should have a right to an equal share of the atmosphere. It simply isn't ethically plausible that the rights to use a common resource would be attributed in equal shares to every country. The benefits of the use of the resource fundamentally accrue to people; the allocation of emissions rights to countries is a pragmatic compromise. No one would argue that Fiji should have the same emissions rights as the United States.

I bring up this seemingly obvious point only because opponents of the Kyoto Protocol often argue that a reason for the United States to oppose Kyoto is that because the protocol restricts U.S. emissions but not China's, China will soon emit more than the United States. It is reasonable for the United States to be concerned that if China never accepts limits, U.S. emissions reductions will not prevent climate change. However, the Kyoto Protocol only addresses the period through 2012. One cannot claim that it's wrong if China some day emits more than the United States without a real argument about the basis for emissions rights, and the United States has a very weak argument. After all, China has more than four times the U.S. population; it must be acceptable for them to emit some amount more than we do.

## Why Emissions Rights Can't Be Grandfathered

The second principle of resource allocation I will consider is grandfathering, the principle that a party's current level of use establishes a firm property right. Under this principle, if we need to establish a limit to use, a country is entitled to the same proportion of the limited resource that it had been using when use was unrestricted.

It is rare for anyone to make an ethical argument for pure grandfathering in the case of climate; freezing the relative emission rates of different countries at their current proportions can plainly be seen to be unfair to the low-emitting countries. Imagine being born in a poor country in the year 2050 and finding that you are allocated fewer permits than people in much wealthier countries simply because your country had been poor in 2005. You might very reasonably conclude that this was not a fair situation and might reconsider whether your nation should continue to abide by the agreement.

There is a weaker form of the argument for grandfathering that is more plausible, and that implicitly underlies a large number of proposed mixed or transitional allocation schemes: Because the high-emitting countries did not know that they were overusing a commons, it would be unfair to ask them to immediately restrict their use to a fair, sustainable share. However, this argument confuses two different points. The first is whether it would constitute an undue hardship on the high emitters to restrict their emissions sharply and rapidly (or to pay for their excess consumption). The second is whether the high emitters are entitled to the benefits of their current overconsumption. There are numerous precedents for allowing parties to stretch the repayment of their debts over time. But the legitimacy of the debt isn't determined by the harm that is caused by repaying it, and it is usually assumed to be up to the party who is owed to determine whether and how much to reschedule or reduce the debt. Thus this is at best an argument for temporary grandfathering as part of a transition.

## Why Emissions Rights Can't Be Proportional To GDP

Others have argued that permits should be allocated at least in part proportionally to gross domestic product (GDP);<sup>13</sup> the greater a country's GDP, the greater its emission rights. This gives additional permits to the wealthier nations (attractive for getting them to buy in but not in itself an ethical argument), and it creates incentives to use one's allocation as efficiently (in the sense of reducing emissions per GDP) as possible. However, this principle has some unacceptable effects if carried to its conclusion; the wealthiest countries would always have the



largest share of the permits, which, given their value, would have the effect of increasing inequality. Again, imagine a resident of a poor country some years from now, who may not burn as much coal as a resident of a rich country precisely because he is not as rich; it is hard to see how he or she would consider this to be fair.

### Why Emissions Rights Should Be Per Capita

The central argument for equal per capita rights is that the atmosphere is a global commons, whose use and preservation are essential to human well being. Therefore, as I argued using the aquifer example, all people should hold both decision-making rights and use rights equally unless there is a compelling higher principle.

We might be able to determine what would count as a higher principle by considering the implications of the *reductio ad absurdum* of equal per capita rights.<sup>14</sup> No single *reduction* can capture all possible failures of an ethical principle, and there are several that might be interesting and relevant in this case. One possible *reduction* is that emissions permits are allocated immediately on a strict per capita basis and are not tradeable; this would clearly cause a harmful economic shock to the countries that had to make sharp reductions. This might well be judged unacceptable on utilitarian grounds if it caused more harm to those who were forced to reduce than it brought benefit to those who were not or if it actually harmed those it was meant to help due to global economic interdependence.

However, what we actually seem to care about here is outcomes, not principles of allocation; if an unequal allocation could be shown to permanently benefit those who receive lower allocations, few would argue that we should insist on strict equality. However, other than suggesting that developing countries might suffer if the North underwent economic contraction, no one has ever argued that poor countries actually would benefit from having lower emissions allocations than rich countries, especially not permanently.

Another possible *reduction* is that a global energy administration would actually issue a GHG emissions permit to every person on the planet and require them all to buy and sell them in a single enormous global market. This boggles the mind because of its impracticality, not its ethical failure. If the reason for an equal right is because each person is truly entitled to an equal share of the benefits, there are only practical reasons, not logical or ethical ones, for the permits to be issued to countries. Similarly, the idea that each person on the globe might vote on the total amount of emissions to be allowed seems absurd, but again for practical rather than ethical reasons.

## Beyond Equal Annual Allocations: The Principle of Historical Accountability

Many analysts have also extended the principle of equal per capita rights to the principle of historical accountability. At the individual level, historical accountability could mean that each individual gets the same amount in their lifetime, regardless of when they are born; those who have already used more than their allowable share would have to purchase permits from those who haven't. Returning to the aquifer example, this is precisely the argument Sam has for why he should get a larger than equal share of the remaining water.

In practice, this would mean that a country's current allowed emissions are reduced if it has cumulatively overused the commons. There are many possible formulas for quantifying overuse and using it to modify current allocations;<sup>15</sup> however, the essential point is that countries are assumed to have benefited permanently (as by increased wealth and infrastructure) from that overuse and to have a debt to repay. There are some plausible ethical objections to historical accountability, such as the dubiousness of holding living persons responsible for the activities of their ancestors or the fact it hasn't been known for long that overuse was causing a problem.<sup>16</sup> Also, not everyone in wealthy countries has contributed equally to or benefited equally from their cumulative emissions. However, the correlation between the cumulative emissions of countries and their levels of overall wealth is clear, and the fact that wealth is unequally distributed within countries does not seem to justify ignoring the common benefits that have accrued.

In a hypothetical case, if we could identify the precise contribution that overuse of the commons had made to an individual's current wealth, it would be reasonable to consider that benefit to be an individual debt to those who will be unable to obtain a similar benefit. It seems reasonable that a country that has cumulatively but unequally overused the commons should be responsible for fairly distributing the debt among its citizens.

## Practical Versus Ethical Objections to Equal Per Capita Rights

This leads to a more general consideration of the relationship between practical and ethical objections to equal per capita allocations. The three most common objections to equal per capita rights are that it provides an incentive to population growth, that poor people who would have a surplus of allocations would not benefit from their sale, and that the North (and the United States in particular) would never accept the financial burden. I will address each of these in turn and show that although they may indeed have some practical relevance, they do

not in themselves constitute arguments that per capita allocations are not ethically justified.

Because governments would get permits to use or sell based on the size of their populations, opponents of equal per capita rights argue that it would give governments an incentive to increase, or at least not to limit, population growth.<sup>17</sup> However, this concerns the practical effect of a per capita allocation principle; it is not an ethical argument that people should not intrinsically have equal rights to the commons. This is not to say that practical arguments do not have ethical implications; again, if an equal per capita allocation led to substantial additional population growth that caused identifiable harm, we might therefore reject per capita rights because of the consequences. But because there are a variety of plausible solutions (one simple example being fixing the allocation to a base-year population), this argument does not carry much weight.

Another argument that has been made against equal per capita rights is that the resulting financial transfers would not aid the people they are supposed to help. Because the permits would be traded by governments, there is no guarantee that the poorest people who should be the owners of surplus permits would see much of the benefits from their sale. However, this again is a pragmatic, not ethical argument; the fact that there is not currently a channel for permit purchasers to pay the rightful owners of the resource does not mean they are not ethically obligated to do so. They certainly may not simply keep the money.

For better or worse, we generally accept national sovereignty as a basis for determining the internal allocation of resources; we do not judge the democratic nature of the Saudi royal family before we pay for the oil we import. Nor has anyone suggested that the United States did not deserve a large allocation because the benefits of emissions are unequally distributed domestically. Moreover, if we think that individuals should receive the benefits of the use (or sale) of their permits, we can help empower them to make that demand effectively by giving international recognition to the principle of equal rights.

### **Cost as an Objection to Per Capita Allocations**

Finally, it is necessary to discuss what is usually given as the ultimate argument against equal per capita emission rights: that the industrialized countries, and the United States in particular, would never agree because of the high costs they would incur. In a tradeable permit system with a cap at today's global level, an immediate transition to an equal per capita allocation would result in trading of roughly 2 billion tons of carbon permits each year. Recent economic studies have estimated that for a cap based on the Kyoto framework, permits might trade in a global market at \$20–\$100 per ton,<sup>18</sup> but estimates of up to \$200/ton

or more have been made for more restrictive global caps. The United States alone exceeds its equal per capita share by more than a billion tons and thus could be required to purchase permits worth tens or even hundreds of billions of dollars.

Thomas Schelling, among others, has argued that because poor people in developing countries are the most likely to suffer from climate change, money spent by wealthy countries to prevent it is a form of foreign aid.<sup>19</sup> He also argues that it is unreasonable to expect the United States to pay so much more in this case than we currently do for other forms of foreign aid. However, if one accepts that there should be equal rights to global common resources, any costs associated with tradeable permits are payment for the use of resources, not foreign aid. The fact that the United States might not like or agree to such costs is not an ethical argument; I may not like the high price of oil, but that doesn't mean I can steal it.<sup>20</sup>

It is possible to argue that the harm that would come from paying a fair price for emissions rights is greater than the benefit that would come to those who sell the permits. There is some evidence that people feel that the loss of a given amount of income causes greater harm than the gain of the same amount of income causes benefit. One way to look at this is to consider that people have expectations built around their material lives and that even wealthy people suffer significantly when their expectations fail to be met.<sup>21</sup> However, in the case of global emissions trading, this is not a very plausible argument. The standard analysis of transfers between rich and poor, based on the declining marginal utility of income, is that the gain of \$10 to a poor person means more than the loss of \$10 to a rich person; the huge disparities of wealth between North and South suggest that the marginal utility of income in the South must be much higher.<sup>22</sup>

If rights to the global commons should be shared equally and paying for those rights would not cause more overall harm than good, there is little remaining justification for the North to refuse to agree to such payments. A country does not have the ethical right to opt out of the governance of a commons—to be a free rider—simply because it doesn't want to reduce its overconsumption. Because one country's use affects all the others, the moral community and moral obligations exist whether they are respected or not.

## Conclusions

As I suggested at the beginning of this chapter, I consider myself to be not merely an analyst but also a participant in the process of defining equity in the climate change debate. Because the economic stakes are quite high, many parties are actively engaged in this process. It is my central claim that self-interest

and ethical justification are not the same and that one can and must use reasoned argument to determine what is right. If the arguments for equal rights are justified, it follows that the U.S. government should change its negotiating position and agree to a treaty that establishes at least an eventual goal of equal per capita allocations.

With a commitment to equal per capita allocations, a global emissions cap covering developing and developed countries becomes possible, with enormous associated advantages. Such an agreement would create a large and (hopefully) efficient market for permits and thus bring down the cost of compliance worldwide. It would eliminate the need to establish baselines that dogs the Clean Development Mechanism and other project-based mitigation schemes. Per capita entitlements would eliminate the incentive for developing countries to delay reductions in emissions in order to increase their claim to atmospheric space. In all these ways, a transition to an agreement based on equal per capita rights would help us to stabilize atmospheric GHG concentration at lower levels and to limit the risks of dangerous climate change.

I do not presume to have addressed all the ethical questions concerning the equitable allocation of emissions rights. At the very least I hope I have made clear what a justification for a principle of equity must look like to be an ethical rather than practical (or selfish) argument. Finally, I hope that I have demonstrated that it is both possible and necessary for us to take part in the creation of new norms of international equity, and that the climate change debate offers us an opportunity to make an important contribution to a more just and sustainable world.

## Acknowledgments

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## Notes

1. In the form of carbon dioxide from fossil fuel burning and industrial activities; multiply by 44/12 to get the equivalent mass in CO<sub>2</sub>.
2. World Bank, 2000: *World Development Report 2000/2001: Attacking Poverty* (Oxford: Oxford University Press).
3. This reasoning is embedded in the UN Framework Convention on Climate Change

- itself, in the Berlin Mandate passed at the first Conference of Parties in 1995, and in the Kyoto Protocol.
4. For an excellent review of issues of intergenerational equity, particularly as it is connected with the theory of discounting in economics, see Arrow, K. J., W. R. Cline, K.-G. Mäler, M. Munasinghe, R. Squitieri, and J. E. Stiglitz, 1996: "Intertemporal equity, discounting, and economic efficiency," in J. P. Bruce, H. Lee, and E. F. Haites (eds.), *Climate Change 1995: Economic and Social Dimensions of Climate Change* (Cambridge, England: Cambridge University Press), 125–144. For a discussion of the question of liability for climate damages and other equity concerns, see Banuri, T., K. Göran-Mäler, M. Grubb, H. K. Jacobson, and F. Yamin, 1996: "Equity and social considerations," in the same book. See also Grubb, M. J., 1995: "Seeking fair weather: ethics and the international debate on climate change," *International Affairs*, 71: 463–496.
  5. See Schelling, T. C., 1997: "The cost of combating global warming: facing the tradeoffs," *Foreign Affairs*, 76: 8–14; Rayner, S., E. L. Malone, and M. Thompson, 1999: "Equity issues and integrated assessment," in F. Tóth (ed.), *Fair Weather? Equity Concerns in Climate Change* (London: Earthscan Publications Ltd.), or Victor, D., 1999: "The Regulation of Greenhouse Gases: Does Fairness Matter?" in the same book.
  6. Important articles using this framework include Ghosh, P., 1993: "Structuring the equity issue in climate change," in A. N. Achanta (ed.), *The Climate Change Agenda: An Indian Perspective* (New Delhi: Tata Energy Research Institute). Shue, H., 1993: "Subsistence emissions and luxury emissions," *Law and Policy*, 15 (1): 39–59; Bhaskar, V., 1995: "Distributive justice and the control of global warming," in V. Bhaskar and A. Glyn (eds.), *The North the South and the Environment: Ecological Constraints and the Global Economy* (New York: St. Martin's Press). Paterson, M., 1996: "International justice and global warming," in B. Holden (ed.), *The Ethical Dimensions of Global Change* (New York: St. Martin's Press).
  7. I am indebted to Sunita Narain for clarifying this distinction.
  8. More than a few articles have "burden sharing" in their titles: e.g., Grubb, M., J. Sebenius, A. Magalhaes, and S. Subak, 1992: "Sharing the burden," in I. M. Mintzer (ed.), *Confronting Climate Change: Risks, Implications and Responses* (Cambridge, England: Cambridge University Press); Parson, E. A. and R. J. Zeckhauser, 1995: "Equal measures or fair burdens: negotiating environmental treaties in an unequal world," in H. Lee (ed.), *Shaping National Responses to Climate Change* (Washington, DC: Island Press). Many more articles use it as their conceptual framework, and numerous workshops have been held on the subject.
  9. The fact that it may be possible to cheat and that there is incentive to do so may lead to the need for an enforcement mechanism; it is precisely because the situation creates a moral community that each party may grant that it is fair for the other side to enforce a penalty on them if they are caught.
  10. I thank Dick Norgaard for this insight.
  11. Comprehensive bibliographies can be found in the IPCC's Second and Third Assessment Reports: Banuri et al., 1996; Banuri, T. and J. Weyant, 2001: "Setting the stage: climate change and sustainable development," Chapter 1 in B. Metz and

- O. Davidson (eds.), *Climate Change, 2001: Mitigation* (Cambridge, England: Cambridge University Press). Important early work that I haven't cited elsewhere includes Krause, F., W. Bach, and J. Koomey, 1989: *Energy Policy in the Greenhouse*, Volume I (El Cerrito, CA: International Project for Sustainable Energy Paths); Rose, A., 1990: "Reducing conflict in global warming policy: the potential of equity as a unifying principle," *Energy Policy*, December 1990: 927–948; Agarwal, A. and S. Narain, 1991: *Global Warming in an Unequal World: A Case of Environmental Colonialism* (New Delhi: Centre for Science and Environment); Solomon, B. D. and D. R. Ahuja, 1991: "International reductions in greenhouse-gas emissions: An equitable and efficient approach," *Global Environmental Change*, 1 (5): 343–350; and Bertram, G., 1992: "Tradable emission permits and the control of greenhouse gases," *Journal of Development Studies*, 28 (3): 423–446. More recent discussions include Meyer, A., 1999: "The Kyoto Protocol and the emergence of 'contraction and convergence' as a framework for an international political solution to greenhouse gas emissions abatement," in O. Hohmayer and K. Rennings (eds.), *Man-Made Climate Change: Economic Aspects and Policy Options* (Heidelberg: Physica-Verlag); Baer, P., J. Harte, B. Haya, A. V. Herzog, J. Holdren, N. E. Hultman, D. M. Kammen, R. B. Norgaard, and L. Raymond, 2000: "Equity and greenhouse gas responsibility in climate policy," *Science*, 289: 2287; and an entire edited collection: Tóth, *Fair Weather?* 1999.
12. Some authors explicitly argue that tradable permits are more desirable than a carbon tax scheme, which in economic theory can also separate efficiency from equity. Epstein, J. M. and R. Gupta, 1990: *Controlling the Greenhouse Effect: Five Global Regimes Compared* (Washington, DC: The Brookings Institute). Many other authors assume the benefits of trading with little analysis.
  13. For example, Sagar includes GDP in a hybrid proposal with population and historical emissions. Sagar, A., 2000: "Wealth, responsibility and equity: exploring an allocation framework for global GHG emissions," *Climatic Change*, 45: 511–527.
  14. *Reductio ad absurdum* means roughly what it sounds like: "reduction to the point of absurdity." In ethical reasoning this means applying a moral principle in an extreme form to a hypothetical situation, typically to show that in cases related to the real example, there are higher principles that take precedence.
  15. See Grübler, A. and Y. Fujii, 1991: "Intergenerational and spatial equity issues of carbon accounts," *Energy*, 16 (11/12): 1297–1416; Smith, K., 1991: "Allocating responsibility for global warming: the natural debt index," *Ambio*, 20 (2): 95–96; Hayes, P. and K. Smith (eds.), 1993: *The Global Greenhouse Regime: Who Pays* (London: Earthscan Publications Ltd.); Smith, K., 1996: "The natural debt: North and South," in T. W. Giambelluca and A. Henderson-Sellers (eds.), *Climate Change: Developing Southern Hemisphere Perspectives* (New York: John Wiley and Sons Ltd.).
  16. For an articulation of the case against historical accountability, see Beckerman, W. and J. Pasek, 1995: "The equitable international allocation of tradable carbon permits," *Global Environmental Change*, 5: 405–413; for a response see Neumayer, E., 2000: "In defence of historical accountability for greenhouse gas emissions," *Ecological Economics*, 33 (2): 185–192.
  17. In fact, this is raised by defenders of per capita rights more often than by opponents

- because it is so easy to defeat; several solutions have been discussed in all the literature since Michael Grubb's seminal work. Grubb, M., 1989: *The Greenhouse Effect: Negotiating Targets* (London: Royal Institute of International Affairs).
18. Weyant, J. P. and J. H. Hill, 1999: "Introduction and overview," *The Energy Journal*, Special Kyoto Issue: vii–xiv.
  19. Schelling, 1997.
  20. David Victor has made a similar argument that a difficulty of adopting a tradable permit scheme is that wealthy countries will be reluctant to allocate assets worth hundreds of billions of dollars. Victor, D. G., 2000: "Controlling emissions of greenhouse gases," in D. Kennedy and J. A. Riggs (eds.), *U.S. Policy and the Global Environment: Memos to the President* (Washington, DC: The Aspen Institute). Others have pointed out that if the assets indeed have this value, the overconsuming countries are free-riding and increasing their unfair appropriation by delaying the transition to equal per capita rights. Parikh, J. and P. Parikh, 1998: "Free ride through delay: risk and accountability for climate change," *Environment and Development Economics*, 3: 384–389.
  21. For an extensive discussion of this argument, see Wesley, E. and F. Peterson, 1999: "The ethics of burden sharing in the global greenhouse," *Journal of Agricultural and Environmental Ethics*, 11: 167–196.
  22. In fact, if one uses a standard assumption about the declining marginal utility of income (i.e., that utility increases as the log of income), it can be shown that in a system of tradable permits, equal per capita rights are utility maximizing compared with grandfathering or any mixture of the two. Baer, P. and P. Templet, 2001: "GLEAM: a simple model for the analysis of equity in policies to regulate greenhouse gas emissions through tradable permits," in M. Munasinghe, O. Sunkel, and C. de Miguel (eds.), *The Sustainability of Long Term Growth* (Cheltenham, England: Edward Elgar Publishing Company).