

ALLOCATING THE COSTS OF THE CLIMATE CRISIS: EFFICIENCY VERSUS JUSTICE

Amy Sinden*

Abstract: In the international negotiations aimed at reaching an agreement to reduce the greenhouse-gas emissions that are driving global warming, the developed and developing countries are talking past each other. The developed world is speaking the language of efficiency, while the developing world speaks the language of justice. Economic theory and the concept of efficiency are fine for answering the question of who should *reduce*, but that is not the contentious issue. When it comes to the hotly contested issue of who should *pay*, economic theory offers no guidance, and the developing world is right to insist that we look to principles of justice. This Article considers three kinds of approaches to the who-should-pay question: 1) those that take status quo emissions levels as their starting point; 2) those that allocate emissions rights on a per capita basis; and 3) those that allocate the costs of emissions reductions on the basis of ability to pay. The Article then considers three possible models for conceptualizing the who-should-pay question in light of widely shared principles of justice: 1) the property model views it as a problem of dividing and allocating a commonly held property right—the capacity of the atmosphere to absorb greenhouse gases; 2) the tort model views it as a question of how to allocate costs when one party causes injury to another; and 3) the tax model views it as a situation in which a group of persons or entities are all engaged in a common enterprise to promote the common good and must allocate the costs of that enterprise. The Article evaluates each of the three approaches to the who-should-pay question under each of these three models of justice, and concludes that the per capita approach is the clear winner. It comports best with the property and tort models of justice, and with respect to the tax model, it comes in a close second. A rough calculation reveals that, if a per capita approach is indeed the most just, then the recent proposals by developing countries that the developed countries each contribute 1% of their gross domestic product to adaptation and mitigation efforts in the developing world is quite reasonable, perhaps even a bargain. Finally, the Article considers and responds to several counterarguments against the per capita approach.

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* Associate Professor, Temple University Beasley School of Law; Member Scholar, Center for Progressive Reform. See <http://www.progressivereform.org>. Thanks to Gary Every for invaluable research assistance.

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INTRODUCTION

As we face increasingly dire warnings from the scientific community about the perils of the climate crisis, the need to reach an effective and meaningful international agreement to reduce greenhouse-gas emissions becomes ever more urgent. The question of who should *reduce* is not actually that controversial. The contentious issue is who should *pay* both

the costs of the reductions (mitigation) and the costs of coping with the damage that has already become inevitable (adaptation). On the who-should-reduce question, there is broad agreement that it will be most “efficient,” and therefore best, to first implement those emissions reductions that are cheapest (many of which will be in the developing world), and then move progressively toward those that are more expensive. Most people are comfortable with the idea that efficiency, in the sense of cost-effectiveness, is an appropriate goal in this context, and economic theory usefully demonstrates that either a cap-and-trade program or a tax scheme will produce an efficient and desirable result by inducing a given amount of emissions reduction for the cheapest aggregate price.

This broad consensus breaks down, however, on the question of who should *pay*. On the one hand, the United States and other developed countries point to the large aggregate emissions of countries like China and India and argue that it is pointless for the developed world to take expensive steps to reduce emissions until the developing countries commit to do likewise. The developing world, on the other hand, argues the developed countries caused the problem to begin with, and should therefore take the lead in solving it and bear the lion’s share of the costs. This clash of views played out in the lead up to the Copenhagen Climate Conference last fall, as U.S. negotiators balked at proposals by several developing countries that the developed countries each set aside 1% of their gross domestic product (GDP) to pay for mitigation and adaptation efforts in the developing world.¹ Indeed, the agreement that came out of the Copenhagen talks, under which the developed countries committed to establish a Green Climate Fund that will reach \$100 billion per year by 2020, falls far short of that goal.²

1. Sasha Chavkin, *Paying for Rain*, MOTHER JONES, Nov.–Dec. 2009, at 50, 50, available at <http://motherjones.com/environment/2009/11/bolivia-paying-rain> (describing Bolivian President’s calls for developed nations to contribute 1% of gross domestic product (GDP) to a United Nations Fund for poor countries, and the endorsement of this position by Venezuela and Nicaragua); *China Demands Richer Countries Allocate 1% of GDP to Fight Global Warming*, BELFAST TELEGRAPH, Oct. 28, 2008, <http://www.belfasttelegraph.co.uk/breaking-news/world/asia/china-demands-richer-countries-allocate-1-of-gdp-to-fight-global-warming-14018542.html> (describing China’s calls for developed nations to spend 1% of GDP to deal with climate change); *Where Countries Stand on Copenhagen*, BBC NEWS, <http://news.bbc.co.uk/2/hi/8345343.stm> (last visited Mar. 25, 2010) (describing China’s position that developed countries should spend 1% of GDP per year to help developing countries adapt, and describing the “Small Island Nations” position that at least 1% of developed nations’ GDP should be spent on “climate-inflicted damage”).

2. See James Kanter, *Copenhagen’s One Real Accomplishment: Getting Some Money Flowing*, N.Y. TIMES, Dec. 20, 2010, http://www.nytimes.com/2009/12/21/business/energy-environment/21iht-green21.html?_r=2&bl). U.S. GDP is currently approximately \$14.4 trillion, so 1% of U.S. GDP alone is around \$140 billion per year. See Press Release, Bureau of Econ. Analysis, Gross

This is not simply a problem of conflicting self-interests. If each side were simply arguing to promote its own selfish ends, at least they would be on the same wavelength. But the problem runs far deeper. The developed and developing worlds are speaking entirely different languages. The developed world is speaking the language of economics³ while the developing world speaks the language of justice.⁴ If we are going to make any progress in forging an international solution to the climate crisis and preserving a livable planet for our grandchildren, however, those in the developed world must come to understand that, when it comes to who should pay, the developing world is right to insist on justice, not efficiency.

Economic theory is fine for finding answers to the first question—who should reduce—because this is at bottom a question of aggregate social welfare, or “efficiency.” By wisely allocating greenhouse-gas reductions, we can minimize the costs to society as a whole. But the second question—who should pay—is of an entirely different kind. It is not a question of how much aggregate social welfare we can produce, but of how that welfare should be distributed. As such, it raises questions that economic theory cannot answer. These are questions not of efficiency, but of *justice*.⁵ As the United States enters international negotiations in the wake of the failed Copenhagen talks, it would be prudent to recognize the limitations of the efficiency principle and instead take long-standing and widely shared principles of justice as at least one starting point in crafting a new climate change policy.⁶

Domestic Product: Fourth Quarter 2009 (Advanced Estimate) 3 (Jan. 29, 2010), http://www.bea.gov/newsreleases/national/gdp/2010/pdf/gdp4q09_adv.pdf.

3. Dale Jamieson, *Ethics, Public Policy, and Global Warming*, in DALE JAMIESON, *MORALITY'S PROGRESS: ESSAYS ON HUMANS, OTHER ANIMALS, AND THE REST OF NATURE* 282, 285 (2002) (“In recent years, economic vocabularies and ways of reasoning have dominated the discussion of social issues. Participants in the public dialogue have internalized the neoclassical economic perspective to such an extent that its assumptions and biases have become almost invisible.”).

4. See Louise Gray, *Copenhagen Climate Summit: Developing Countries Warn of “Absolute Devastation,”* THE TELEGRAPH (London), Dec. 9, 2009, <http://www.telegraph.co.uk/earth/copenhagen-climate-change-confe/6764877/Copenhagen-climate-summit-developing-countries-warn-of-absolute-devastation.html> (quoting Lumumba Stanislaus Di-Aping, chairman chief negotiator of the G77 group, as saying the developed world has a “‘moral obligation’ to cut greenhouse gases”).

5. See *infra* notes 11–28 and accompanying text; see generally Amy Sinden, *The Abandonment of Justice*, in *ECONOMIC THOUGHT AND U.S. CLIMATE CHANGE POLICY* 107 (David M. Driesen ed., forthcoming 2010).

6. See Cecilia Albin, *Rethinking Justice and Fairness: The Case of Acid Rain Emissions Reductions*, 21 REV. INT'L STUD. 119, 119 (1995) (arguing that agreements to address international environmental issues must “be viewed as fair and just if they are to be politically accepted,

The language of economics has obscured the distributional questions that lie at the heart of the climate-change debate. By focusing on efficiency and aggregate social welfare, the economic rhetoric of the developed world implicitly and unselfconsciously embraces a status quo distribution of emissions rights, with allocations made proportional to existing emissions levels. When we look at the question of who should pay through the lens of justice, however, the distributional issues come into sharp focus and point toward a very different solution. Indeed, no matter how we conceptualize the question from the perspective of justice, a status quo distribution consistently emerges as the worst solution. Conversely, a per capita allocation of emissions rights easily emerges as the best (i.e., most just) solution.

Thus, when developing countries push for a per capita allocation of emissions entitlements in international negotiations, those in the developed world need to understand that the developing countries have justice on their side. A back-of-the-envelope calculation shows that even under a per capita allocation that is purely prospective (and thus leaves the historical debt of the developed world unaccounted for), the United States owes a “carbon debt” to the developing world of roughly 4.7 metric tons of CO₂ per year.⁷ If we assume the value of a metric ton of CO₂ to be \$28, that puts the U.S. annual carbon debt at right around 1% of GDP. While attaching a dollar figure to the “value” of carbon dioxide emissions is fraught with difficulty and controversy, \$28 per metric ton is well within the mid-range of recent prominent estimates.⁸ In this light, the developing countries’ request that developed countries each contribute 1% of GDP to the developing countries as part of a climate change treaty seems eminently reasonable.⁹

Part I of this Article reviews the basic concepts of economic theory. In so doing, it explains how the efficiency principle helps to answer the who-should-reduce question, and yet offers no guidance on the who-should-pay question. Instead, the efficiency principle obscures distributional issues and implicitly promotes the status quo.

Part II reviews various approaches for answering the who-should-pay question. These proposals cluster in three categories: 1) the status quo approaches; 2) the per capita approaches; and 3) the ability-to-pay approaches.

implemented and honoured in the long term,” yet most research and negotiation focuses instead on economic effectiveness).

7. See *infra* notes 173–79 and accompanying text.

8. See *infra* notes 182–98 and accompanying text.

9. See *supra* note 1.

Part III asks the question: What is just? From the perspective of justice, the who-should-pay question can be conceptualized under three different models: 1) the property model views it as a problem of allocating a commonly held resource; 2) the tort model views it as a question of how to allocate costs when one party causes injury to another; and 3) the tax model views it as a situation in which a group is engaged in a common enterprise to promote the common good and must allocate the costs of that enterprise. Part III analyzes the various proposals identified in Part II under each of these three models and concludes that the per capita approach outperforms the others. It comports best with the property and tort models, and, with respect to the tax model, it comes in a close second. The status quo approach, on the other hand, performs the worst under all three models.

Part IV sets out a back-of-the-envelope calculation to get a rough idea of the magnitude of the transfer of wealth from the developed to the developing world that a per capita approach would implicate. As noted above, U.S. carbon debt to the developing world comes out to roughly 4.7 billion metric tons of CO₂ for just one year. On reasonable assumptions, this could easily amount to a payment on the order of 1% of U.S. GDP, which is what the developing countries proposed in the lead-up to Copenhagen.¹⁰ Finally, Part V considers and responds to some of the major counterarguments that opponents of the per capita approach have put forward.

I. ECONOMIC THEORY AND THE CONCEPT OF EFFICIENCY: MISDIAGNOSING THE PROBLEM

Welfare economics traces its roots to utilitarianism and is built around the normative standard of “efficiency”—the maximization of aggregate social welfare.¹¹ Defining “welfare” is of course problematic. In order to avoid the philosophical conundrums involved in making interpersonal welfare comparisons,¹² economists adopt the concept of “preference satisfaction” or “willingness to pay” as the currency of individual well-being.¹³ Thus, economists can get a measure of well-being, or “utility,”

10. See *supra* note 1.

11. See E. J. MISHAN, *WELFARE ECONOMICS: TEN INTRODUCTORY ESSAYS* 13–17 (1964).

12. See Oscar Lange, *The Foundations of Welfare Economics*, 10 *ECONOMETRICA* 215, 215 (1942); Amartya Sen, *The Possibility of Social Choice*, 89 *AM. ECON. REV.* 349, 352 (1999). *But see id.* at 356–60 (arguing that interpersonal welfare comparisons are possible).

13. See *e.g.*, Nicholas Kaldor, *Welfare Propositions of Economics and Interpersonal Comparisons of Utility*, 49 *ECON. J.* 549, 549–50 (1939).

by simply observing people's willingness to pay for things as expressed in markets.¹⁴

In its purest form, economic efficiency is defined by the Pareto principle. One state of affairs is a "Pareto improvement" over another if it would result in at least one person being better off and no one being worse off.¹⁵ A situation is "Pareto efficient" if there is no alternative state of affairs that would be a Pareto improvement.¹⁶ Under the laws of welfare economics, Pareto efficiency will be produced by a perfectly functioning market.¹⁷ But markets are never really perfect, of course. Where markets fail for one reason or another, economic theory calls for government intervention in the form of a regulatory scheme calibrated to mimic the economically efficient outcome that a perfectly functioning market would have produced—that is, a regulatory scheme that meets the test of cost-benefit analysis.¹⁸

The problem is that any attempt to use Pareto efficiency as the standard for judging the efficiency of government intervention is impractical. Because almost all government action harms at least one person, virtually all government intervention would fail a Pareto-efficiency test. Accordingly, for these purposes, economists turn to a slightly less appealing but more practical standard known as "potential Pareto" or "Kaldor-Hicks" efficiency.¹⁹ A government policy or regulation is "efficient" in the Kaldor-Hicks sense if those who would benefit from the regulation could fully compensate those who would lose and still be better off.²⁰

Efficiency, then, is a measure of *aggregate* social welfare.²¹ And because the hypothetical transfer of wealth from winners to losers under

14. See Richard A. Posner, *Utilitarianism, Economics, and Legal Theory*, 8 J. LEGAL STUD. 103, 129–30 (1979).

15. See Gerard Debreu, *Valuation Equilibrium and Pareto Optimum*, 40 PROC. NAT'L ACAD. SCI. 588, 588 (1954).

16. See *id.*

17. See ANTHONY E. BOARDMAN ET AL., *COST-BENEFIT ANALYSIS: CONCEPTS AND PRACTICE* 53 (1996).

18. See *id.* at 2, 28–35.

19. *Id.* at 32; see David M. Driesen, *The Societal Cost of Environmental Regulation: Beyond Administrative Cost-Benefit Analysis*, 24 ECOLOGY L.Q. 545, 579–80 (1997) ("[D]ecisions producing Kaldor-Hicks efficiency do not have the virtues associated with free market exchange" because they do not involve consensual transactions.).

20. Or, put another way, a regulation is Kaldor-Hicks efficient if, following a hypothetical transfer of wealth from the winners to the losers, the resulting state of affairs would be a Pareto improvement. See BOARDMAN ET AL., *supra* note 17, at 390.

21. The Kaldor-Hicks standard assumes that wealth is a proxy for welfare, a problematic assumption to say the least. See RICHARD POSNER, *ECONOMIC ANALYSIS OF LAW* 13 (5th ed.,

Kaldor-Hicks efficiency need not actually occur, this efficiency standard is entirely insensitive to how welfare is distributed.²² As long as the welfare of all members of society combined is maximized, it does not matter if some benefit at the expense of others. Thus, a world in which Bill Gates owned all the wealth while others starved and an alternative world in which the same amount of wealth were distributed equally among all individuals could each be equally “efficient” under a Kaldor-Hicks test.²³ Economics, as it is often said, shows us how to produce the largest pie, leaving to politics the task of determining how that pie should be divided up and distributed through tax or welfare programs.²⁴

Because it is indifferent to the distribution of wealth, the efficiency principle uncritically accepts the status quo distribution of wealth as its starting point. Thus, while purporting to be neutral with respect to wealth distribution, in actuality it implicitly favors the status quo.²⁵ Economic theory favors the status quo distribution of wealth in other subtle ways as well. By measuring value in terms of money, for example, it gives more weight to the preferences of rich people than poor people. This is a well-known conundrum in economic theory, often referred to as the problem of wealth effects.²⁶ Because an additional dollar is more valuable to a poor person than to a rich person and because a poor person’s willingness to pay is constrained by her ability to pay, a poor person’s willingness to pay for a particular good will generally be lower than a rich person’s, even if the poor person values the good just as much.²⁷ Economic theory (and the efficiency principle)

Aspen 1998); C. Edwin Baker, *The Ideology of the Economic Analysis of Law*, 5 PHIL. & PUB. AFF. 3, 6, (1975); Duncan Kennedy, *Cost-Benefit Analysis of Entitlement Problems: A Critique*, 33 STAN. L. REV. 387, 401–07 (1981); Arthur Leff, *Economic Analysis of Law: Some Realism About Nominalism*, 60 VA. L. REV. 451, 478–79 (1974).

22. See Sen, *supra* note 12, at 352.

23. Pareto efficiency is also indifferent to distributional issues to the extent that it takes the existing distribution of wealth as a given. See FRANK ACKERMAN & LISA HEINZERLING, PRICELESS: ON KNOWING THE PRICE OF EVERYTHING AND THE VALUE OF NOTHING 33–34 (2004). Some economists attempt to account for the decreasing marginal utility of money by using “distributive weights,” which attempt to account for the fact that a dollar is worth more to a poor person than to a rich person. See, e.g., MATTHEW D. ADLER & ERIC A. POSNER, NEW FOUNDATIONS OF COST-BENEFIT ANALYSIS 72–73 (2006). Using such a method, the two worlds described above would not be equivalent, because each dollar would be understood to be more valuable to poor people than to rich people. But distributive weighting techniques are controversial and fraught with difficulty. *Id.* at 152.

24. See Kaldor, *supra* note 13, at 550–51; Sen, *supra* note 12, at 351–52.

25. See Baker, *supra* note 21, at 6; Kennedy, *supra* note 21, at 401–07.

26. See ADLER & POSNER, *supra* note 23, at 72–73.

27. As a result, it is a common practice in cost-benefit analyses of climate change to value the lives of people in the developed world significantly higher than those in the developing world. See,

thus routinely undercount the values of the poor in relation to those of the rich.

Additionally, by aggregating costs and benefits, the efficiency principle obscures issues of causation and responsibility. The notion that one group of people would cause bodily harm to another group in order to achieve incremental, non-needs-related consumption gains would seem to violate ethical norms under virtually any system.²⁸ And yet, the efficiency principle sanctions such results.

Indeed, it is fundamental to the Kaldor-Hicks efficiency criterion that it trades off gains to one set of people for losses to another. The theory is that implementing a policy that is Kaldor-Hicks efficient has the potential to leave all individuals better off than they were before. In a state of Kaldor-Hicks efficiency, it is by definition true that if the winners compensated the losers for their losses, the winners would still have some gains left over. But there is nothing about the Kaldor-Hicks efficiency criterion itself that actually requires such a transfer to take place.

Within a domestic political system, the use of Kaldor-Hicks efficiency can be defended on the ground that, once policies are implemented to achieve efficiency, the “bigger pie” can be re-distributed among members of society according to principles of equity and justice through taxing and spending programs enacted by the government. This argument is problematic, not least because Kaldor-Hicks efficiency often requires trading lives for money. But on the global scale, the problem runs even deeper. Because there is no government with authority to redistribute resources across national borders, we cannot assume that any inequitable distributions that occur as a byproduct of the pursuit of efficiency can be cured at all.

e.g., SAMUEL FANKHAUSER, VALUING CLIMATE CHANGE: THE ECONOMICS OF THE GREENHOUSE 47–48 (1995) (using a statistical value of life in “high income” countries of \$1,500,000, in “middle income” countries of \$300,000, and in “low income” countries of \$100,000). These differing “values of a statistical life” (VSL) are based on studies in different regions investigating people’s willingness to pay to avoid risk (or willingness to accept payment to take on risk). *Id.* The results of such studies can vary dramatically in different regions of the world. While in the United States, such studies yield a median VSL of approximately \$7 million, *see* W. Kip Viscusi, *The Value of Life*, in THE NEW PALGRAVE DICTIONARY OF ECONOMICS AND THE LAW 586, 586 (2d ed., Steven N. Durlauf & Lawrence E. Blume, eds., 2008), studies of VSL in the developing world have produced values as low as \$20,000, *see, e.g.*, K. PARIKH ET AL., VALUING AIR POLLUTION IN BOMBAY (1994), *cited in* Samuel Fankhauser, Richard S. J. Tol & David W. Pearce, *Extensions and Alternatives to Climate Change Impact Valuation: On the Critique of IPCC Working Group III’s Impact Estimates*, 3 ENV’T & DEV. ECON. 59, 67–68 (1998).

28. *See* Christian Azar & Thomas Sterner, *Discounting and Distributional Considerations in the Context of Global Warming*, 19 ECOLOGICAL ECON. 169, 170 (1996).

The question of who should pay is fundamentally a question of distribution. As such, economic theory and the principle of efficiency offer no guidance.²⁹ For the who-should-pay question, we must instead turn to principles of justice and fairness.³⁰ The question of who should *reduce* greenhouse-gas emissions, on the other hand, is a question about how big we can make the pie, and, as such, is an appropriate question for economics.

A. *Economic Theory's Answer to Who Should Reduce: Taxes or Cap-and-Trade*

Economic theory demonstrates that we can get the largest aggregate amount of pollution reduction at the lowest cost by implementing either a tax or a cap-and-trade scheme. To see why such schemes are theoretically efficient, first imagine the most prominent alternative: a traditional permit system. Under such a system, the government issues permits requiring each polluter to reduce its emissions by a particular amount. A polluter that fails to comply with its permit limits pays a fine. If all polluters faced identical pollution-control costs, such a system

29. See Kaldor, *supra* note 13, at 550–51; Sen, *supra* note 12, at 351–52; see also ADLER & POSNER, *supra* note 23, at 186 (“The purpose of [cost-benefit analysis], as typically understood, is to separate out the distributional issue and isolate the efficiency issue, so that the agency will evaluate projects solely on the basis of their efficiency.”); WARWICK J. MCKIBBEN & PETER J. WILCOXEN, CLIMATE CHANGE POLICY AFTER KYOTO: BLUEPRINT FOR A REALISTIC APPROACH 67 (2002) (“Economists are trained to worry about efficiency and to leave matters of equity and distribution to policymakers. With climate change, however, that dichotomy is untenable.”); Joseph E. Aldy et al., *Thirteen Plus One: A Comparison of Global Climate Policy Architectures*, 3 CLIMATE POL’Y 373, 377 (2003) (acknowledging that although distributional issues are “exceptionally important” in climate change policy, no method exists for incorporating these issues into the analysis of efficiency); Jamieson, *supra* note 3, at 286–87; Laurence H. Tribe, *Constitutional Calculus: Equal Justice or Economic Efficiency?*, 98 HARV. L. REV. 592, 594–95 (1985) (“[The] disregard of the *distributional* dimension of any given problem is characteristic of the entire law-and-economics school of thought, which assumes a world in which no one is economically coerced and in which individuals who do not ‘buy’ things are said to be ‘unwilling,’ rather than unable, to do so.”). *But see* Matthew D. Adler, *Risk Equity: A New Proposal*, 32 HARV. ENVTL. L. REV. 1, 1 (2008) (arguing that questions of distributional justice are “firmly grounded in the social-welfare-function tradition in welfare economics” and proposing a new method for incorporating such questions into government decision making).

30. Adam Rose et al., *International Equity and Differentiation in Global Warming Policy*, 12 ENVTL. & RESOURCE ECON. 25, 25–26 (1998) (asserting that efficiency is not enough when addressing global warming policy; equity considerations are also crucial and may play a practical role as unifying principles that help facilitate international agreement: “Many analysts of the issue have concluded that greater cooperation is likely to be forthcoming if the policy process, implementation decision, and outcomes are perceived to be fair”). *But see* Wilfred Beckerman & Joanna Pasek, *The Equitable International Allocation of Tradable Carbon Emission Permits*, 5 GLOBAL ENVTL. CHANGE 405, 411 (1995) (“It is doubtful, however, if any theories of justice can provide much help in determining the international allocation of [emissions] permits.”).

would be just as efficient as a tax or cap-and-trade scheme. But, in fact, pollution-control costs usually vary significantly from facility to facility. Accordingly, a traditional permit scheme requires polluters for whom reduction is expensive to reduce just as much as polluters for whom reduction is cheap.

A tax or a cap-and-trade scheme, on the other hand, induces more pollution reduction from those for whom it is cheap and less from those for whom it is expensive. Under a pollution tax, each polluter has to pay some amount of money to the government for every unit of pollution it releases into the atmosphere. The polluters for whom pollution reduction is cheap will reduce pollution levels rather than pay the tax. But the polluters for whom pollution reduction is expensive will simply pay the tax rather than reduce pollution. Thus, for any given tax rate, more of the pollution reduction will come from those for whom it is cheaper, and less will come from those for whom it is expensive. In this way, a tax can achieve the same aggregate amount of pollution reduction for less cost than a traditional regulatory scheme that simply demands the same amount of pollution reduction from each polluter.³¹

A cap-and-trade scheme reaches the same result in a different way. First, the government (or some international body) sets an overall cap on the amount of pollution it will allow all sources in the aggregate to emit. Then it prints up a number of tradable allowances equal to the total amount of the cap and distributes them. It may distribute them through an auction, or it may hand them out to firms or individuals (or countries) for free based on some criterion like existing emissions levels or equal per capita shares. Finally, it tells the polluters they must have an allowance for each unit of pollution they emit. This creates a market in pollution allowances. As with a tax, those for whom pollution reduction is cheapest do most of the reducing. Firms for whom pollution reduction is cheap will reduce their pollution levels a lot and then sell their excess allowances and make a profit. Firms for whom reducing pollution costs more than the price of an allowance will prefer to simply buy extra allowances on the market and pollute more. The result is a cost-effective system of pollution reduction, much like that which would be achieved

31. See TOM TIETENBERG, ENVIRONMENTAL AND NATURAL RESOURCE ECONOMICS 51–54 (1992). In an economist's ideal world, the government would set the tax rate at the dollar amount precisely equal to the marginal social cost of the pollutant and let the market determine the overall pollution level. In practice, however, such precise calculations of social costs are impossible. See Amy Sinden, *The Tragedy of the Commons and the Myth of a Private Property Solution*, 78 U. COLO. L. REV. 533, 555 & n.65 (2007).

under a tax.³² In fact, from the standpoint of economic theory, the two systems are generally equivalent.³³

B. Distributional Implications of Taxes and Cap-and-Trade

Tax and cap-and-trade schemes are thus lauded for their efficiency, but their distributional implications often remain unexamined. Technically, any distributional scheme is possible under a tax or a cap-and-trade system. It all depends on how the tax revenues are distributed under a tax, and how either the auction revenues or the allowances themselves are distributed under a cap-and-trade.³⁴ But in practice, particularly at the global scale, such systems tend to promote a status quo distribution. Because there is no global institution for collecting and distributing tax or auction revenues, taxes or cap-and-trade systems are likely to be administered by national governments. The revenues generated by a tax or an auction are therefore likely to be collected by

32. The idea was first developed by Canadian economist J.H. Dales in 1968. J.H. DALES, POLLUTION, PROPERTY, AND PRICES: AN ESSAY IN POLICY MAKING AND ECONOMICS 93–98 (1968). Nearly two decades later, it was introduced into the legal literature by Bruce Ackerman and Richard Stewart. See Bruce A. Ackerman & Richard B. Stewart, *Reforming Environmental Law*, 37 STAN. L. REV. 1333 (1985); Bruce A. Ackerman & Richard B. Stewart, *Reforming Environmental Law: The Democratic Case for Market Incentives*, 13 COLUM. J. ENVTL. L. 171 (1988); Richard B. Stewart, *Controlling Environmental Risks Through Economic Incentives*, 13 COLUM. J. ENVTL. L. 153 (1988); Richard B. Stewart, *Economics, Environment, and the Limits of Legal Control*, 9 HARV. ENVTL. L. REV. 1 (1985).

If, in fact, the global cap on greenhouse-gas emissions must ultimately be reduced to zero, or near zero, trading in allowances will eventually slow down and then stop altogether. As the cap declines toward zero, eventually, there will no longer be enough allowances to create a functioning market. At this point, the program would operate like a traditional regulatory permit scheme.

33. More precisely, the economics literature shows that where the regulator knows the marginal costs of pollution control, then taxes and trading are equivalent—that is, they can be used to achieve exactly the same outcomes. See WILLIAM J. BAUMOL & WALLACE E. OATES, *THE THEORY OF ENVIRONMENTAL POLICY* 58 (2d ed., Cambridge Univ. Press 1988) (1975) (“It is clear that when the relevant functions are known with certainty by a welfare-maximizing regulator, exactly the same result will be achieved by a market in allowances permits and by a system of effluent charges.”); M.L. Weitzman, *Prices Versus Quantities*, 41 REV. ECON. STUD. 477 (1974). Where the costs of control are not known (as is typically true in practice), there is substantial debate as to which system is better. See, e.g., Robert N. Stavins, *Correlated Uncertainty and Policy Instrument Choice*, 30 J. ENVTL. ECON. & MGMT. 218, 219–29 (1996) (asserting that where there is uncertainty about both costs and benefits, and where those two uncertainties are correlated—if costs are *under*-estimated, benefits are also *under*-estimated—then trading will be more efficient); Weitzman, *supra*, at 479–85 (asserting that where there is uncertainty about costs, which instrument produces the more efficient result will depend on the relative slopes of the marginal benefit and cost curves); William Pizer, *Prices vs. Quantities Revisited: The Case of Climate Change* 19 (Resources for the Future Discussion Paper No. 98-02, 1997) (arguing taxes are better in climate change context).

34. See Rose, *supra* note 30, at 29 (noting that same distributional results can be achieved by either distributing permits in cap-and-trade or distributing tax revenues under a tax).

national governments and perceived as rightly belonging to the national government that collected them, unless, as described below, there is some system for distributing allowances across national boundaries.

If the costs of cutting emissions were roughly the same throughout the world, then a globally uniform tax imposed by each national government would induce approximately the same percentage reduction in each country. If every country imposed a tax of \$20 per ton of CO₂, for example, we might expect that to result in emissions reductions of roughly 15% in each country.³⁵ Under such a scenario, the United States would reduce its emissions from 7 to 6.3 billion tons, and India would reduce its emissions from 1.5 to 1.35 billion tons.³⁶ And while national governments could use tax revenues to redistribute the costs of those reductions any way they liked within their borders, each country would bear the costs of its own reductions. The same result would occur if each national government administered a cap-and-trade program and auctioned the allowances.³⁷

Either arrangement would essentially amount to a status quo or equal-percentage-reduction approach to the who-should-pay question.³⁸ It would be analogous to a flat tax.³⁹ Countries with very low emissions levels would have to bear the costs of cutting emissions by the same percentage as countries with very high emissions levels.

In reality, a globally uniform tax would be even more regressive. Because mitigation costs are generally lower in the developing world, such a tax would undoubtedly result in a higher rate of abatement—more tons of CO₂ abated per ton of CO₂ emitted—in the developing world

35. See WILLIAM NORDHAUS, *THE CHALLENGE OF GLOBAL WARMING: ECONOMIC MODELS AND ENVIRONMENTAL POLICY* 121–24. (2007).

36. See ENERGY INFO. ADMIN., DOE/EIA-0573, *EMISSIONS OF GREENHOUSE GASES IN THE UNITED STATES 2008 1* (2009), available at <http://www.eia.doe.gov/oiaf/1605/ggrpt/pdf/0573%282008%29.pdf> (reporting 2007 U.S. greenhouse-gas emissions of 7.209 billion metric tons in CO₂ equivalents); Subodh Sharma et al., *Greenhouse Gas Emissions from India: A Perspective*, 90 *CURRENT SCI.* 326, 328 (2006) (reporting 2000 greenhouse-gas emissions in India of 1.485 billion metric tons in CO₂ equivalents).

37. See Eric A. Posner & Cass R. Sunstein, *Climate Change Justice*, 96 *GEO. L. J.* 1565, 1586 (2008) [hereinafter Posner & Sunstein, *Justice*] (noting the similarity between a uniform tax and a cap-and-trade program that distributes allowances on the basis of existing emissions: “both take existing emissions rates as the starting point”). This is the general form that the Kyoto protocol took, at least with respect to those countries that took on binding emissions reduction targets. Those targets were tied to existing emissions levels, with most countries agreeing to reduce emissions by 8% from 1990 levels. See Kyoto Protocol to the United Nations Framework Convention on Climate Change art. 3.1 & annex B, *opened for signature* Mar. 16, 1998, 2303 U.N.T.S. 148 (*entered into force* Feb. 16, 2005) available at <http://unfccc.int/resource/docs/convkp/kpeng.pdf>.

38. See *infra* notes 46–48 and accompanying text.

39. See *infra* note 170 and accompanying text.

than in the developed world.⁴⁰ Thus, developing countries would bear the costs of reducing their emissions by an even greater percentage than developed countries.⁴¹

A more globally progressive tax system could not be implemented without some international institution with the authority to redistribute tax revenues across borders. Such an institution, which would look perilously similar to a world government, is a political impossibility at present. A global cap-and-trade system, on the other hand, that allocated allowances among countries so as to achieve a more progressive distribution of costs is perhaps more politically conceivable.⁴² One could imagine, for example, an international cap-and-trade system under which allowances were allocated to countries on a per capita basis. Under such a scheme, while a lot of the reductions would occur in the developing world where outdated technologies provide numerous opportunities for low-cost reductions, the costs of those reductions would be borne largely by the developed countries, which would have to buy allowances from developing countries in order to support their present level of development. Indeed, many developing countries would (initially, at least) get more allowances than they had emissions, and thus could make money by selling allowances to developed countries without reducing at all.⁴³ One might view these payments from the developed to the developing world either as paying for future emissions cuts that the developing world would have to make eventually as the cap ratcheted down, or as helping to pay adaptation costs for harms that have already been made inevitable.

Technically, a similar distribution could be achieved by wealthy countries simply transferring a large share of the revenues they generated through either a tax or an allowance auction to developing countries. But no matter how well-intentioned, such a system would have a very different feel. Once one country has collected tax or auction revenues within its own borders, those revenues look and feel like the legitimate property of that country. When that country then uses such revenues to make a payment to others, the payment looks far more like a discretionary charitable donation than like payment of a debt or an

40. See Kristen Sheeran, *Beyond Kyoto: North-South Implications of Emissions Trading and Taxes*, 5 SEATTLE J. SOC. JUST. 697, 700 (2007).

41. See Aldy et al., *supra* note 29, at 377, 382.

42. Such a system might adopt much of the same structure as the Kyoto Protocol, but extend participation to all nations and use a different formula to determine each country's emissions reduction obligations.

43. This assumes a cap that starts higher and ratchets down over time.

obligation owed. Furthermore, because collection of taxes and distribution of revenues are fundamental powers of government, a global institution with the power to effectuate such international transfers of tax or auction revenues would look far too much like “world government” to be politically saleable.

In sum, economic theory is helpful in answering the who-should-reduce question. Who should pay, on the other hand, is fundamentally a distributional question. As such, economic theory and the principle of efficiency, or aggregate social welfare, in which it is grounded offers no guidance. Indeed, economic theory contains implicit biases in favor of the status quo that, as we will see in the following sections, are at odds with widely accepted notions of fairness and justice.

II. WHO SHOULD PAY? THREE APPROACHES

Many different approaches to the who-should-pay question have been proposed, but they cluster roughly in three categories. The status quo approaches involve various schemes that are the rough equivalent of distributing allowances based on existing emissions. These approaches take each country’s existing emissions levels as the starting point and prescribe roughly equivalent percentage reductions from those levels. The per capita approaches allocate emissions allowances to each country in proportion to population. Finally, the ability-to-pay approaches allocate allowances on the basis of financial need so that those with the least wealth and resources receive the largest share of allowances. While there are also plenty of hybrid proposals that combine elements of each of these approaches,⁴⁴ for the purposes of this analysis, it will be clearer to treat each one separately.

A. *Status Quo Approaches*

These approaches all explicitly or implicitly endorse the status quo with respect to the level of emissions that each country produces. They all start with each country’s existing level of emissions and require each country to pay for roughly equal percentages of reductions from those levels.⁴⁵

44. See generally DANIEL BODANSKY, PEW CENTER ON GLOBAL CLIMATE CHANGE, INTERNATIONAL CLIMATE EFFORTS BEYOND 2012: A SURVEY OF APPROACHES (2004).

45. Eric Posner and Cass Sunstein use the same term—“status quo approach”—to refer to a similar idea, which they characterize as “tempting.” See Eric A. Posner & Cass R. Sunstein, *Should Greenhouse Gas Permits Be Allocated on a Per Capita Basis?*, 97 CAL. L. REV. 51, 51 (2009) [hereinafter Posner & Sunstein, *Per Capita*] (“It is tempting to suggest that the status quo, across

1. *Equal-Percentages Approach*

A seemingly simple approach is to require each country to pay to reduce its existing emissions by the same percentage.⁴⁶ This was roughly the formula first proposed in the negotiation of the Kyoto Protocol (at least among developed countries), before the United States insisted on incorporating trading mechanisms into the accord.⁴⁷ Assuming that different countries face different emissions-control costs, of course, such a system results in an inefficient answer to the who-should-reduce question, because countries for whom emissions reduction costs are high are forced to implement the same percentage reductions as those for whom emissions reduction costs are low.⁴⁸ This also has distributional implications because, to the extent pollution control costs vary from country to country, the costs borne by each country would not be equal, even as a percentage of existing emissions.

2. *Allocation of Allowances Based on Existing Emissions*

A similar approach that produces an efficient answer to the who-should-reduce question imposes a global cap-and-trade program and allocates allowances to each country based on existing emissions levels. To the extent that the cap is lower than total existing emissions, each country's allocation is reduced by the same percentage. This achieves an efficient allocation of emissions reductions and also achieves a certain kind of equity, at least in comparison to the last approach. The costs borne by each country do not depend on their per-unit emissions-control costs. Rather, two countries with the same existing emissions levels incur the same emissions-control costs.

nations, provides the appropriate baseline [for the allocation of emissions rights]."). See also Michael Grubb, *Seeking Fair Weather: Ethics and the International Debate on Climate Change*, 71 INT'L AFF. 463, 487 (1995) (calling this approach the "status quo" approach).

46. This is the outcome of a globally uniform tax where all countries have similar marginal cost curves. See *infra* Part II.A.3.

47. See Michael Grubb, *Kyoto and the Future of International Climate Change Responses: From Here to Where?*, 5 INT'L REV. FOR ENVTL. STRATEGIES 1, 1 n.7, available at <http://www.econ.cam.ac.uk/rstaff/grubb/publications/J37.pdf> (noting that the European Union initially called for flat rate reductions of 10–15%); Derald J. Hay, *Post-Kyoto Stress Disorder: How the United States Can Influence International Climate Change Policy*, 15 MO. ENVTL L. & POL'Y REV. 494, 502 (2008) ("During the negotiations in Kyoto, the United States pushed for the adoption of a framework to permit emissions trading among the nations as a means for nations to meet obligations under the treaty.").

48. See *supra* Part I.A.

This is a common approach to trading schemes in general.⁴⁹ It is also the general approach the Kyoto Protocol took, at least among the developed countries.⁵⁰ Even the United States, which refused to ratify Kyoto, endorsed this general principle.⁵¹ Indeed, the United States objected to Kyoto precisely because it failed to make this principle broadly applicable to all countries.⁵² Despite its prominence, this proposal has the obvious drawback of rewarding past inefficiency in carbon-based energy use.⁵³

3. *Globally Uniform Tax*

A variant on the status quo approach is a globally uniform tax. This is an approach advocated by many economists.⁵⁴ As noted above, the use of a tax as the regulatory mechanism should have no distributional implications in theory and thus should have no implications for the who-should-pay question. In practice, however, a tax is very likely to have distributional implications. Because tax revenues do not flow across national boundaries, the costs of emissions reductions under a globally uniform tax would remain in the country in which they were incurred.⁵⁵ Assuming similar marginal-cost curves for reducing emissions in each country, such a tax would produce roughly the same percentage of emissions reductions (and the same percentage of costs) in each country. In that case, a globally uniform tax would have the same distributional effect as the equal-percentages approach. Assuming the marginal-cost curves for reducing emissions in developing countries are lower

49. See Richard N. Cooper, *Toward a Real Global Warming Treaty*, FOREIGN AFF., Mar.–Apr. 1998, at 66, 70.

50. See Tom Tietenberg & David G. Victor, *Possible Administrative Structures and Procedures for Implementing a Tradeable Entitlement Approach to Controlling Global Warming*, in UNITED NATIONS, COMBATING GLOBAL WARMING 10 (1994) (“[T]he normal presumption for Annex I countries would be that they would receive entitlements equal to their 1990 emissions levels.”); Richard N. Cooper, *The Kyoto Protocol: A Flawed Concept* 15 (Fondazione Eni Enrico Mattei (FEEM), Working Paper No. 52, 2001), available at <http://ssrn.com/abstract=278536> (noting that Kyoto allocated emissions rights on the basis of historical emissions).

51. DONALD A. BROWN, AMERICAN HEAT: ETHICAL PROBLEMS WITH THE UNITED STATES’ RESPONSE TO GLOBAL WARMING 37–39, 70 (2002).

52. See Byrd-Hagel Resolution, S. Res. 98, 105th Cong. (1997).

53. See WILLIAM R. CLINE, THE ECONOMICS OF GLOBAL WARMING 352–53 (1992); Sujata Gupta & Preeti M. Bhandari, *An Effective Allocation Criterion for CO₂ Emissions*, 27 ENERGY POL’Y 727, 729 (1999) (arguing the equal-percentages approach penalizes countries that are efficient in their use of carbon-intensive energy).

54. See, e.g., CLINE, *supra* note 53, at 352; Cooper, *supra* note 49, at 74.

55. See Cooper, *supra* note 49, at 76 (“Each country would be free to dispose of the emission tax revenues as it judged best.”).

(probably a more realistic scenario), a globally uniform tax would be even more regressive in its distributional effects than the status quo approach. Under this scenario, because even more of the reductions would occur in the developing world and because revenues would remain within national borders, developing countries would pay to reduce their emissions by an even larger percentage than developed countries.⁵⁶

Indeed, one could even imagine a situation in which a globally uniform tax results in the developing world performing all of the emissions reductions and bearing all the costs, while the developed world pays nothing. Imagine there are just two countries on earth: Country *A* is a developed country and Country *B* is a developing country. In Country *A*, every ton of emissions reduction costs \$6 or more. In Country *B*, every ton of emissions reduction costs \$4 or less. Now imagine that both countries impose a globally uniform tax of \$5 on each ton of emissions. In Country *A*, no emissions reduction will occur because polluters will pay the \$5 tax on each ton of emissions they produce rather than the \$6 (or more) that it costs to reduce one ton of emissions. The government will collect lots of tax revenue, which it can distribute back to its citizens any way it likes, but the country as a whole will incur zero emissions-control costs. Conversely, in Country *B*, would-be polluters will instead eliminate every ton of emissions at \$4 or less in order to avoid paying the \$5 tax. The government will collect no tax revenue, but the country as a whole will incur large emissions-control costs. Indeed, Country *B* will incur all the emissions-control costs for the world.

4. *Allocation of Allowances Based on GDP*

Another approach would award allowances in a cap-and-trade program on the basis of GDP.⁵⁷ This approach is roughly equivalent to the equal-percentages approach because GDP roughly tracks emissions, but the GDP approach has the advantage of not directly rewarding countries that have used carbon-intensive methods of energy

56. See *supra* notes 35–41 and accompanying text. A similar distribution would result from a global cap-and-trade program in which all permits were auctioned by individual national governments, but this option is less frequently treated as being entirely divorced from distributional considerations. This is probably because cap-and-trade allows for the obvious possibility of an alternative distribution scheme through the direct allocation of allowances.

57. See CLINE, *supra* note 53, at 353; David A. Wirth & Daniel A. Lashof, *Beyond Vienna and Montreal: A Global Framework Convention on Greenhouse Gases*, 2 *TRANSNAT'L L. & CONTEMP. PROBS.* 79, 101 (1992).

production.⁵⁸ If two countries had the same GDP, but one achieved that GDP by producing large amounts of carbon emissions and the other managed to keep carbon emissions to a minimum, the equal percentages approach would produce the perverse result of awarding more allowances to the carbon-profligate country. The GDP approach, in contrast, would award the same emissions quota to each country.

B. Per Capita Approaches

While the last set of approaches all use a nation's aggregate emissions as their starting point, another set of approaches treats individual emissions as the relevant unit of measure. These per capita approaches are generally easiest to conceptualize in the context of a global cap-and-trade program. They are all grounded in the idea that each individual on earth should be entitled to an equal share of the absorptive capacity of the atmosphere. So under a global cap-and-trade program that took a per capita approach, each individual would be entitled to an equal number of allowances, or alternatively, each country would be allocated allowances in proportion to its population. Because per capita emissions in the developed world are currently many times larger than those in the developing world, developed countries would have far too few allowances to cover existing emissions. Conversely, most developing countries would initially have allowances far in excess of their existing emissions and would therefore have extra allowances to sell. Accordingly, developed countries would, initially at least, have to pay substantial sums of money to the developing world to buy allowances from them. A similar distribution could theoretically be achieved through the use of a tax, though it would require large transfers of tax revenues across national borders.

1. Prospective Equal Shares

Assuming a global cap-and-trade program, a prospective-equal-shares approach would work by dividing the global cap by world population (as of some specified date) to derive a yearly greenhouse-gas-emissions quota for each individual. Each country⁵⁹ would then be allocated an

58. See CLINE, *supra* note 53, at 353.

59. Ideally, an equal-shares approach would allocate allowances or shares directly to each individual on earth. Indeed, some have proposed that national governments could administer systems of personal carbon entitlements that would be tradable. But such schemes obviously present formidable logistical challenges. See, e.g., Mayer Hillman, *A Modest Proposal to Save the Planet*, THE INDEPENDENT (May 27, 2004), <http://www.independent.co.uk/environment/a-modest-proposal->

annual allotment of emissions allowances derived by multiplying its population (on the specified date) by the individual quota.⁶⁰ Per capita emissions levels in developed countries might well continue to exceed those in developing countries, but in order to do so the developed countries would have to buy allowances from the developing world.⁶¹

The question of which population statistics to use raises some difficult issues. If each country's emissions budget were adjusted each year to reflect changes in population, this would create a perverse incentive, effectively rewarding those countries with the fastest growing populations. This problem could be solved by arbitrarily picking a date and using that date's population statistics to allocate national allowances.⁶² Some have proposed using 1990 population numbers.⁶³ Peter Singer argues for using estimates of future population levels at some agreed-upon date several decades into the future, in order to avoid penalizing those countries with younger populations.⁶⁴ But such an approach would arguably have the effect of penalizing countries that

to-save-the-planet-564794.html. But in light of the fact that international relations rest fundamentally on a system of mutual respect for national sovereignty, any global solution to climate change will have to begin with an agreement to allocate the costs of mitigation among sovereign nations rather than among individuals. *See* Gupta & Bhandari, *supra* note 53, at 728.

60. *See* Gupta & Bhandari, *supra* note 53, at 729. *But see* Henry Shue, *Climate*, in *A COMPANION TO ENVIRONMENTAL PHILOSOPHY* 455 (Dale Jamieson ed., 2001) (arguing that each individual should be entitled to the minimum share of emissions rights necessary to survival and that this minimum share should be non-tradable: "A society in which food is available only for payment is a brutal and uncivilized place. What is suggested here is merely the equivalent of food stamps on the global level for vital emissions."). *See also* BODANSKY, *supra* note 44, at 39 (describing an approach grounded in human development goals which "[s]ets emission targets at levels that would allow emissions to satisfy basic human needs, but would limit 'luxury' or 'excessive' emissions").

61. Deciding which emissions to attribute to each country for accounting purposes is not necessarily as straightforward as it might seem. Who, for example, should be held responsible for the emissions produced by a factory in China that produces a toy bought by a consumer in the United States? While the standard approach is to hold countries responsible for all the emissions produced within their borders, a system that allocated emissions based on consumption instead might arguably be more consistent with principles of causation on which notions of responsibility are ultimately grounded. The choice of how to attribute responsibility for these emissions embodied in the consumer goods that are traded across international borders is not trivial. Indeed, a recent study found that the carbon embodied in U.S. imports from China in 2003 represented 6% of total U.S. CO₂ emissions. *See* Bin Shui & Robert C. Harriss, *The Role of CO₂ Embodiment in U.S.-China Trade*, 34 *ENERGY POL'Y* 4063, 4067 (2006).

62. *See* BRIAN BARRY, *WHY SOCIAL JUSTICE MATTERS* 257, 267 (2005) (arguing that current population statistics should be used as long as rich countries implement proposed policies to keep their population increase down). A similar effect would be created by Michael Grubb's suggestion that only people above a certain age be counted. *See* Grubb, *supra* note 45, at 486.

63. *See* BROWN, *supra* note 51, at 215.

64. PETER SINGER, *ONE WORLD: THE ETHICS OF GLOBALIZATION* 36 (2002).

have already taken steps to limit population growth. China, for example, now has a relatively old population as a result of its one-child policy.⁶⁵

Some have also suggested that we should measure each nation's budget of greenhouse-gas emissions by taking into account not only each country's sources of emissions, but its terrestrial sinks as well. This would involve estimating the amount of CO₂ absorbed by forests and other vegetation within the country's borders. We might also further reduce each country's budget by its "fair share of the oceanic and tropospheric sinks" that are outside the jurisdiction of any one country and therefore part of the "common heritage of humankind."⁶⁶ Under this kind of measurement system, some developing countries might well have a zero or negative balance. For example, in the early 1990s, India produced only 6% of the CO₂ and 14.4% of the methane that is absorbed by the earth's ecological systems.⁶⁷ Because India's population at that time comprised 16.2% of the world's total population, under such a scheme it would have had a negative emissions balance.⁶⁸

2. *Historical Equal Shares*

The prospective-equal-shares approach takes no account of history. It simply looks at the distribution of the absorptive capacity of the atmosphere at the present moment and asks how it might be fairly distributed.⁶⁹ But arguably, an equal-shares approach should also take the historical distribution of emissions into account. Greenhouse gases can remain in the atmosphere for centuries or even millennia after they are emitted,⁷⁰ and it is the total accumulation of greenhouse gases in the atmosphere that drives the greenhouse effect, rather than the flow of

65. Arguably, China ought to get some credit under a future-population scheme because of the fact that it has already limited its population growth. Indeed, China takes the position that its one-child policy is part of its climate change policy, and has had the effect of preventing 1.3 billion tons of annual CO₂ emissions that would otherwise have occurred. See NAT'L DEV. & REFORM COMM'N, P.R.C., CHINA'S NATIONAL CLIMATE CHANGE PROGRAMME 11 (2007), <http://en.ndrc.gov.cn/newsrelease/P020070604561191006823.pdf>.

66. See ANIL AGARWAL & SUNITA NARAIN, GLOBAL WARMING IN AN UNEQUAL WORLD: A CASE OF ENVIRONMENTAL COLONIALISM 4 (1991).

67. See *id.* at 6.

68. *Id.*

69. The prospective-equal-shares approach applies what some philosophers would call "current time-slice principles of justice." See ROBERT NOZICK, ANARCHY, STATE, AND UTOPIA 153-55 (1974).

70. See Alvaro Montenegro et al., *Long Term Fate of Anthropogenic Carbon*, 34 GEOPHYSICAL RES. LETTERS L19707, 1 (2007) (concluding that "25% [of CO₂ emissions] have lifetimes much longer than 5000 years").

emissions into the atmosphere at any given time.⁷¹ Accordingly, we can think of the greenhouse gases already emitted into the atmosphere over the last century as having already begun to “use up” some of the available absorptive capacity of the atmosphere. The United States, for example, with less than 5% of the world’s population, is responsible for well over 25% of the greenhouse gases currently accumulated in the atmosphere.⁷²

One way to try to account for history would be to imagine going back in time and applying the prospective-equal-shares principle at the moment humans first began using up the atmosphere’s absorptive capacity by emitting greenhouse gases in substantial amounts. We might, for example, imagine dividing the absorptive capacity of the atmosphere into equal shares two centuries ago, at the eve of the Industrial Revolution. We could then use this historical accounting to hold the developed countries responsible for the atmospheric debt that they have accrued over the last two hundred years.

Some have suggested beginning a historical accounting at a much later date in order to avoid the conceptual difficulties involved in holding a current generation responsible for the actions of previous generations and in order to diffuse objections to holding countries responsible for emissions that occurred before the harms associated with those emissions were reasonably foreseeable.⁷³ One might begin the accounting in the late 1980s or early 1990s, for example.⁷⁴

A historical-equal-shares approach would calculate the total amount of global greenhouse-gas emissions that occurred between the start date and the present date; it would then divide that total by the average world population during that period to get a per capita carbon-emission entitlement. Multiplying that per capita entitlement by each country’s average population during that period would then yield a historical

71. See Richard B. Alley et al., Intergovernmental Panel on Climate Change (IPCC), *Summary for Policymakers*, in CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS 17 (Susan Solomon et al. eds., 2007) (“Both past and future anthropogenic carbon dioxide emissions will continue to contribute to warming and sea level rise for more than a millennium, due to the time scales required for removal of this gas from the atmosphere.”).

72. See KEVIN A. BAUMERT, ET AL., WORLD RESOURCES INSTITUTE, NAVIGATING THE NUMBERS: GREENHOUSE GAS DATA AND INTERNATIONAL CLIMATE POLICY 32 (2005) (finding the United States responsible for 29.3% of cumulative CO₂ emissions from 1850 to 2002).

73. See *infra* Part V.C. and accompanying text.

74. See Daniel A. Farber, *Adapting to Climate Change: Who Should Pay*, 23 J. LAND USE & ENVTL. L. 1, 29–30 (2007) (suggesting 1992 as a cut-off date for apportioning responsibility for climate change adaptation according to a polluter-pays principle); Lisa Heinzerling, *Climate Change, Human Health, and the Post-Cautionary Principle*, 96 GEO. L.J. 445, 454–57 (2008) (arguing that scientific consensus on climate change became clear in the late 1980s or early 1990s).

allowance for each country. By comparing each country's historical allowance with its actual emissions during that period, we could then calculate the amount by which each country's actual total emissions exceeded (or fell short of) its allowance. Those countries whose total emissions exceeded their respective allowances would be required to buy down their excess emissions by purchasing credits from those whose total emissions fell short of their allowances.

3. *The Brazilian Proposal*

Another approach that would take historical responsibility into account was proposed by Brazil in a submission to the United Nations in 1997 in preparation for the negotiation of the Kyoto Protocol.⁷⁵ This proposal did not take a strict per capita approach; like the agreement that ultimately came out of the Kyoto negotiations, Brazil's proposal left the developing nations out of the proposal entirely. Like a per capita approach, however, it put the initial burden of reducing greenhouse-gas emissions and paying for those reductions on the developed countries, requiring the Annex I⁷⁶ countries to collectively reduce their emissions to 30% below 1990 levels by 2020.⁷⁷ But the Brazilian proposal also took historical emissions into account. It specified that the burden of reducing emissions to meet the 2020 target would fall on the Annex I countries in proportion to each country's relative share of responsibility for the increase in global temperature from 1840 on.⁷⁸ Under a complex formula, the proposal would have required the United Kingdom to reduce its emissions to 66% below 1990 levels by 2020, and the United States to reduce by 23%.⁷⁹ Trading emission allowances would have

75. See U.N. Framework Convention on Climate Change, Ad Hoc Group on the Berlin Mandate, 7th Session, Bonn, F.R.G., July 31–Aug. 7, 1997, *Implementation of the Berlin Mandate: Additional Proposals from Parties*, 7, U.N. Doc. FCCC/AGBM/1997/MISC.1/Add.3 (May 30, 1997) [hereinafter *Berlin Mandate*].

76. Annex I refers to the countries listed in Annex I to the U.N. Framework Convention on Climate Change. See United Nations Framework Convention on Climate Change (UNFCCC), Annex I, *opened for signature* June 4, 1992, 1771 U.N.T.S. 107 (*entered into force* Mar. 21, 1994) [hereinafter UNFCCC].

77. *Berlin Mandate*, *supra* note 75, at 7.

78. *Id.* at 32–34.

79. *Id.* See also Emilio L. La Rovere, et al., *The Brazilian Proposal on Relative Responsibility for Global Warming*, in BUILDING ON THE KYOTO PROTOCOL: OPTIONS FOR PROTECTING THE CLIMATE 157, 159 (Kevin A. Baumert et al., eds. 2002), available at http://pdf.wri.org/opc_chapter7.pdf.

been allowed under the proposal, but only among the developed countries.⁸⁰

4. *Contraction and Convergence*

The Global Commons Institute has been advocating a per capita approach in international climate negotiations since 1990, under the name “Contraction and Convergence.”⁸¹ This model has been endorsed by a number of governmental and non-governmental organizations, including the European Parliament,⁸² the United Kingdom’s Royal Commission on Environmental Pollution,⁸³ and India.⁸⁴

Under the Global Commons Institute’s proposal, emissions quotas would ultimately be allocated to countries on a per capita basis. But the developed nations would first be given an adjustment period of several decades during which time they would reduce their emissions to a universal per capita level.⁸⁵ This is the “contraction” phase. Once the heaviest emitters of CO₂ had reduced their emissions levels, the right to emit carbon would be allocated to countries on a per capita basis.⁸⁶ This is the “convergence” phase. The precise rate and magnitude of the two phases would be worked out through international negotiations.⁸⁷ Once the convergence phase began, a global cap-and-trade program would be established so that nations that were unable to work within their per

80. *Berlin Mandate*, *supra* note 75, at 5.

81. See AUBREY MEYER, *CONTRACTION & CONVERGENCE: THE GLOBAL SOLUTION TO CLIMATE CHANGE* 19 (2000) (laying out the essence of Contraction & Convergence in three steps).

82. See Resolution on “Winning the Battle Against Global Climate Change,” EUR. PARL. DOC. (INI 2049) 4 (2005), available at <http://www.europarl.europa.eu/sides/getDoc.do?type=TA&reference=P6-TA-2005-0433&format=XML&language=EN> (“[A] future regime should be based on common but differentiated responsibilities, aiming at contraction and convergence.”).

83. See ROYAL COMM’N ON ENVTL. POLLUTION, ENERGY—THE CHANGING CLIMATE 3, 28, (2000), <http://www.rcep.org.uk/reports/22-energy/2000-22-summary.pdf>.

84. See BROWN, *supra* note 51, at 213 (describing the argument for equal per capita shares in greenhouse-gas emissions made by the Indian representative at global warming negotiations in Geneva in 1991).

85. This universal per capita level would be calculated based on an overall global cap calculated to stabilize atmospheric CO₂ levels at 450 parts per million (ppm). See BROWN, *supra* note 51, at 213.

86. See MEYER, *supra* note 81, at 19.

87. The Global Commons Institute has suggested setting a deadline of either 2020 or 2050 for reaching an equal-shares allotment (“convergence”). See GLOBAL COMMONS INST., *GCI BRIEFING: CONTRACTION AND CONVERGENCE*, <http://www.gci.org.uk/briefings/ICE.pdf> (last visited Mar. 25, 2010) (reproducing Aubrey Meyer, *Briefing: Contraction and Convergence*, 157 *ENGG SUSTAINABILITY* 189, 190 (2004)).

capita allocations of allowances would be able to purchase additional emissions allowances from other, more carbon-frugal countries.⁸⁸

While the second phase of the contraction and convergence model looks quite similar to a prospective-equal-shares approach, the overall distribution of costs it would accomplish would look considerably different. During the transition or “contraction” phase, developed countries would be allowed to emit significantly more greenhouse gases than their equal per capita share of emissions and would not be penalized for those excess emissions by having to buy allowances—as they would have to do under a prospective-equal-shares approach. In contrast, a prospective-equal-shares approach would distribute costs on the basis of equal shares immediately by allocating allowances on a per capita basis from the outset. This would allow the developed world to transition, not by letting them off the hook for their share of costs initially, but by allowing them to buy the right to continue releasing emissions in excess of their per capita equal share. Thus, by delaying an equal-shares allocation of costs for several decades, contraction and convergence would result in a much smaller transfer of money from the developed to the developing world than would a prospective-equal-shares approach.

C. Ability-to-Pay Approaches

Another set of approaches bases the allocation of costs on wealth (or lack thereof). Under these ability-to-pay approaches, allowances are allocated in inverse proportion to wealth. In this way, the richer countries, which have more ability to pay, bear more of the costs of reducing emissions, while poorer countries with little ability to pay, bear little or no cost.

1. Inverse Per Capita GDP Multiplied by Population

Perhaps the purest and simplest ability-to-pay approach would use a formula that multiplied population by the inverse of per capita GDP to produce an “ability-to-pay score.” Each country would then be allocated allowances in proportion to their score. Thus, countries with low per capita GDPs and large populations would get the largest allocation of allowances and countries with large per capita GDPs and small populations would get the smallest allocation. Such a formula would favor the developing world in the distribution of allowances, and like a per capita approach it would probably require developed countries to pay

88. See MEYER, *supra* note 81, at 19–20.

developing countries for the right to emit.⁸⁹ Indeed, it could well require an even greater payment from the developed to the developing world than the per capita approach.

2. *Hybrid Approaches*

Often, ability to pay is included as one of several factors in a more complicated formula.⁹⁰ The formula might, for example, simply divide countries into different categories based in part on per capita GDP and then apply requirements of differing stringencies to different categories.⁹¹ Or it might begin from a baseline of status quo allocations, but then increase a country's allocation of allowances if its per capita GDP falls below a certain level, or increase its allocation by an amount inverse to per capita GDP.⁹²

III. THREE MODELS OF JUSTICE

If we approach the who-should-pay question from the perspective of justice rather than efficiency, we can conceptualize the problem in several different ways. First, we can think of it as a property problem. We can think of the absorptive capacity of the atmosphere as a commonly held resource that must be allocated among all people or countries on earth. Second, we can think of it as a tort problem. One group of people has engaged in activities that are inflicting harm on themselves and others, and the problem is how to allocate the costs of stopping and compensating for those harms. Third, we can think of it as a kind of tax problem on an international scale. The nations of the world are engaged in a joint enterprise to promote the common good. The problem is how to apportion the costs of that enterprise.

The discussion that follows considers each of these models in turn. It evaluates how each of the three approaches to the who-should-pay

89. See BODANSKY, *supra* note 44, at 36 (describing a similar approach dubbed "Graduation and Deepening").

90. See, e.g., CLINE, *supra* note 53, at 353 (suggesting a formula that would combine status quo emissions, GDP, and per capita emissions).

91. See BODANSKY, *supra* note 44, at 43.

92. See Henry D. Jacoby et al., *Toward A Useful Architecture for Climate Change Negotiations* 10–12 (MIT Joint Program on the Sci. & Policy of Global Change, Report No. 49, 1999). A variation on this theme would allocate permits in such a way as to make gross national product (GNP) costs per capita equivalent to how the costs of supporting the budget of the United Nations are allocated among countries. See Mustafa J. Babiker & Richard S. Eckaus, *Rethinking the Kyoto Emissions Targets* 10 (MIT Joint Program on the Sci. & Politics of Global Change, Report No. 65, 2000).

question identified in the last Part holds up from a justice perspective. Overall, the per capita approach fares best: it comports best with the property and tort models, and it comes in a close second under the tax model. The status quo approach, on the other hand, fares worst under all three models.

A. A Property Model: Apportioning a Common Resource

One way to conceptualize the who-should-pay question is to think of the capacity of the atmosphere to absorb CO₂ and other greenhouse gases as property. Up until now, we have treated this resource—the greenhouse-gas-carrying capacity of the atmosphere—as common property. This made sense when it was thought to be unlimited. Now that we have come to understand the limits on the capacity of the atmosphere to absorb greenhouse gases without triggering dangerous climate change, however, we should treat it as a scarce and finite resource that must be somehow allocated among the people of the earth.⁹³

In general, when a group of people takes a resource that was previously held in common as an undifferentiated whole and then divides it up among the individual members of the group, the default assumption is that the resource should be allocated to each individual in equal shares.⁹⁴ This default assumption of equal shares is fundamental and intuitive. When a parent gives a chocolate bar to two children, generations of children have approached the situation with a time-honored approach that ensures the bar is divided into two equal portions: “You break it, I choose.” This equality principle is also reflected in the provisions of the Law of the Sea Convention relating to exploitation of minerals on the sea floor, which require that revenues from such exploitation be divided “equitably.”⁹⁵ And it is reflected in the state of

93. See Grubb, *supra* note 45, at 483.

94. See H. PEYTON YOUNG, EQUITY IN THEORY AND PRACTICE 163 (1994) (“[E]very distributive rule begins with some conception of equality”); Albin, *supra* note 6, at 124 (“The principle of equality . . . is partly rooted in the claim of natural law that, by virtue of shared human characteristics, all people should be treated the same. Any differential treatment must be justified with a special, legitimate reason.”); *id.* at 126–27 (The equality principle “converges with common, intuitive ideas about ‘intrinsic’ or ‘impartial’ justice . . . and enjoys wide acceptability as a basis for concession-making which produces fair agreements.”).

95. See United Nations Convention on the Law of the Sea, Dec. 10, 1982, 1833 U.N.T.S. 397, 447.

Alaska's distribution of oil revenues from its Permanent Fund in equal shares to each man, woman, and child in the state.⁹⁶

Under the equality principle, the default assumption that a common resource should be divided in equal shares can only be overcome if we can identify, on the grounds of merit or deservedness, some good reason to give some people a larger share than others.⁹⁷ Because commonly held natural resources are widely viewed as a common heritage, or even a birthright of humankind, it seems particularly anomalous in this context to attempt to justify any deviation from equal shares.⁹⁸

Conceivably, one could try to construct an argument that those who have already begun to use a disproportionate share of the atmosphere have built up a reliance interest in their continued ability to do so, and that those reliance interests should be protected through some version of adverse possession or squatter's rights. But those who try to construct such an argument face steep hurdles.⁹⁹ Even the doctrine of adverse possession, which has been well-entrenched in Western property law for centuries, faces fierce criticism for its perverse moral implications.¹⁰⁰ From a deontological perspective, it is ethically problematic to reward someone for taking more than her fair share of a common resource. From a consequentialist view, such a rule would create a moral hazard by incentivizing people generally to appropriate as much of a common resource to themselves as they can. When resources turn out to be

96. ALASKA STAT. § 43.23.025 (1962) (stating that the amount of dividends issued from the permanent fund is determined by dividing the number of persons eligible for a dividend by the amount of money available to pay dividends).

97. See BROWN, *supra* note 51, at 211–12 (“[T]hose who propose criteria for defining equity that is different than giving all people equal rights to use the atmosphere have the burden of proving that differences in treatment are based on merit or deservedness of such a kind that should be recognized by distributive justice.”); YOUNG, *supra* note 94, at 79–80 (“Equal treatment is an unambiguous and desirable ideal when everyone is similarly situated When they differ—in contribution, need, ability, or blame—equal treatment is not appropriate.”).

98. See United Nations Convention on the Law of the Sea, Dec. 10, 1982, 1833 U.N.T.S. 397, 398 (“[T]he area of the sea-bed and ocean floor and the subsoil thereof, beyond the limits of national jurisdiction, as well as its resources, are the common heritage of mankind.”).

99. See Grubb, *supra* note 45, at 487 (noting that hurdles include the approach's disputable ethical acceptability, the absence of a common law sanction for pollution rights, and the problems of constructing an emissions baseline that counterfactually discounts any abatement efforts).

100. See, e.g., Thomas W. Merrill, *Property Rules, Liability Rules, and Adverse Possession*, 79 NW. U. L. REV. 1122, 1145–53 (1985) (arguing that whether an adverse possessor is acting in good faith or bad faith should be relevant to law of adverse possession to avoid rewarding those acting in bad faith and arguing that bad faith adverse possessors should be forced to indemnify true owners); Jeffrey Evans Stake, *The Uneasy Case for Adverse Possession*, 89 GEO. L.J. 2419, 2434 (2001) (“There must be times when poor, unsuspecting, innocent owners lose all or part of their land without having done anything wrong.”).

limited, such incentives drive the tragedy of the commons. That seems a bad precedent to set in an age in which we are continually discovering the limits of the carrying capacities of the various natural resources on which we collectively rely.

This property model, then, seems clearly to support a per capita approach to the who-should-pay question that would ground a country's allocation of emission allowances on the principle that we should distribute to each individual on the planet an equal share in the absorptive capacity of the atmosphere.¹⁰¹ Whether this model leads to a prospective-equal-shares approach or a historical-equal-shares approach depends on how the property resource is defined. Defining it as the remaining absorptive capacity of the atmosphere from this point forward would lead to a prospective-equal-shares approach. Defining it as the total capacity the atmosphere has ever had available to absorb non-naturally-occurring greenhouse-gas emissions would lead to a historical-equal-shares approach in conjunction with a prospective-equal-shares approach.

Even though the property model seems clearly to point toward a per capita approach, because the equality principle has such widespread and intuitive appeal, status quo approaches are also frequently defended through appeals to the equality principle. President George W. Bush, for example, argued that an international climate treaty that demanded similar percentage reductions from developed and developing countries alike would be "even-handed."¹⁰² In a similar vein, Eric Posner and Cass Sunstein have argued that "[a] [globally] uniform greenhouse gas tax has a great deal to recommend it . . . nations and their citizens will in an important sense be treated the same."¹⁰³

On a superficial level, a status quo approach may seem to comport with the principle of equality. It does, after all, require an equal

101. See AGARWAL & NARAIN, *supra* note 66, at 4; BARRY, *supra* note 62, at 267–69; BROWN, *supra* note 51, at 213–15; MEYER, *supra* note 81, at 19; SINGER, *supra* note 64, at 43; Discussion Paper from Climate Action Network to COP9 at Milan, Italy, A Viable Global Framework for Preventing Dangerous Climate Change 2 (Dec. 2003), <http://www.greenpeace.org/raw/content/new-zealand/press/reports/clean-coal-technology-briefing/a-viable-global-framework-for.pdf> [hereinafter Climate Action Network]. This approach also comports with the arrangement that agents behind a Rawlsian veil of ignorance would likely choose. See JOHN RAWLS, A THEORY OF JUSTICE 118–23 (Rev. ed., Belknap Press of Harvard Univ. Press 1999).

102. See SINGER, *supra* note 64, at 26 (quoting Bush's statement in the second of the three televised debates during the 2000 campaign).

103. See Eric A. Posner & Cass R. Sunstein, *Climate Change Justice* 33 (John M. Olin Law & Econ., Working Paper No. 354, 2007), available at <http://www.law.uchicago.edu/files/files/354.pdf>. See also Albin, *supra* note 6, at 126 (describing proposals in international negotiations of equal-percentage reductions of acid rain that were defended under the equality principle).

percentage of emissions reductions from each country. But such an arrangement arbitrarily anoints the status quo emissions pattern as a legitimate baseline, and thus in reality only superimposes a veneer of equal treatment on an otherwise vastly unequal situation.¹⁰⁴ The percentage reduction being demanded of each country is equal, but the amounts being emitted by each country to begin with vary wildly, especially in per capita terms. Requiring equal-percentage reductions might, for example, allow an American who has been emitting twenty tons of greenhouse gases each year to continue to emit sixteen tons per year, while asking an Indian who has been emitting only 1.2 tons per year to ratchet her emissions down to 0.96 tons.¹⁰⁵ Or, as Peter Singer puts it, “if, to meet the limits set for the United States, taxes or other disincentives are used that go no further than providing incentives for Americans to drive more fuel-efficient cars, it would not be right to set limits on China that prevent the Chinese from driving cars at all.”¹⁰⁶

Finally, the ability-to-pay approach probably comes in second under a property model. It is not as neat a fit with the equality principle as the per capita approach, but it can be defended. The best defense of the ability-to-pay approach under a property model would probably take the form of an argument that the equality principle allows for a deviation from equal shares on the basis of wealth. Such an argument might at least be easier to defend than the argument that the equality principle would allow deviation from equal shares on the basis of status quo emissions. One might argue that those who have less wealth generally should get a larger allocation of the atmospheric resource—that this resource should be allocated in a way that makes up, at least in part, for past inequities in the distribution of wealth in general. Such an arrangement could certainly be justified on utilitarian grounds. Because a dollar is generally worth more to a poor person than a rich person, utilitarians often favor redistribution from the rich to the poor because it increases aggregate social welfare.¹⁰⁷ Such an arrangement might also be defended on Rawlsian grounds. Rawls’s “difference principle” allows inequalities in the distribution of goods only if those inequalities benefit

104. See Albin, *supra* note 6, at 127 (“A closer examination reveals that [an equal-percentage-reduction approach] establishes justice and fairness only in a very restricted sense.”); Grubb, *supra* note 45, at 487 (arguing that status quo approach violates all sorts of ethical principles, and asserting that no one advocates it on ethical grounds, but only on practical grounds).

105. See U.N. STATISTICS DIV., U.N. DEP’T OF ECON. & SOC. AFF., CARBON DIOXIDE EMISSIONS (CO₂), METRIC TONS OF CO₂ PER CAPITA, <http://mdgs.un.org/unsd/mdg/SeriesDetail.aspx?srid=751&crd=> (last visited Mar. 27, 2010).

106. SINGER, *supra* note 64, at 38.

107. Posner & Sunstein, *Justice*, *supra* note 37, at 1571.

the worst-off members of society.¹⁰⁸ But arguments for generalized wealth redistribution also face significant obstacles, not the least of which is the well-worn objection that too much wealth redistribution erodes incentives for hard work.

Without delving further into such arguments, it is fair to say that examining the who-should-pay question under a property model leads to application of the equality principle, and that this analysis of the question strongly supports a per capita approach. An ability-to-pay approach comes in second, and a status quo approach comes in a distant third.

B. *A Tort Model: Allocating the Costs of Harmful Activities*

Alternatively, we can think of climate change as a tort problem—as a question of how to allocate costs when one party causes injury to another. The principle that animates tort law in legal systems around the world—that when one person causes harm to another, she should pay to remedy it—is fundamental and broadly shared among virtually all religions and ethical systems.¹⁰⁹ It is captured in the common adage: “You broke it, you fix it.”¹¹⁰

This principle is also embodied in international law. It is reflected in the oft-cited “polluter pays”¹¹¹ principle, which was memorialized in Principle 16 of the Rio Declaration:

National authorities should endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that *the polluter should*, in principle, *bear the cost of pollution*, with due regard to the public interest and without distorting international trade and investment.¹¹²

It is also incorporated in the U.N. Framework Convention on Climate Change, under which the developed nations agreed to:

108. See RAWLS, *supra* note 101, at 65–70.

109. See Natalia M. Bartels & M. Stuart Madden, *A Comparative Analysis of United States and Colombian Tort Law: Duty, Breach, and Damages*, 13 PACE INT’L L. REV. 59, 60 (2001); Saul Levmore, *Rethinking Comparative Law: Variety And Uniformity in Ancient and Modern Tort Law*, 61 TUL. L. REV. 235, 243–45 (1986).

110. See Henry Shue, *Global Environment and International Inequality*, 75 INT’L AFF. 531, 533 (1999) (“All over the world, parents teach their children to clean up their own mess.”).

111. As Michael Grubb points out, the polluter pays principle does not tell us exactly how much the polluter should pay. See Grubb, *supra* note 45, at 490.

112. United Nations Conference on Environment and Development, June 3–14, 1992, *Rio Declaration on Environment and Development*, U.N. Doc. A/CONF.151/26 (emphasis added).

[P]rotect the climate system . . . on the basis of equity and in accordance with their *common but differentiated responsibilities* and respective capabilities. Accordingly, *the developed country Parties should take the lead* in combating climate change and the adverse effects thereof.¹¹³

And it is reflected in the general principle of international law that one country should not allow activities within its borders to interfere with activities within another sovereign state's borders.¹¹⁴

Tort law is typically justified on both consequentialist grounds, as deterring harmful behavior, and deontological grounds, as embodying norms of corrective justice.¹¹⁵ The point here is not to apply the doctrine of tort law literally to see whether climate change victims would actually win if they brought a lawsuit against emitters of greenhouse gases, though a number of such suits are currently making their way through the U.S. courts.¹¹⁶ Tort law does not directly apply to the international negotiations on climate change. Rather, we look to tort law to see if it offers any general insights into broadly shared notions of fairness and justice that might prove useful in thinking about how a fair and just international agreement might allocate the costs of climate change among countries. Looking at the who-should-pay question through a tort law lens raises a number of complex issues. They cluster roughly in

113. UNFCCC, *supra* note 76, at art. 3, para. 1 (emphasis added). It also states that the developed countries "shall . . . assist the developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects." *Id.* at art. 4, para. 4.

114. See Jutta Brunnée, *The United States and International Environmental Law: Living with an Elephant*, 15 EUR. J. INT'L L. 617, 628 (2004) ("The genesis of one of the cornerstone principles of international environmental law, the prohibition against causation of significant transboundary environmental harm, is closely linked to the United States. One of the sources to which this principle is typically traced back is the arbitral award in the *Trail Smelter* case, which arose between the United States and Canada in the early part of the 20th century.") (footnote omitted); Climate Action Network, *supra* note 101, at 3.

115. See Heidi M. Hurd, *The Deontology of Negligence*, 76 B.U. L. REV. 249, 260–61 (1996); Stephen R. Perry, *The Moral Foundations of Tort Law*, 77 IOWA L. REV. 449, 449 (1992); Benjamin C. Zipursky, *Civil Recourse, Not Corrective Justice*, 91 GEO. L.J. 695, 699–700 (2003) ("Corrective justice theory explains tort law as the embodiment of a deontological . . . set of values.") (footnote omitted).

116. See, e.g., *Comer v. Murphy Oil USA*, 585 F.3d 855 (5th Cir. 2009) (Gulf Coast owners bringing putative class action against oil and energy companies for their contributions to global warming that added to the ferocity of Hurricane Katrina); *Connecticut v. Am. Elec. Power Co.*, 582 F.3d 309 (2d. Cir. 2009) (states and nonprofits suing electric utilities for abatement of public nuisance related to global warming); *Native Vill. of Kivalina v. ExxonMobil Corp.*, 663 F. Supp. 2d 863 (N.D. Cal. 2009) (Native Alaskan village suing gas company alleging contributions to global warming that are speeding erosion of traditional land).

three groups: 1) culpability issues, 2) causation issues, and 3) remedy issues.

1. *Culpability*

Tort law typically—though not always—requires the plaintiff to show some level of culpability or fault on the part of the defendant.¹¹⁷ This is often viewed as an important element of the corrective justice goal of tort law: holding wrongdoers accountable. Are greenhouse-gas emitters culpable? While no one emits greenhouse gases with the intent to cause harm, such activity might be negligent, at least if it took place after the point at which a reasonable person should have known of the dangers of global warming.¹¹⁸ Those corporate actors who engaged in a deliberate campaign to mislead the public and policymakers about the science of global warming might arguably meet an even higher standard of culpability.¹¹⁹

The concept of negligence is, of course, rooted in the notion of reasonableness—the reasonable person standard.¹²⁰ And defining what is reasonable in the context of climate change is bound to create controversy. First, there is the issue of knowledge. The reasonable person standard is usually construed to incorporate a requirement of objective knowledge.¹²¹ That is, we typically hold a tort defendant liable only for actions that a reasonable person would have known might cause injury.¹²² Thus, it would be difficult to argue that those who emitted greenhouse gases before sometime in the early 1990s, when knowledge

117. See Pery, *supra* note 115, at 496–500; RESTATEMENT (SECOND) OF TORTS § 328A (1965).

118. See Daniel A. Farber, *Apportioning Climate Change Costs*, 26 U.C.L.A. J. ENVTL. L. & POL'Y 21, 31 (2007–2008) [hereinafter Farber, *Apportioning*]. But see Matthew D. Adler, *Corrective Justice and Liability for Global Warming*, 155 U. PA. L. REV. 1859, 1862 (2007) (arguing that negligence on the part of greenhouse-gas emitters would be hard to show). Plenty of scientific uncertainty remains regarding the extent to which specific effects will be triggered by global warming. But for our purposes here—evaluating how costs might be shared among nations in an international treaty, rather than awarding damages to a particular plaintiff in a lawsuit—it seems unnecessary to show that the emitters had reason to know their emissions would lead to some particular effect (like the damage to coral reefs in Australia). Knowledge that emissions would lead to global warming which would produce harmful effects seems sufficient to support culpability for this purpose. *Cf. id.* at 1861–62.

119. See Farber, *Apportioning*, *supra* note 118, at 31.

120. See RESTATEMENT (THIRD) OF TORTS § 3 cmt. a (2001).

121. RESTATEMENT (SECOND) OF TORTS § 289 (1965).

122. *Id.*

of the phenomenon of global warming became widespread, were acting negligently.¹²³

Some might argue that even emissions after the 1990s do not rise to the level of negligence because, in light of local community standards, these actions were reasonable.¹²⁴ One might contend that the countless normal day-to-day activities that virtually every citizen of the developed world has engaged in for decades—from driving a car to heating one’s house—cannot possibly be unreasonable. A set of activities that virtually every person in the community is regularly engaged in cannot be said to violate the reasonable person standard—particularly when the government allows, and in some cases even condones, those activities. A similar argument might be made on behalf of the companies that were supplying the oil, coal, and electricity to all those reasonable consumers—often with the approval and outright encouragement of government.¹²⁵

But the Second Restatement of Torts actually specifies that, while community customs are “factors to be taken into account” in determining whether conduct is negligent, they are “not controlling where a reasonable man would not follow them.”¹²⁶ In any event, it is not at all clear that it is appropriate to judge the reasonableness of the wrongdoer’s actions by the standards of a community that excludes many of the victims. While the day-to-day activities that have led to warming may seem reasonable in the developed world, to a person in Bangladesh who lives without a car and without electricity, they may seem unreasonable. Once we expand the community-standards lens to an international scope, it is difficult to view as reasonable actions taken in order to achieve incremental, non-needs-related consumption gains with the knowledge that they will cause serious harms, including death to others.¹²⁷

123. See Farber, *Apportioning*, *supra* note 118, at 32 (suggesting 1992 as a cut-off date for apportioning responsibility for climate change adaptation according to a polluter pays principle); Heinzerling, *supra* note 74, at 455–57 (arguing that scientific consensus on climate change became clear in the late 1980s or early 1990s).

124. *E.g.*, *Breault v. Ford Motor Co.*, 305 N.E.2d 824, 828 (Mass. 1973) (“If one does what others do in like circumstances, the inference that he is conforming to the community standard of reasonable conduct may be so strong in particular circumstances as to establish that the individual was not negligent.”); RESTATEMENT (SECOND) OF TORTS § 295A.

125. See *The Best Bill Corporations Could Buy: A Summary of Industry Giveaways in the 2005 Energy Bill*, PUBLIC CITIZEN, Aug. 2005, <http://www.citizen.org/documents/aug2005ebsum.pdf>.

126. RESTATEMENT (SECOND) OF TORTS § 295A.

127. See Christian Azar & Thomas Sterner, *Discounting and Distributional Considerations in the Context of Global Warming*, 19 *ECOLOGICAL ECON.* 169, 170 (1996).

It seems particularly difficult to make the case for reasonableness when we consider that many of the emissions in the developed world over the past two decades could easily have been prevented—in many instances at a net cost savings—by simply implementing known technologies to improve energy efficiency. In many more instances, prevention could have been achieved by incurring a modest increase in cost or a modest decrease in convenience. Indeed, under standard economic understandings of tort law, if the marginal costs of measures to reduce greenhouse-gas emissions are lower than the marginal benefits that would accrue in the form of decreased climate-change harms, then the failure to implement such reductions is, by definition, unreasonable.¹²⁸

Even if some emissions are unreasonable, however, not all emissions are necessarily equally unreasonable. Henry Shue argues, for example, that we should distinguish between subsistence emissions and luxury emissions.¹²⁹ Dan Farber argues that emitters should be held liable not for all their emissions, but only their “excess” emissions—that is, those emissions that exceed some threshold of reasonableness or optimality.¹³⁰ A similar notion animates the argument that compliance with domestic or international greenhouse-gas regulations should shield an emitter from culpability for climate-change harms.¹³¹ Perhaps a state, like the Netherlands, for example, that is in full compliance with its obligations under the Kyoto Protocol, should not be held responsible for climate change damages to the same degree as a state like the United States.¹³² It

128. See Michael Faure & André Nollkaemper, *International Liability as an Instrument to Prevent and Compensate for Climate Change*, 26A STAN. ENVTL. L.J. 123, 151 (2007). This is in essence simply a restatement of the famous Learned Hand Formula. See *United States v. Carroll Towing*, 159 F.2d 169, 173 (2d. Cir. 1947) (Hand, J.) (“[T]he owner’s duty . . . to provide against resulting injuries is a function of three variables: (1) The probability . . . ; (2) the gravity of the resulting injury . . . ; [and] (3) the burden of adequate precautions.”).

129. See Shue, *supra* note 60, at 449, 455 (arguing that each individual should be entitled to the minimum share of emissions rights necessary to survival and that this minimum share should be non-tradable: “A society in which food is available only for payment is a brutal and uncivilized place. What is suggested here is merely the equivalent of food stamps on the global level for vital emissions.”).

130. See Farber, *Apportioning*, *supra* note 118, at 40 (“Using excess emissions as the basis for liability is more closely linked with culpability. Emitters have some kind of responsibility for all of the harms caused by their emissions, but they seem most to blame for harms that they should have avoided through prudent mitigation measures.”).

131. See Faure & Nollkaemper, *supra* note 128, at 151.

132. *Id.* at 152 (arguing that there is “little or no evidence” that the parties to the Kyoto Protocol intended it to replace customary international law regarding liability for transboundary environmental harms). This may be a moot point in any case because Kyoto is about to expire with no subsequent agreement to take its place. An economic approach to tort law usually argues against

certainly seems reasonable that emissions below a certain level should be shielded from liability—that an Indian who pedals a rickshaw for a living should not be held liable for his small amount of emissions at the same rate as an American who drives an SUV. The difficulty comes in defining the level at which emissions are deemed “reasonable.”¹³³ As I argue below, a per capita allocation of an agreed-upon cap offers a simple and appealing benchmark.

Even in the absence of knowledge or culpability, tort law sometimes imposes liability under the doctrine of strict liability.¹³⁴ Many jurisdictions impose strict liability for ultrahazardous activities.¹³⁵ The Superfund statute is another prominent example of this approach.¹³⁶ Indeed, the deterrence rationale for tort law arguably justifies imposing liability even in some situations where the defendants are ignorant of the harms that may flow from their conduct. For example, imposing retroactive liability on a chemical manufacturer for harms caused by its chemicals before those chemicals were proven harmful can be defended on the ground that it will create incentives for such companies to go to extra lengths to seek out information on the toxicity of their chemicals in the future.¹³⁷

treating compliance with regulatory standards as a shield from liability, because it cannot be assumed that regulatory standards are set efficiently. Accordingly, imposing liability regardless of regulatory compliance gives a polluter incentive to take additional precautions over and above what regulatory standards might require. See Paul Burrows, *Combining Regulation and Legal Liability for the Control of External Costs*, 19 INT’L REV. L. & ECON. 227, 236–39 (1999); Susan Rose-Ackerman, *Public Law Versus Private Law in Environmental Regulation: European Union Proposals in the Light of United States and German Experiences*, in LAW AND ECONOMICS OF THE ENVIRONMENT 13, 22–23 (Erling Eide & Roger Vanden Bergh eds., 1996); Steven Shavell, *Liability for Harm Versus Regulation of Safety*, 13 J. LEGAL STUD. 357, 365–71 (1984).

133. See Farber, *Apportioning*, *supra* note 118, at 41.

134. But even in strict liability, there is usually some element of wrongfulness in the defendant’s conduct. See DAN B. DOBBS, *THE LAW OF TORTS* 822, 942 (2000); see also Stephen R. Perry, *The Impossibility of General Strict Liability*, 1 CAN. J.L. & JURISPRUDENCE 147, 154–59 (1988) (discussing a theory of strict liability based on the notion that a defendant should not be permitted to reap the benefits of his activity while forcing its costs upon someone else).

135. See Faure & Nollkaemper, *supra* note 128, at 150. Under American law, however, the type of activity that warrants imposition of strict liability is often described as “abnormally dangerous.” See RESTATEMENT (THIRD) OF TORTS § 20(a) (2001) (“A defendant who carries on an abnormally dangerous activity is subject to strict liability for physical harm resulting from the activity.”). The requirement that the activity must be “abnormal” might be hard to meet in the context of greenhouse-gas emissions.

136. 42 U.S.C. § 9607 (2006) (imposing strict liability on any person who disposed of or arranged to dispose of hazardous substances that are subsequently released into the environment).

137. See Louis Kaplow, *An Economic Analysis of Legal Transitions*, 99 HARV. L. REV. 511, 551–52 (1986).

Furthermore, even intuitive notions of corrective justice may not necessarily require culpability in order to impose liability. “You broke it, you fix it” does not, after all, require that you *knew* you might break it. In Henry Shue’s view, those who argue that liability for climate-change harms requires knowledge on the part of the emitters of the potential harms confuse punishment and responsibility.¹³⁸ As a matter of intuitive fairness, it is perfectly reasonable to hold people responsible for harms they caused, even when they were unforeseeable and unavoidable, rather than allowing the burden to fall on blameless victims.¹³⁹

In sum, a credible argument can be made that culpability should not be required in order to hold greenhouse-gas emitters responsible for the costs of climate change—that those who are responsible for emitting greenhouse gases should be held strictly liable for the harms they cause. But even if a negligence standard is appropriate, a strong argument can be made that those who emitted greenhouse gases after some point in the early 1990s are sufficiently culpable, at least with respect to those emissions that exceed some specified threshold of reasonableness. Part III.B.3 argues that such a threshold should be set at a per capita share of an agreed-upon global emissions cap.

2. Causation

Tort law also requires a causal link between the actor’s conduct and the victim’s injury. In a lawsuit in which particular plaintiffs seek to hold particular defendants liable, proving causation raises a host of difficulties. While the general link between greenhouse-gas emissions and increases in average global temperature is by now well established,¹⁴⁰ the causal link between a particular defendant’s emissions and a particular plaintiff’s injury can be difficult to fit within the traditional legal framework of but-for causation.¹⁴¹

First, the causal link between any individual entity’s emissions of greenhouse gases and the accumulation of dangerous levels of greenhouse gases in the atmosphere can be difficult to establish. The accumulation of greenhouse gases in the atmosphere is characterized by

138. Shue, *supra* note 110, at 535.

139. *Id.*

140. See Alley et al., *supra* note 71, at 5; Naomi Oreskes, *The Scientific Consensus on Climate Change*, SCI., Dec. 3, 2004, at 1686, 1686 (“In recent years, all major scientific bodies in the United States whose members’ expertise bears directly on the matter have . . . all issued statements concluding that the evidence for human modification of climate is compelling.”).

141. Michael Duffy, *Climate Change Causation: Harmonizing Tort Law and Scientific Probability*, 28 TEMP. J. SCI. TECH. & ENVTL. REV. 185, 219–21 (2010).

the “bathtub effect.” CO₂ is continuously being added to the atmosphere, but it is also continuously being removed from the atmosphere as plants, trees, and algae absorb CO₂ through photosynthesis. The problem is that CO₂ is currently being added to the atmosphere at about twice the rate that it is being removed. Thus, we can imagine the atmosphere as a bathtub with the tap on full blast and a slow drain, so that the water is gushing in twice as fast as it is draining out. Accordingly, we cannot say that every molecule of CO₂ released into the atmosphere necessarily causes harm. Some molecules make their way down the “drain”—they are simply absorbed back into the forests and oceans as part of the earth’s natural carbon cycle. Because no one entity’s emissions would be enough on their own to cause the bathtub to overflow, it is difficult to say that, *but for* an individual’s emissions of CO₂, a climate-change injury would not have occurred.¹⁴²

Second, establishing a but-for causal link between increases in average global temperature and any particular climate-change impact can be problematic as well. Impacts that are themselves continuing trends that result directly from rising temperatures pose less of a problem—rising sea levels or melting arctic ice, for example. But linking discrete weather events, like heat waves, droughts, and hurricanes, to global warming is more difficult. Even though the evidence linking global warming to overall trends in such weather events is very well-established, definitively attributing any particular such event to global warming is challenging. Such causal links can be established, if at all, only in probabilistic terms.¹⁴³

142. Some philosophers have characterized this as a “moral collective action problem.” Adler, *supra* note 118, at 1862–63; Jamieson, *supra* note 3, at 293. *But see* Carl Cranor, *Collective and Individual Duties to Address Global Warming*, in ECONOMIC THOUGHT AND U.S. CLIMATE CHANGE POLICY, *supra* note 5, at 153 (arguing for collective moral duties); Jonathan Glover & M. Scott-Taggart, “*It Makes No Difference Whether or Not I Do It*,” 49 PROC. OF THE ARISTOTELEAN SOC’Y 171, 174 (1975) (arguing for a “Principle of Divisibility,” which “says that, in cases where harm is a matter of degree, subthreshold actions are wrong to the extent that they cause harm, and where a hundred acts like mine are necessary to cause a detectable difference I have caused 1/100 of that detectable harm”).

143. For example, a recent study published in *Nature* concludes that it is very likely (confidence level > 90%) that human influence at least doubled the risk of a heat wave of the magnitude of the 2003 European heat wave. Peter A. Stott, D.A. Stone & M.R. Allen, *Human Contribution to the European Heatwave of 2003*, 432 NATURE 610 (2004) (“It is an ill-posed question whether the 2003 heatwave was caused, in a simple deterministic sense, by a modification of the external influences on climate—for example, increasing concentrations of greenhouse gases in the atmosphere—because almost any such weather event might have occurred by chance in an unmodified climate. However, it is possible to estimate by how much human activities may have increased the risk of the occurrence of such a heatwave.”).

Finally, because of feedback loops¹⁴⁴ and other factors, the relationship of accumulations of greenhouse gases in the atmosphere to overall warming and to other climate change impacts is not linear. One particular molecule of CO₂ might be the straw that breaks the camel's back, triggering a feedback loop that dramatically increases the pace of warming. To the extent that climate change takes this kind of non-linear form, it may not be appropriate to assume that each molecule (or ton) of CO₂ has the same level of impact. It might be appropriate, as Dan Farber has suggested, to hold emitters liable not for the average effect of all molecules of CO₂ emitted by everyone, but for the marginal effect of each molecule or unit of CO₂.¹⁴⁵

All of this is to say that calculating the precise amount of damage caused by a particular molecule or ton of CO₂ released by a particular entity at a particular time is enormously challenging. Nonetheless, tort law may well evolve to adapt to these challenges. Even before climate change became a subject of tort suits, scholars had begun to recognize that formalistic concepts of but-for causation were outmoded in an age in which science had long ago evolved beyond the kind of definitive, mechanistic terms that Newtonian physics used to describe the movement of physical objects through space, and that the legal system needed to develop doctrines capable of incorporating contemporary scientific notions of probabilistic causation.¹⁴⁶ And during the last several decades, that evolution has already begun to occur; courts have employed concepts of proportional liability in cases involving harmful medications,¹⁴⁷ environmental toxins,¹⁴⁸ the contamination of common

144. The term "feedback loop" refers to a phenomenon in which processes interact such that a change in one process works to either reinforce another process (positive feedback) or suppress it (negative feedback). For example, an increase in global temperature causes snow and ice to melt, which reduces the reflectivity of the earth's surface and thereby increases solar absorption, which in turn further raises temperatures, and so on. As a result of this feedback loop, the IPCC has explained that "[a]nthropogenic warming and sea level rise would continue for centuries due to the timescales associated with climate processes and feedbacks, even if greenhouse gas concentrations were to be stabilized." *Contribution of Working Group I to the Fourth Assessment on Intergovernmental Panel on Climate Change*, in CLIMATE CHANGE 2007, *supra* note 71, at 16.

145. See Farber, *Apportioning*, *supra* note 118, at 42–44.

146. See Troyen A. Brennan, *Causal Chains and Statistical Links: The Role of Scientific Uncertainty in Hazardous-Substance Litigation*, 73 CORNELL L. REV. 469, 478–91 (1988); Eduardo M. Peñalver, *Acts of God or Toxic Torts? Applying Tort Principles to the Problem of Climate Change*, 38 NAT. RESOURCES J. 563, 582–85 (1998).

147. See *Sindell v. Abbott Labs., Inc.*, 607 P.2d 924 (Cal. 1980).

148. See *In re Hanford Nuclear Reservation Litig.*, 292 F.3d 1124, 1127, 1133–37 (9th Cir. 2002); *In re "Agent Orange" Prod. Liab. Litig.*, 597 F. Supp. 740 (E.D.N.Y. 1984).

pool resources,¹⁴⁹ and elsewhere. It is not impossible to imagine courts resolving some of the causation dilemmas raised by climate change by adopting a proportional-liability approach under which, for example, defendants pay for a plaintiff's climate-change damages in proportion to their contribution of greenhouse gases to the overall accumulation in the atmosphere and in proportion to the probability that climate change caused the particular weather event that resulted in the plaintiff's injury.¹⁵⁰

Here, however, where we seek guidance only for international negotiations, it is not as crucial that we establish causal links between individual emitters and individual victims with the same precision that might be required in a tort lawsuit. Accordingly, we need not consider these issues in depth. Here the relevant entities are countries, or perhaps even groups of countries, not individual persons or corporations. Thus, the conundrums associated with establishing the causal link between individual emissions and accumulations of heat-trapping gases in the atmosphere are significantly obviated.¹⁵¹ Moreover, we are not concerned with tracing causal responsibility for some particular harm suffered by particular individuals, or even for some particular weather event. Rather, we are concerned with allocating the aggregate costs of climate change to the globe as a whole. Thus, the difficulties associated with tracing a causal link from increases in average global temperatures to particular weather events do not arise in this context.

In the realm of international negotiations, then, it seems reasonable to say that the developed countries have each contributed significantly to causing the climate change problem. It also seems fair to say that they should be treated as culpable for their post-1990 emissions that exceed

149. See, e.g., *Michie v. Great Lakes Steel Div.*, 495 F.2d 213, 216, 218 (6th Cir. 1974) (operating joint and several liability on three corporations for injuries caused by air pollution); *In re Methyl Tertiary Butyl Ether Prods. Liab. Litig.*, 379 F. Supp. 2d 348, 378 (S.D.N.Y. 2005) (in suit for harm caused by MTBE released into groundwater by multiple defendants, holding each defendant severally liable in proportion to its share of the market at the time the risk of harm to plaintiffs was created: "[a plaintiff] should be able to recover damages from any defendant that contributed to the harm, even if a defendant was not responsible for all of it"); *City of Tulsa v. Tyson Foods, Inc.*, 258 F. Supp. 2d 1263, 1300 (N.D. Okla. 2003) (applying doctrine of concurrent wrongdoing to negligence claim against seven defendants for pollution of lake); *Union Tex. Petroleum Corp. v. Texas*, 909 P. 2d 131, 150 (Okla. Civ. App. 1995) (applying doctrine to claim for saltwater contamination of aquifer by two oil companies).

150. See Duffy, *supra* note 141, at 222.

151. See Adler, *supra* note 118, at 1866 (suggesting that looking at climate change liability in terms of countries or governments, rather than individuals, may obviate the moral collective action problem).

some threshold of reasonableness. But how do we translate these general principles into a specific formula for cost sharing?

3. *Remedy*

This is, in essence, the question of remedy. Returning to the analogy of a tort lawsuit, we might imagine that the appropriate remedy would take two forms. First, for those injuries that have already occurred or become inevitable due to the greenhouse gases already accumulated in the atmosphere, the emitters would be liable for money damages. These damages would include both adaptation costs and compensation for those effects to which adaptation is impossible. Second, because so much of the injury that will occur due to climate change can be characterized as irreparable and will not be adequately remedied by money damages, the emitters would also incur a duty to reduce future emissions.¹⁵² That is, in a lawsuit they would be subject to an injunction.¹⁵³ But how would such an injunction be tailored? To what level would it require emitters to reduce? Recall that, assuming a culpability approach, emitters would not be held liable for all their emissions, but only for those that exceed some threshold of reasonableness.¹⁵⁴ The injunction, then, would require emitters to reduce their emissions to “reasonable” levels. This would require them to pay for whatever new technologies or other measures would be necessary to accomplish such reductions. In the parlance of climate change, these are mitigation costs. The next section considers how those costs might be calculated, how the notion of “reasonable” emissions levels might be defined, and how well each of the three approaches to the who-should-pay question (status quo, per capita, and ability-to-pay) comports with this model of fairness.

152. See RESTATEMENT (SECOND) OF TORTS § 933 cmt. a (1965) (The availability of an injunction as a remedy in a tort case “has traditionally been stated in terms of the ‘inadequacy of the remedy at law,’ ‘inadequacy of damages,’ and ‘irreparable injury.’”); see also *id.* §§ 936, 938 cmt. b.

153. See Faure & Nollkaemper, *supra* note 128, at 174 (asserting that under international law, the remedy in an action by one state against another for liability for climate change harms would include both monetary damages for past harms and imposition of a duty to mitigate to prevent future harm); *id.* at 175 (noting that European Directive 2004/35/CE on environmental liability takes a similar approach of providing for liability for the costs of both preventive and remedial action).

154. See *supra* Part III.B.1.

a. *“Injunctive Relief”: Mitigation Costs*

Calculating the mitigation costs for which a particular country should be responsible first requires pinpointing that country's reasonable emissions level. Let us begin by imagining that the international community could agree on an appropriate series of annual global caps on greenhouse-gas emissions that would, for example, stabilize emissions by mid-century at a level likely to avoid catastrophic harm. From there, we can derive each individual's reasonable emissions level by simply applying the Golden Rule. In order to “do unto others as you would have others do unto you,” each individual would want to keep her emissions at or below the maximum amount which, if matched by every individual on earth, would not exceed reasonable levels—i.e., the global cap. Thus, the individual reasonable emissions level is simply a per capita share of that overall cap. An individual who kept her emissions within this limit could reasonably say that she had not caused harm—if harm is defined as exceeding the global cap.

Thus, the imaginary injunction described above would require each individual on earth to ensure that her emissions were at or below a per capita share of the global cap. Alternatively, it would require each country to reduce its emissions to the per capita share of the cap times its population.

As a practical matter, most developed countries probably would not be able to immediately reduce their own emissions to the per capita level. Initially, it would make more sense for them to offset at least some of their excess emissions by paying developing countries for extra emissions rights. Assuming a global cap-and-trade program, they would do this by buying allowances from developing countries whose emissions, at least initially, would likely be below their reasonable emissions level and who would accordingly have extra allowances to sell. As discussed above, this approach also has the advantage of being less costly overall because reductions are generally cheaper in the developing world.¹⁵⁵

Accordingly, under a tort theory, each (developed) country's share of mitigation costs should be the cost of implementing reductions anywhere in the world or buying emissions rights equivalent to the amount of

155. *See supra* Part I.A. Because under a per capita approach, developing countries might, in the early years at least, receive allocations of allowances larger than their existing emissions, purchases of allowances by developed countries in those early years might not directly represent immediate emissions reductions. Assuming a steadily decreasing cap and a program that allowed banking of allowances, however, such early purchases by developed countries of “excess” allowances from developing countries would represent a reduction in the overall future emissions trajectory.

reduction that would be necessary to bring the country's emissions below its per capita share of the global cap. In other words, assuming a trading scheme, this is the amount of money a developed country would have to pay to reduce emissions and/or purchase allowances from other countries under a per capita allocation of allowances.

Under this line of reasoning, at least with respect to mitigation costs, the tort theory seems to lead to the same place the property theory led: to a cap-and-trade system with a per capita allocation of allowances. In particular, a tort theory suggests an allocation of mitigation costs that tracks a prospective-equal-shares approach to the allocation of allowances under a global cap-and-trade program.

A status quo approach, in contrast, is a very poor fit for allocating mitigation damages under the tort model. The status quo approach fails to serve both the corrective justice and deterrence goals of tort. Because it demands equal percentage reductions from all, it fails to differentiate between those whose emissions exceed a threshold of reasonableness and are therefore culpable for causing climate change, and those whose emissions remain below that threshold and who therefore bear no responsibility.

An ability-to-pay approach would comport with a tort model for allocating mitigation costs in a very general sense to the extent that emissions roughly track GDP. Thus, those countries with high per capita GDP would get the smallest allocation of allowances and thus bear the largest share of the costs under an ability-to-pay approach. These countries are also by and large those with the highest per capita carbon emissions who would bear the largest share of mitigation costs under a tort model. But the fit is not perfect. Some countries with relatively high GDP have been able to keep emissions low by instituting energy taxes or using other means to encourage the use of alternative technologies.¹⁵⁶ But under an ability-to-pay approach, such countries would get no reward for good behavior. They would be responsible for just as big a share of mitigation costs as those that had taken no steps to reduce emissions.

In this way, an ability-to-pay approach misaligns the incentives. If anything, it produces an incentive not to increase GDP. Such an incentive is undoubtedly outweighed by the numerous other strong

156. Sweden, for example, has made impressive strides with its carbon tax, reducing CO₂ emissions by 9% between 1990 and 2006, exceeding its target under the Kyoto Protocol, while enjoying booming economic growth of 44%. Gwladys Fouché, *Sweden's Carbon-Tax Solution to Climate Change Puts It Top of the Green List*, THE GUARDIAN (Apr. 29, 2008), <http://www.guardian.co.uk/environment/2008/apr/29/climatechange.carbonemissions>.

incentives favoring economic growth, and countries would most likely continue efforts to boost GDP. But, by using GDP as its only criterion, the ability-to-pay approach fails to create any incentive to try to keep emissions low while raising GDP. Accordingly, it undermines the deterrence goal of tort law.

In sum, the ability-to-pay approach weakly serves the goals of corrective justice to the extent that GDP roughly tracks emissions. But conceptually, it is untethered from corrective justice, because ability to pay has no direct relationship to culpability, which is the touchstone of corrective justice.

b. “Damages Relief”: Adaptation and Compensation Costs

Deriving a formula for adaptation and compensatory damages presents even more complications than doing so for mitigation damages. First, unlike a typical tort suit, in which damages are purely retrospective, the damages in this context must be both retrospective and prospective. Because there is a significant lag time—decades or even centuries—between when greenhouse gases accumulate in the atmosphere and when the earth’s temperature warms in response to the change, some of the harms from climate change that have already been set in motion by past emissions will not be felt for many years.¹⁵⁷ Accordingly, those responsible for unreasonable emissions owe the victims of climate change adaptation costs and compensation not only for impacts that have already occurred, but also for harms that have already become inevitable because of past emissions but have not yet occurred.

A second set of complications arises because actually calculating these damages—even on the scale of countries—would require confronting some of the sticky causation issues described above. In order to determine exactly how much a particular country is owed in adaptation costs and compensation, one would have to be able to establish a causal link between climate change and particular events. But as noted above, proving that any particular drought, storm, flood, crop failure, or disease outbreak was caused by climate change is difficult. When such a link can be established at all, it is usually in probabilistic terms. Even assuming one could clear that hurdle, it would be necessary to then quantify and monetize all of the particular harms caused by each such event. Given the diverse array of harms, including such intangibles as loss of human life and health, destruction of communities and

157. See Alley et al., *supra* note 71, at 17.

cultures, extinction of species, and disruption of ecosystems, such an assessment would be difficult and controversial in any case.¹⁵⁸ But in this context, the problem would be made even worse by the fact that most of the impacts of climate change—even those that have already been made inevitable by past emissions—have yet to occur. We cannot accurately predict exactly what those impacts will be, where they will occur, whom they will harm, or whether various adaptation efforts will succeed or fail. Should attempts be made now to estimate future damages,¹⁵⁹ or should some system be set up for victims to periodically apply for damages in the future?¹⁶⁰

Under any approach, an exact calculation of adaptation and compensation costs would be, at best, difficult and controversial, and probably impossible. Indeed, given the multiple dimensions of uncertainty involved, it is not at all clear that an attempt to calculate such damages directly would be worth the effort. A better method might be to find some proxy that would offer a rough approximation of adaptation and compensation costs.¹⁶¹

In light of that reality, a historical-equal-shares approach with a start date in the early 1990s might offer an attractive second-best solution. While it would not attempt to calculate the actual damages to be incurred by victims of climate change, it would offer a powerful symbolic link to the genesis of the problem, and in that way would support both the corrective justice and deterrence goals of tort law.

If we were to go back in time and take historical emissions into account in allocating emissions allowances for a cap-and-trade scheme, we would be essentially penalizing developed countries for their past emissions, requiring them to buy even more allowances from the

158. Such valuations in the context of cost-benefit analysis have received harsh criticism. *See, e.g.,* ACKERMAN & HEINZERLING, *supra* note 23, at 39–40. *See infra* notes 182–88 and accompanying text.

159. *See, e.g.,* *Boomer v. Atl. Cement*, 257 N.E.2d 870 (N.Y. 1970) (granting permanent damages in plaintiffs' favor for ongoing damages caused by nearby cement plant, but denying a permanent injunction).

160. *See* Farber, *Apportioning*, *supra* note 118, at 46–47.

161. *See id.* at 23–24, 51 (analogizing to the Superfund statute, which “has gotten along with a very rough system for almost thirty years”). Given the difficulties of measuring and apportioning climate change damages, Farber has also suggested using restitution or “unjust enrichment” as an alternative standard for apportioning liability. He draws an analogy to calculations often made by EPA in the context of calculating civil penalties for polluters. A computer program allows the agency to estimate the economic benefit that a firm gained by delaying the adoption of a particular pollution control technology or method. Farber suggests a similar approach might be taken with CO₂ emitters. *See id.* at 47–48.

developing world to offset those historical emissions.¹⁶² Under a tort model that requires culpability—a negligence model—we would begin the historical accounting in the early 1990s, at a point when a reasonable person should have known of the risks of climate change.¹⁶³ But these payments could not really be conceptualized as paying for mitigation, because the past emissions they represented would already have been released and could no longer be mitigated. Moreover, as detailed above, the prospective aspect of an equal-shares approach would already account for the costs of the mitigation measures that could still be taken. Any shift of additional costs to the developed world would best be attributed to the second category of damages: adaptation and compensation.

While such payments would not necessarily correlate with the actual adaptation and compensation costs incurred as a result of the emissions they represent, they would constitute a significant sum over and above mitigation damages. Because that sum would be tied to the level of past emissions, it would have significant symbolic appeal. Those with higher past emissions would pay more. This would comport with the corrective justice goals of tort law. It would also serve the deterrence goals of tort law, creating an incentive for polluters in the future to try to anticipate trends in science, public policy, and law in order to avoid future penalties for harmful conduct that might also be retroactively applied. Thus, while a precise formula for allocating adaptation and compensation costs under a tort model is probably out of reach, a historical-equal-shares approach offers a reasonable second-best solution.

The status quo approach, on the other hand, is a poor fit for allocating adaptation and compensation costs under a tort model. Indeed, it fails to take into account in any way the historical emissions that caused the harms that adaptation and compensation costs seek to address. While current emissions are in many instances generally reflective of a country's level of historical emissions in a very rough sense, this is not always the case. In particular, a number of developing countries are experiencing rapid economic growth that has led to a high level of current emissions, even though their historical emissions were quite low.¹⁶⁴ Under a status quo approach, such a country might well pay the same amount as a country with high historical emissions. Thus, a status

162. *See supra* Part II.B.2 (explaining the historical-equal-shares approach).

163. *See supra* Part III.B.1.

164. *See* RUCHI ANAND, INTERNATIONAL ENVIRONMENTAL JUSTICE: A NORTH-SOUTH DIMENSION 30 (2004).

quo approach unfairly penalizes developing countries, which bear little responsibility for the adaptation and compensation costs incurred as a result of historical emissions. In this way, it undermines both the corrective justice and deterrence goals that underlie the tort model.

An ability-to-pay approach is similarly a poor fit for allocating adaptation and compensation costs under a tort model because it also fails to account for historical emissions. While it is generally true that those countries with high GDPs also had high historical emissions, this is not a perfect correlation. Indeed, as some developing countries like China and India experience exponential GDP growth, the correlation is becoming less and less tight over time. As with the status quo approach, an ability-to-pay approach would unfairly penalize rapidly developing countries that bear little responsibility for the adaptation and compensation costs currently being incurred as a result of past emissions.

In sum, a tort model would require countries whose current and past (post-1990) emissions exceeded reasonable levels to bear the costs of mitigation, adaptation, and compensation made necessary by those excess emissions. Such a model comports extremely well with a per capita approach to cost allocation. With respect to mitigation costs, the conceptual fit with a prospective-equal-shares approach is near perfect, if we assume a global cap that sets a reasonable, harm-avoiding level of aggregate emissions. With respect to adaptation and compensation costs, there is no perfect formula for cost assessment and allocation, but a historical-equal-shares approach with an early 1990s start date offers a reasonable second-best approximation that comports well with the deterrence and corrective justice goals that underlie the tort model.

C. A Tax Model: Allocating the Costs of a Common Enterprise

Finally, one can conceptualize the who-should-pay question as a tax problem—a situation in which a group of persons or entities is engaged in a common enterprise to promote the common good. In such a situation, it is common to expect those with more than enough resources (i.e., the ability to pay) to contribute more toward the common enterprise.¹⁶⁵ Income taxes regularly follow this principle, imposing

165. See EDWARD A. PAGE, CLIMATE CHANGE, JUSTICE AND FUTURE GENERATIONS 170–72 (2006); Shue, *supra* note 110, at 537–40; Climate Action Network, *supra* note 101, at 3 (“The ability to pay and the capacity to act are important principles in deciding who should act, when and in what way.”).

higher tax rates on the rich than the poor,¹⁶⁶ as do the formulas for countries to contribute to the United Nations, the World Bank, and the International Monetary Fund.¹⁶⁷ The U.N. Framework Convention on Climate Change also incorporates this principle, committing the developed nations to “protect the climate system . . . in accordance with their common but differentiated responsibilities and *respective capabilities*.”¹⁶⁸ In Henry Shue’s words: “Even in an emergency one pawns the jewelry before selling the blankets . . . whatever justice may positively require, it does not permit that poor nations be told to sell their blankets in order that the rich nations keep their jewelry.”¹⁶⁹

This view aligns perfectly with the ability-to-pay approach. To the extent that emissions track wealth, this view also aligns roughly with the per capita approach, which would generally result in those countries with the most wealth bearing the lion’s share of the costs of climate change. It is at odds, however, with the status quo approach, which is regressive and essentially the equivalent of a flat tax—taking the status quo distribution of wealth (or emissions) as given and demanding an equal percentage reduction from each party, whether rich or poor.¹⁷⁰

D. *The Per Capita Approach as the Best Approximation of Justice*

The above discussion demonstrates that the per capita approach is a perfect fit with a property model of justice, a very good fit (and the best of the three) with a tort model of justice, and comes in a close second

166. See HUGH J. AULT & BRIAN J. ARNOLD, *COMPARATIVE INCOME TAXATION: A STRUCTURAL ANALYSIS* 5, 24, 40, 55, 76–77, 91, 102, 120, 139–40 (2d ed. 2004) (finding progressivity in the tax structures of Australia, Canada, France, Germany, Japan, the Netherlands, Sweden, the United Kingdom, and the United States); Walter J. Blum & Harry Kalven, Jr., *The Uneasy Case for Progressive Taxation*, 19 U. CHI. L. REV. 417, 417 (1952) (“Progressive Taxation is now regarded as one of the central ideas of modern democratic capitalism and is widely accepted as a secure policy commitment which does not require serious examination.”). For defenses of progressive taxation on normative grounds, see *id.* and Martin G.J. McMahon, Jr. & Alice G. Abreu, *Winner Take All Markets: Easing the Case for Progressive Taxation*, 4 FLA. TAX. REV. 1, 10 (1998).

167. See Babiker & Eckaus, *supra* note 92, at 6.

168. United Nations Framework Convention on Climate Change, art. 3, para. 1, May 9, 1992, UN Doc. A/CONF. 151/26 (emphasis added).

169. See Grubb, *supra* note 45, at 478 (quoting Henry Shue, *The Unavoidability of Justice*, in *THE INTERNATIONAL POLITICS OF THE ENVIRONMENT: ACTORS, INTERESTS & INSTITUTIONS*, 373, 397 (Andrew Hurrell & Benedict Kingsbury eds., 1992)).

170. Posner & Sunstein, *Per Capita*, *supra* note 45, at 81 (“Perversely, the status quo approach creates a kind of entitlement to the continuation of practices that violate those requirements. No such entitlement can be defended. Even if corrective justice does not require high-emissions states to compensate those nations that are at special risk, a climate change agreement would be unacceptably unfair if it made development more difficult for poor nations.”).

with a tax model of justice. The status quo approach fares worst under all three models, and thus can be easily rejected.¹⁷¹ The ability-to-pay approach fares much better and, indeed, is the best fit under the tax model. But it suffers a major drawback. By linking the cost allocation directly to GDP rather than emissions, the ability-to-pay approach creates the wrong incentives. It creates a weak incentive against increasing GDP, which is undoubtedly outweighed by the numerous and strong incentives that favor economic growth. But it fails to create any incentive to keep emissions down while increasing GDP. The per capita approach, in contrast, preserves the incentive to develop, but creates an incentive to make development less carbon intensive.

Moreover, while the ability-to-pay approach provides the best fit with a tax model of fairness, the tax model is arguably not the best fit for the problem of climate change. By defining the issue in solely prospective and positive terms—as allocating the costs of a common enterprise—the tax model defines away an aspect of climate change that, to many observers, is one of its most salient features: the large role that the developed countries played in causing the problem historically to the detriment of those in the developing world who played little, if any, role in causing it. Thus, the tax model fails to capture an important element of justice: holding those who caused the problem accountable. An approach that fails to address this important aspect of the problem may well have poor prospects for being perceived as fair and just, particularly by those in the developing world. Under both the tort and property models, in contrast, this aspect of justice plays a prominent role.

IV. A BACK-OF-THE-ENVELOPE CALCULATION

Considering all three models of justice, then, the per capita approach comes out as the clear winner.¹⁷² It comports best with the first two

171. See 1 FLORENTIN KRAUSE ET AL., *ENERGY POLICY IN THE GREENHOUSE* 5–8 (1989) (“The lowest level of equity would be achieved in allocations . . . on the basis of current release patterns.”).

172. See AGARWAL & NARAIN, *supra* note 66, at 4; BARRY, *supra* note 62, at 267–68 (arguing that “treating the atmosphere as a global commons to be divided up equally would itself constitute a just distribution of a scarce resource”); BROWN, *supra* note 51, at 213–15 (arguing that the per capita approach is just because it treats all individuals as equals, provides all people with equal rights to use a global commons, and implements the polluter pays principle); CLINE, *supra* note 53, at 353 (arguing a per capita allocation “has the merit of equity”); KRAUSE ET AL., *supra* note 171, at 5–6 (A per capita allocation “allow[s] a more rigorous equity approach: All human beings should be equally entitled to make use of global resources such as the planet’s atmosphere.”); *id.* at 5–8 (“The highest level of equity would be provided by [a per capita allocation formula.]”); MEYER, *supra* note 81, at 55 (“Since the world’s atmosphere belongs equally to everyone if it belongs to anyone at

models, and with respect to the third, it comes in a close second. There may be an argument for giving the tax model less weight in any case, because it is prospective only and thus fails to take past actions into account. Moreover, the perverse incentive against development that the ability-to-pay approach fosters makes the per capita approach more attractive as well.

So the per capita approach comports best with broadly shared notions of justice and fairness, but what are the practical implications of this conclusion? Since last year's failed Copenhagen talks, the prospects of a comprehensive international climate change agreement of any kind seem bleak. Certainly, the chances of an international agreement instituting a global cap-and-trade program and allocating allowances on a per capita basis are virtually non-existent. Nonetheless, it is useful to try to estimate the magnitude of the wealth transfer from the developed to the developing world that such an approach would entail. Such an estimate should at least inform our thinking about international negotiations.

We can do a rough, back-of-the-envelope calculation to get a ballpark estimate of the amount of money that the developed world would actually have to pay to the developing world to buy back the right to emit greenhouse gases at current levels under a per capita approach. We will use 2006, because that is the most recent year for which good statistics are available. For simplicity's sake, we will assume a "cap" of the actual global emissions for that year, and we will take a prospective-equal-shares approach. Keep in mind that a historical-equal-shares approach would imply an even bigger payment from developed to developing countries.

Global emissions of carbon dioxide in 2006 were 29 billion metric tons and world population was 6.5 billion.¹⁷³ Accordingly, a per capita

all, the only basis on which such an agreement seems possible is that there must . . . be an equal quota allocation to everyone in the world."); SINGER, *supra* note 64, at 43; Henry Shue, *Avoidable Necessity: Global Warming, International Fairness, and Alternative Energy*, in NOMOS XXXVII: THEORY AND PRACTICE 239, 257–58 (Ian Shapiro & Judith Wagner DeCew eds., 1995) (arguing that carbon emissions are an essential of life, and that therefore, developed nations who emit more than their fair share deprive people in poor nations of one of life's essentials); Amy Sinden & Carl Cranor, *Toward Distributional Justice*, in ECONOMIC THOUGHT AND U.S. CLIMATE CHANGE POLICY, *supra* note 5, at 237, 240 ("[T]he equality principle requires that we distribute to each individual on the planet an equal share in the absorptive capacity of the atmosphere."); *The Isolation of America*, SPIEGEL ONLINE, Aug. 31, 2007, <http://www.spiegel.de/international/germany/0,1518,503176,00.html> (German Chancellor Angela Merkel advocates equalizing worldwide per capita greenhouse-gas emissions).

173. See ENERGY INFO. ADMIN., WORLD ENERGY-RELATED CARBON DIOXIDE EMISSIONS BY FUEL TYPE, 1990–2030, at 1 (2009), http://www.eia.doe.gov/oiaf/ieo/excel/figure_81data.xls; U.S. Census Bureau, Total Midyear Population for the World: 1950–2050, <http://www.census.gov/ipc/www/idb/worldpop.php> (last visited Apr. 10, 2010).

allocation of those emissions would have worked out to approximately 4.4 metric tons of CO₂ per person.¹⁷⁴ Thus, under a per capita (equal-shares) approach the United States, with a population of 298 million,¹⁷⁵ would have been entitled to emit a total of only 1.3 billion metric tons of carbon dioxide.¹⁷⁶ In fact, total U.S. CO₂ emissions in 2006 were around 6 billion metric tons.¹⁷⁷ In contrast, India was entitled to emit 4.8 billion metric tons of carbon dioxide in 2006,¹⁷⁸ far more than its actual CO₂ emissions, which were around 1.3 billion metric tons.¹⁷⁹

In sum, a per capita approach to 2006 CO₂ emissions leads to the conclusion that U.S. carbon dioxide emissions were approximately 4.7 billion metric tons over its entitlement that year and that CO₂ emissions from developing countries were far less than their entitlements. If we imagine a trading scheme in which the developed countries, like the United States, were required to buy allowances from the developing world for each ton of carbon dioxide they emitted in excess of their per capita entitlement, how much money would the United States have to pay to developing countries to pay back its CO₂ debt?

This is no simple question. Under Phase II of the European Union's emissions trading system, allowances have been trading at between \$11 and \$42 per metric ton of CO₂.¹⁸⁰ At these prices, the U.S. "carbon debt" to the developing world for just its 2006 emissions would be somewhere between \$52 billion and \$197 billion. That translates to between 0.4 and 1.5 percent of U.S. GDP, which was roughly \$13 trillion in 2006.¹⁸¹

174. Twenty-nine billion divided by 6.53 billion yields 4.44.

175. U.S. Census Bureau, International Database, <http://www.census.gov/idb/ranks.html> (select 2006 in the drop-down menu and click "Submit") (last visited Apr. 10, 2010).

176. Two hundred ninety-eight million multiplied by 4.4 equals 1.3 billion.

177. See ENERGY INFO. ADMIN., GREENHOUSE GAS EMISSIONS IN THE UNITED STATES I (2007), <http://www.eia.doe.gov/oiaf/1605/archive/gg08rpt/pdf/table1.pdf>.

178. The population of India in 2006 was 1.1 billion, see U.S. Census Bureau, International Database, <http://www.census.gov/idb/ranks.html> (select "2006" in the drop-down menu and click "Submit") (last visited Apr. 10, 2010), which, multiplied by 4.44 metric tons, yields 4.88 billion metric tons.

179. See World Resources Institute-Climate Analysis Indicators Tool, Total GHG Emissions in 2006 (on file with author), available at <http://cait.wri.org/cait.php?page=yearly> (free registration required).

180. See European Climate Exchange, ECX EUA Indices, <http://www.ecx.eu/ECX-EUA-Indices> (last visited Apr. 10, 2010) (reporting prices during Phase II ranging from approximately 8 to 30 Euros per metric ton of CO₂, which—assuming a 1:1.4 euros to dollars exchange rate—is roughly equivalent to \$11 to \$42 per metric ton of CO₂).

181. See U.S. Bureau of Economic Analysis, Current-Dollar and "Real" Gross Domestic Product (Mar. 26, 2010), <http://www.bea.gov/national/xls/gdplev.xls>.

But these prices are essentially arbitrary, based largely on a political decision to set the cap at a particular level, and do not necessarily reflect the true “value” of a ton of CO₂ emissions. Estimates of the “social cost of carbon”—the monetary value of the damage done by an incremental ton of carbon emissions—vary wildly, from less than \$0 to over \$400 per metric ton of CO₂.¹⁸² Indeed, there are strong arguments that attempting to express in monetary terms the many varied, complex, and uncertain harms associated with global climate change is a fool’s errand and that any such estimate will inevitably undercount the true costs of climate change.¹⁸³ Nonetheless, such estimates can perhaps at least give us a ballpark sense of the magnitude of the carbon debt owed by the developed to the developing world.

The Stern Review estimated the social cost of carbon at \$85 per metric ton of CO₂, which would put the 2006 U.S. carbon debt at 3% of GDP.¹⁸⁴ Using the Stern Review as a basis for its own estimate, the United Kingdom set the price of carbon to be used in government reports at £25 in 2007,¹⁸⁵ or approximately \$40 per metric ton of CO₂.¹⁸⁶ Using this value would put the U.S. carbon debt at around 1.4 % of GDP. In the United States, an inter-agency work group recently produced a report providing a range of estimates for the social cost of carbon ranging from

182. NICHOLAS STERN, *THE ECONOMICS OF CLIMATE CHANGE* 322 (2006).

183. See Douglas A. Kysar, *Climate Change, Cultural Transformation, and Comprehensive Rationality*, 31 B.C. ENVTL. AFF. L. REV. 555 (2004) (criticizing attempts to quantify and monetize harms of climate change); Richard S.J. Tol, *The Social Cost of Carbon: Trends, Outliers and Catastrophes* 2, ECON.: OPEN-ACCESS, OPEN-ASSESSMENT E-J. (Aug. 12, 2008), <http://www.economics-ejournal.org/economics/journalarticles/2008-25> (acknowledging that estimates of the social cost of carbon (SCC) often “omit some impacts . . . tend to ignore interactions between different impacts and neglect higher order effects on the economy and population . . . use simplistic models of adaptation . . . often ignore uncertainties, . . . and use controversial valuation measures”).

184. See STERN, *supra* note 182, at 322.

185. See ECON. GROUP, U.K. DEP’T FOR ENV’T, FOOD AND RURAL AFFAIRS (DEFRA), *THE SOCIAL COST OF CARBON AND THE SHADOW PRICE OF CARBON: WHAT THEY ARE, AND HOW TO USE THEM IN ECONOMIC APPRAISAL IN THE UK* 7 (2007), http://www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/valuation/shadow_price/shadow_price.aspx (the Report’s title is a link to the PDF); see also U.K. DEP’T OF ENERGY & CLIMATE CHANGE, *CARBON APPRAISAL IN UK POLICY APPRAISAL: A REVISED APPROACH* 23–35 (2009), http://www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/valuation/valuation.aspx (the Report’s title is a link to the PDF) [hereinafter U.K. DEP’T OF ENERGY & CLIMATE CHANGE] (adopting a new approach to valuing CO₂ emissions based on marginal abatement costs rather than damages and estimating such costs at £25 to £60 in the short term). *But see generally* Elizabeth A. Stanton & Frank Ackerman, *Out of the Shadows: What’s Behind DEFRA’s New Approach to the Price of Carbon*, SEI PROJECT REP. (Stockholm Env’t Inst., Stockholm, Swed.), July 2008, http://ase.tufts.edu/gdae/Pubs/rp/shadow_price_of_carbon.pdf (criticizing the UK estimate as too low).

186. British pounds converted to U.S. dollars using a conversion rate of £1.00 = \$1.625.

\$5 and \$65 per metric ton of CO₂.¹⁸⁷ These estimates, which are controversial and have already received criticism for being too low,¹⁸⁸ would put the U.S. carbon debt somewhere between 0.2% and 2.4% of GDP.

In this light, the developing countries' demand that the developed countries contribute 1% of GDP to the climate change effort actually seems quite reasonable. A prospective-equal-shares approach could easily result in payments at that level, if not higher,¹⁸⁹ and that is without even taking historical emissions into account.

V. IN DEFENSE OF THE PER CAPITA APPROACH

Though many authors treat a per capita allocation scheme as self-evidently the most fair and equitable¹⁹⁰ (though perhaps facing challenges with regard to feasibility), several authors have criticized this approach. This Part considers and responds to several of those criticisms.

187. INTERAGENCY WORKING GROUP ON SOCIAL COST OF CARBON, U.S. DEP'T OF ENERGY, FINAL RULE TECHNICAL SUPPORT DOCUMENT (TSD): ENERGY EFFICIENCY PROGRAM FOR COMMERCIAL AND INDUSTRIAL EQUIPMENT: SMALL ELECTRIC MOTORS, app. 15A.2 (2010) ("Monetizing Carbon Dioxide Emissions"), available at http://www1.eere.energy.gov/buildings/appliance_standards/commercial/pdfs/smallmotors_tsd/sem_finalrule_appendix15a.pdf [hereinafter U.S. DEP'T OF ENERGY].

188. See FRANK ACKERMAN & ELIZABETH A. STANTON, THE SOCIAL COST OF CARBON 7 (2010) ("[T]he working group's interim and revised SCC estimates rely on a biased and incomplete reading of the economic literature on climate change. The methods used to set these values reveal an unexplained confidence in a handful of authors and models and offer arbitrary, unsupported judgments as grounds for ignoring important alternatives. Most of the errors, omissions, and arbitrary judgments tend to reduce the estimate of the SCC; a corrected version of the same calculations, therefore, would likely result in a larger SCC."). The U.S. working group study relied heavily on a recent study by Richard Tol. See Tol, *supra* note 183. This "meta-analysis" surveyed 211 estimates of the social cost of carbon in the economics literature and concluded that the mean estimate was approximately \$20 to \$25 per metric ton of carbon in 2000 dollars, *id.* at 9–10, which translates into \$5 to \$7 per metric ton of CO₂. Tol has been criticized, however, for using a highly skewed sample. See ACKERMAN & STANTON, *supra*, at 8–11. Of the 211 studies included, for example, 112 were authored by Tol. They did not represent 112 separate estimates of the SCC, but rather simply multiple scenarios and sensitivity analyses within the same small number of studies. Tol's models were also based on certain unwarranted assumptions, like the assumption that climate change in the early stages will produce a large *reduction* in mortality. *Id.*

189. Assessments of the social cost of carbon generally assume that the cost will increase over time. See U.S. DEP'T OF ENERGY, *supra* note 187, at 2 (estimating SCC rising from \$16 to \$136 per metric ton CO₂ by 2050); U.K. DEP'T OF ENERGY & CLIMATE CHANGE, *supra* note 185, at 3 (estimating SCC rising to £200 per metric ton of CO₂ by 2050).

190. See *supra* note 172.

A. *Allowances Awarded to Governments, Not People*

One common objection to the per capita approach is that it awards allowances to countries, not people.¹⁹¹ Because so many countries, particularly in the developing world, are ruled by corrupt and non-democratic governments, this argument posits that the wealth generated by the excess allowances allocated to the developing world will go, not to help those countries' citizens, but to line the pockets of dictators.

While this objection raises an important point about implementation, it does not fundamentally challenge the theoretical soundness of the per capita approach. The point of this Article is not to propose any particular mechanism for implementing cost sharing among countries. Nor does it presume that any international agreement that actually gets hammered out through the political process will in the end be shaped primarily by principles of justice and fairness. The point here is simply to paint a picture of what an agreement based solely on such principles would look like, in the hopes that such a vision at least can be acknowledged and perhaps play a role in pushing the developed world to take on more of the costs of climate change.

It is certainly valid to ask whether the political necessity of implementing a per capita approach in a second-best manner, by giving allowances to governments rather than individuals, so undermines the equity of the proposal that it is not worth following through with.¹⁹² But the problem this question identifies arises any time we try to provide aid to developing countries. While it is important to try to devise ways to deliver such aid that minimize the risk that it will be hijacked by corrupt political leaders, it is not clear that we should abandon all efforts at foreign aid on these grounds.

Exactly how such cost sharing is implemented is a separate question. If it takes the form of cash payments to the developing world, presumably some mechanism can be developed to ensure that such funds are not funneled to the coffers of corrupt governments. Even if cost sharing takes the form of an allocation of allowances to the developing world, such allowances need not necessarily be given to governments

191. See Beckerman & Pasek, *supra* note 30, at 409; Posner & Sunstein, *Justice*, *supra* note 37, at 1586–87; Posner & Sunstein, *Per Capita*, *supra* note 45, at 75.

192. See Beckerman & Pasek, *supra* note 30, at 408 (“[S]ince sovereign nation states are the primary actors in international politics, intercountry redistribution should be viewed as a ‘second-best’ solution to the global application of the difference principle.” (citing Charles Beitz, *International Distributive Justice*, in *PROBLEMS OF INTERNATIONAL JUSTICE* 27 (Steven Luper-Foy ed., 1988))).

directly. They might instead be allocated to aid groups with a proven track record, or to the World Bank's carbon fund, for example.

B. Failure to Account for Differential Effects of Climate Change

Another objection to the per capita approach is its failure to account for the different effects that climate change is likely to have in different regions of the globe. Eric Posner and Cass Sunstein, for example, take this view:

Some poor states will become far poorer as a result of climate change; other poor states are less vulnerable. Similarly, some rich states will face serious adverse economic effects from climate change; other rich states are less vulnerable. Some states may even be net gainers from climate change. If distribution is our concern, why should two highly populated poor nations receive the same number of permits from a program from which one nation would gain a lot and another a little—or from which one would gain a lot and another would actually lose? Ideally, permits should be distributed in light of these consequences, but the per capita approach fails to take them into account.¹⁹³

Posner and Sunstein view redistribution of wealth from the rich to the poor as a worthy goal on both fairness and welfarist grounds.¹⁹⁴ A more equal distribution of wealth promotes fairness, and the declining marginal utility of money means that it also promotes welfarist goals. Because a dollar is worth more to a poor person than a rich person, redistribution from rich to poor increases overall social welfare.¹⁹⁵ But the per capita approach falls short, in their view, because it fails to take into account all aspects of wealth, including the costs and benefits that will arise from climate change mitigation itself.¹⁹⁶

One problem with such arguments is that they overstate the extent to which the impacts of climate change will vary. While climate change may produce some isolated beneficial effects in certain regions in the

193. Posner & Sunstein, *Per Capita*, *supra* note 45, at 74–75; *see also* Babiker & Eckaus, *supra* note 92, at 2–3 (noting that climate change will have differential impacts across the globe, and “[i]n principle, it is necessary to know both costs and benefits in order to place a value on the public good created by emissions constraints”).

194. *See* Posner & Sunstein, *Per Capita*, *supra* note 45, at 72, 80.

195. *See* Beckerman & Pasek, *supra* note 30, at 406 (“[I]deally, the maximization of utility of the whole human race would no doubt justify international redistribution.”); Posner & Sunstein, *Per Capita*, *supra* note 45, at 72 (“[O]ther things being equal, distribution to those who are poor will increase welfare.”).

196. *See* Posner & Sunstein, *Per Capita*, *supra* note 45, at 74–75.

short term, in the long term, the effects will be unqualifiedly bad.¹⁹⁷ Moreover, there is a small but non-trivial risk that the results will be catastrophic.¹⁹⁸ Additionally, to suppose that the regional impacts of climate change will remain confined to those regions is naïve at best. Even the U.S. Department of Defense is concerned that widespread food shortages, disease, floods, and droughts in the developing world will produce political instability in many regions that will pose a grave national security threat in this country.¹⁹⁹ Criticisms of the per capita approach for its failure to account for the differential effects of climate change also overstate the extent to which we can accurately predict the impacts of climate change.

But the bigger problem is that this argument shifts the question from what is a fair initial allocation of costs or allowances to what is a fair allocation of outcomes.²⁰⁰ By subtly shifting the question in this way, such arguments succeed in complicating the issue so that any equity-based solution can be criticized as being incomplete and imperfect. Once the relevant “wealth” to be distributed includes the costs and benefits of climate change mitigation, most of which are highly uncertain and will not come to fruition for many years, a full accounting in order to design a fair or welfare maximizing distribution becomes impossible.²⁰¹

Indeed, Posner and Sunstein shift the target even further, until the goal is no longer just distributing the “wealth” of the atmosphere or the “wealth” of climate change regulation generally, but nothing less than a wholesale redistribution of all wealth on earth:

[T]here is no reason to think that the per capita approach to climate regulation is the right way to redistribute wealth and thus to increase global welfare. From a welfarist perspective, a sensible redistributive policy would . . . redistribute all resources rather than shares of the atmosphere’s capacity to absorb greenhouse gases.²⁰²

197. See Jody Freeman & Andrew Guzman, *Climate Change and U.S. Interests*, 109 COLUM. L. REV. 1531, 1599–1601 (2009); IPCC, CLIMATE CHANGE 2007: SYNTHESIS REPORT 48 (2007), http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf.

198. See Freeman & Guzman, *supra* note 197, at 1554.

199. See Heinzerling, *supra* note 74, at 448–49.

200. See Rose, *supra* note 30, at 29–30 (identifying “equity in “initial allocation” and “equity in “final outcome” as two separate ways to think about equity in climate change context).

201. See Jamieson, *supra* note 3, at 288 (“[T]here is no way to assess accurately all the possible impacts [of global climate change] and to assign economic values to alternative courses of action. A greenhouse warming, if it occurs, will have impacts that are so broad, diverse, and uncertain that conventional economic analysis is practically useless.”).

202. Posner & Sunstein, *Per Capita*, *supra* note 45, at 75.

Under this new standard, if the per capita approach does not achieve a perfectly fair or welfare-maximizing redistribution of all of the wealth on the planet among all of the people on the planet, it misses the mark. Against such a monumentally ambitious goal, it is easy to find virtually any proposal sorely wanting.

Having redefined the normative goal as overall redistribution of all forms of wealth (rather than the far simpler goal of redistributing the “wealth” of the atmosphere), Posner and Sunstein then object that “the per capita system is only indirectly connected to the underlying normative goal—indeed, so indirectly that it is *conceivable in principle* that it has worse distributive effects than the status quo approach.”²⁰³ It is technically “conceivable,” I suppose, that a per capita approach could have negative distributive effects. But in light of the way the projected impacts of climate change and the responsibility for causing it are distributed across the globe, on this planet, at least, the per capita approach tracks the goal of overall wealth redistribution remarkably well.²⁰⁴

The bottom line is that, by insisting that if we are going to distribute any one resource, we have to take on a massive redistribution of all resources on earth, Posner and Sunstein doom any equity-based argument for the distribution of emissions allowances to certain failure. And yet, it is not even clear that generalized wealth redistribution is an appropriate goal. Certainly, it is a highly controversial goal—far more controversial than a goal of simply redistributing one particular kind of wealth—here, the absorptive capacity of the atmosphere. The classic argument against generalized wealth redistribution—that taking resources away from the wealthy will undermine incentives for hard work—does not translate to this context. One might try to argue that those who have used the lion’s share of the atmosphere worked hard to do so, producing valuable economic goods in the process, and that if we take their share of the atmosphere away, we will lessen their incentive to

203. *Id.* (emphasis added).

204. Greenhouse-gas emissions are highly correlated with wealth, and, in a cruel twist of fate, the burdens of climate change are highly correlated with poverty. PARRY ET AL., CLIMATE CHANGE 2007: IMPACTS, ADAPTATION, AND VULNERABILITY 294, 317, 383 (2007). Some of this is simply the luck of geography. A number of the most severe and disruptive impacts of climate change, including drought, sea level rise, and the spread of disease, are projected to be particularly harsh in the developing world. But in other respects, the disparate impacts of climate change are driven by existing inequalities. Poor countries, as well as poor communities within developed countries, are likely to suffer more from climate change because resources and infrastructure are already stretched thin in poor communities, and because they have fewer resources to devote to adaptation. See Richard S.J. Tol et al., *Distributional Aspects of Climate Change Impacts*, 14 GLOBAL ENVTL. CHANGE 259, 264–66 (2004).

work hard in the future. But redistributing the absorptive capacity of the atmosphere still leaves in place the status quo distribution of all other forms of wealth and so leaves plenty of incentives for productive work. It removes only the incentives to engage in carbon-intensive forms of production, which is precisely what we need to do to tackle the climate crisis in any case.

Ultimately, Posner and Sunstein acknowledge that the per capita approach comports with principles of fairness and welfare considerably better than the status quo approach.²⁰⁵ In the end, they reject it on pragmatic grounds, observing that “[t]here is little reason that the rich states would be willing to agree to such an approach” because it is not in their self-interest.²⁰⁶ While it is undoubtedly true that rich countries, particularly the United States, will balk at the notion that they should pay hundreds of billions of dollars to the developing world, in thinking about international climate policy there is still a place for a normative analysis that puts aside political constraints to focus on what justice would require.²⁰⁷

C. *Arguments Against a Historical Approach*

Two arguments are frequently raised against any allocation scheme that holds countries responsible for past emissions. First, some argue that it is not fair to hold present generations accountable for the actions of prior generations.²⁰⁸ Second, some argue that it is unfair to penalize developed countries for emissions that occurred before it was reasonably foreseeable that such emissions might lead to harm.²⁰⁹ Both of these arguments can largely be diffused by simply beginning the historical accounting at some date by which it is reasonable to say that the scientific understanding of climate change was clear. We might pick 1990, the date of the IPCC’s first assessment report.²¹⁰ Alternatively, we

205. Posner & Sunstein, *Per Capita*, *supra* note 45, at 86 (“In light of . . . justifications [based in welfare or fairness] the per capita approach . . . seems . . . to be far better than the status quo approach.”).

206. *Id.* at 89. *See also* Beckerman & Pasek, *supra* note 30, at 406 (rejecting as impractical the application of utilitarian theories of justice to the climate change context).

207. *See* Daniel A. Farber, *Basic Compensation for Victims of Climate Change*, 155 U. PA. L. REV. 1605, 1607–08 (2008) [hereinafter Farber, *Basic Compensation*].

208. *See, e.g.*, PAGE, *supra* note 165, at 168–69.

209. *See* Posner & Sunstein, *Justice*, *supra* note 37, at 1598–99.

210. *See* Heinzerling, *supra* note 74, at 460 (arguing that scientific consensus on climate change became clear in the late 1980s or early 1990s). Posner and Sunstein acknowledge that the case for finding emitters negligent is stronger after 1990. *See* Posner & Sunstein, *Justice*, *supra* note 37, at 1598 n.146.

could pick 1992, the year negotiations were completed on the U.N. Framework Convention on Climate Change.²¹¹ These dates are recent enough to make the prior-generations objection considerably less forceful. Moreover, because global emissions have increased so dramatically in recent decades, and because greenhouse gases do not linger forever in the atmosphere, beginning the accounting at some point in the early 1990s would still capture most of the historical emissions currently accumulated in the atmosphere. Nonetheless, these two arguments are addressed below.

1. *Ignorance of Prior Generations*

Some argue that it is unfair to hold people responsible for greenhouse-gas emissions that occurred before a scientific consensus had developed on climate change and before the dangers of climate change had become a matter of common knowledge and widespread political discourse. This argument has obvious traction under a tort theory of justice, because liability in tort often requires some finding of culpability, (which requires at least objective knowledge by the wrongdoer that her actions might cause harm).²¹² Even a low standard of culpability, like negligence, requires a finding that the wrongdoer knew or should have known that her actions might cause harm.²¹³ But even under tort law, knowledge is not universally required. As discussed above, strict liability regimes impose liability in the absence of knowledge by the wrongdoer.²¹⁴ And while such a regime is more difficult to justify under the corrective justice goals of tort law, it can serve deterrence goals.

This argument has less traction under a property theory. It might be reasonable to argue that one who used up a disproportionate share of the atmosphere before she reasonably could have known that it was a limited resource should not be penalized. But property law does not always require intent to violate legal or moral norms. While a trespasser must intend to be on the land that she is on, she need not have an intent to trespass (i.e., knowledge that the land she is on is privately owned).²¹⁵

211. See Farber, *Apportioning*, *supra* note 118, at 32 (suggesting 1992 as a cut-off date for apportioning responsibility for climate change adaptation according to a polluter pays principle); Farber, *Basic Compensation*, *supra* note 207, at 1641.

212. See RESTATEMENT (SECOND) OF TORTS § 289 (1965).

213. See *id.*

214. See *id.* § 519.

215. See *id.* § 329.

By analogy, one might argue that one who intended to burn coal and thus to release pollutants (including CO₂) into the atmosphere, should be liable for using up more than her fair share of the atmosphere even in the absence of knowledge that the atmosphere is a limited resource that would need to be legally apportioned.

From a philosophical perspective, Henry Shue finds the argument against historical responsibility for those lacking knowledge of climate change unconvincing. He points out that “[t]his objection rests upon a confusion between punishment and responsibility.”²¹⁶ It is not fair to *punish* people for acts that produced unforeseeable effects. But on the other hand, we frequently hold people *responsible* for unforeseeable and unavoidable harms. Shue explains it this way:

[I]n order to be justifiable, an inequality in something between two or more parties must be compatible with an equality of dignity and respect between the parties. If there were an inequality between two groups of people such that members of the first group could create problems and then expect members of the second group to deal with the problems, that inequality would be incompatible with equal respect and equal dignity. For the members of the second group would in fact be functioning as servants for the first group. If I said to you, “I broke it but I want you to clean it up,” then I would be your master and you would be my servant. If I thought that you should do my bidding, I could hardly respect you as my equal.²¹⁷

2. *Present Generations Not Responsible for the Acts of Prior Generations*

Even if it is appropriate to hold people in prior decades or centuries responsible for the harms caused by greenhouse-gas emissions before the phenomenon of climate change was widely understood, is it appropriate to hold current generations accountable for the actions of their ancestors?²¹⁸ This has been called “the wrongdoer identity problem.”²¹⁹ It rests on the fundamental and unobjectionable principle

216. Shue, *supra* note 110, at 535.

217. *Id.*

218. See Babiker & Eckaus, *supra* note 92, at 7; Simon Caney, *Environmental Degradation, Reparations, and the Moral Significance of History*, 37 J. SOC. PHIL. 464, 468 (2006); Posner & Sunstein, *Justice*, *supra* note 37, at 1593–94.

219. Posner & Sunstein, *Justice*, *supra* note 37, at 1593; see also Babiker & Eckhaus, *supra* note 92, at 7.

that it is wrong to hold some one responsible for the acts of some other, unrelated person.

But the question is, just how unrelated are the citizens of a given country from the generations that came before them?²²⁰ Current generations in the developed world continue to reap the benefits of the industrialization that was brought about through carbon-emitting activities over past decades and centuries. As such, it is appropriate to hold them responsible under a theory of unjust enrichment.²²¹

Additionally, those who make this argument tend to overstate the problem.²²² While a significant portion of the greenhouse gases currently accumulated in the atmosphere were put there by the activities of prior generations, because emissions rates have increased so quickly in recent years, the majority of the greenhouse gases that are now in the atmosphere were put there during the last two decades.²²³

CONCLUSION

In international negotiations on climate change, the developed world is speaking the language of efficiency while the developing world is speaking the language of justice. The principle of efficiency is helpful for determining who should reduce emissions. When it comes to the far more contentious issue of who should pay, however, the efficiency principle obscures the real issues and implicitly promotes a status quo approach. When judged according to widely accepted principles of fairness and justice, on the other hand, a per capita approach to the who-should-pay question is clearly superior to the alternatives.

220. Shue, *supra* note 110, at 536.

221. PAGE, *supra* note 165, at 170–73.

222. See Babiker & Eckaus, *supra* note 92, at 7 (“[I]t is not the current generations that produced most of the accumulated greenhouse gas emissions.”); Caney, *supra* note 218, at 468 (“Obviously . . . almost all of those individuals are no longer alive.”).

223. See Daniel A. Farber, *The Case for Climate Compensation: Justice for Climate Change Victims in a Complex World*, 2008 UTAH L. REV. 377, 387 (finding the United States produced 10% of all CO₂ emissions it had ever produced up to that point in 2000–2004).