

Climate Contracts

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Abstract

Many policymakers and academics argue that a comprehensive global treaty is the only effective method by which to regulate greenhouse gas emissions. Some of them therefore see the failure to reach a post-Kyoto agreement at Copenhagen in 2009 as “catastrophic.” This Article argues instead that the Copenhagen Accord and the negotiations surrounding it reveal some inherent limits to the comprehensive approach. It recounts a number of pitfalls in any comprehensive solution, including “leakage” in economic production and distribution, weaknesses in disclosure and monitoring, limited methods of enforcement, constrained incentives for compliance, and other factors. As an alternative, this Article proposes that comprehensive global agreements should recognize that a plurality of lower-level “climate contracts” of various kinds are likely to provide effective and efficient responses to climate change in the long run. The dynamic complexity of the climate change problem suggests that the best solutions will leverage broad-based social movements favoring the production and maintenance of many kinds of legal, economic, and political agreements involving many institution—not just nation-states negotiating international treaties, but also other agreements involving regional and municipal governments, non-profit organizations (including educational, religious, and environmentalist groups), business firms, and consumer groups. The idea of “climate contracts” is invoked metaphorically to describe these various kinds of non-comprehensive agreements and initiatives. From this perspective, the Copenhagen Accord, rather than a failure, provides useful lessons and direction for the future about what mix of legal, economic, political, and social solutions will work best to address global climate change.

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Table of Contents

Introduction.....	
I. The Weaknesses of Global Comprehensive Approaches to Climate Change.....	
II. Non-Comprehensive Climate Contracts.....	
A. Non-comprehensive International Agreements.....	
B. Bilateral or Multilateral Climate Treaties.....	
C. National and Regional Climate Regulation.....	
D. Municipal Plans and Coordination.....	
E. Energy Efficiency Plans.....	
F. Subsidies for Technological Innovation.....	
G. Non-Governmental Organizations.....	
H. Business Coalitions.....	
I. Consumer Transactions.....	
Conclusion.....	

*The fish applaud the ocean;
I shake hands with the sky.*

Franz Wright¹

Introduction

This Article recommends a different approach to thinking about a variety of possible responses to the problem of climate change than has been offered to date by most policy analysts and academic theorists. In essence, it argues for a large number of different “climate contracts” to be made at different social levels—from the global to the transactional. These “climate contracts” include not only international treaties but also national and regional regulations, public-private partnerships brokered by non-governmental organizations, various organizational alliances, and everyday transactions for goods and services.² Recognizing a multiplicity of climate contracts suggests a “pluralist” or “decentralized” approach that tolerates—and perhaps even celebrates—a very large number of competing strategies to address climate change, as opposed to a “unitary” or “comprehensive” model that insists on one overarching regulatory regime to control climate change and its effects at a global level.

¹ Franz Wright, *The New Child*, in WALKING TO MARTHA’S VINEYARD: POEMS 69 (2005).

² The term “climate contracts” is used here metaphorically. Previous work sketches out the general idea of “environmental contracts” as a political and legal framework to describe the approach adopted here. Eric W. Orts & Kurt Deketelaere, *Introduction: Environmental Contracts and Regulatory Innovation*, and Geoffrey C. Hazard, Jr., & Eric W. Orts, *Environmental Contracts in the United States*, in ENVIRONMENTAL CONTRACTS: COMPARATIVE APPROACHES TO REGULATORY INNOVATION IN THE UNITED STATES AND EUROPE 1-35, 71-91 (Eric W. Orts & Kurt Deketelaere eds., 2001). See also Natasha A. Affolder, *Rethinking Environmental Contracting*, 21 J. ENV. L. & PRAC. 155 (2010); David A. Dana, *The New “Contractarian” Paradigm in Environmental Regulation*, 2000 U. ILL. L. REV. 35 (2000). In future work, I hope to pursue a more rigorous philosophical development of the intuition that traditional social contract theory should be expanded to include ecological considerations such as long-term climate change with attendant implications for politics and law. For an earlier argument in this direction, see MICHEL SERRES, *THE NATURAL CONTRACT* (Elizabeth MacArthur & William Paulson trans., 1995). For a suggestive example of current work in the same vein, see Karen O’Brien, Bronwyn Hayward, & Fikret Berkes, *Rethinking Social Contracts: Building Resilience in a Changing Climate*, 14 ECOLOGY & SOC’Y 12 (2009).

The standard, currently dominant policy approach to thinking about climate change recommends a comprehensive global solution. The argument in support of this approach is straightforward and powerful. The problem of climate change is conceived as one of a global commons: namely, the Earth itself and all of its inhabitants. The atmosphere, oceans, ice packs, forests, and land compose a single large scientific problem that has come to be called “climate change.”³ The basic problem is easily stated, though the underlying science is complex and the future consequences are difficult to predict with precision.⁴ Climate change results from the extraordinary

³ Some scholars argue for using a stronger descriptive term, such as “global destabilization.” See, e.g., DAVID W. ORR, *DOWN TO THE WIRE: CONFRONTING CLIMATE COLLAPSE* 2-4 (2009). For a defense of the term “climate change” as opposed to other options such as “global warming,” see Stephen M. Gardiner, *Ethics and Global Climate Change*, 114 *ETHICS* 555, 557-59 (2004).

⁴ The primary source for the current science and predictable consequences of climate change remains the International Panel on Climate Change (IPCC) organized under the auspices of the United Nations. See IPCC, *FOURTH ASSESSMENT REPORT: CLIMATE CHANGE 2007* (2007) (synthesis report and Working Group I report on science), available at <http://www.ipcc.ch>. In the United States, a recent study by the National Academy of Sciences reinforces the conclusions that “climate change is a reality and is driven mostly by human activity, chiefly the burning of fossil fuels and deforestation.” John M. Broder, *U.S. Science Body Urges Action on Climate*, N.Y. TIMES, May 20, 2010, at A19 (summarizing report). As one recent observer emphasizes, significant climate change has already occurred, and the only question remains how far-reaching and severe its consequences will be. BILL MCKIBBEN, *EAARTH: MAKING A LIFE ON A TOUGH NEW PLANET* (2010). See also V. Ramanathan & Y. Feng, *On Avoiding Dangerous Anthropogenic Interference with the Climate System: Formidable Challenges Ahead*, 105 *PROC. NAT’L ACAD. SCI.* 14245 (2008). One should note that a minority scientific view continues to question the proven extent and severity of climate change and the role of human beings in causing it. E.g., BJORN LOMBERG, *COOL IT: THE SKEPTICAL ENVIRONMENTALIST’S GUIDE TO GLOBAL WARMING* (2007); Freeman Dyson, *The Question of Global Warming*, N.Y. REVIEW OF BOOKS, June 12, 2008; Richard S. Lindzen, *Is the Global Warming Alarm Founded on Fact?*, in *GLOBAL WARMING: LOOKING BEYOND KYOTO* 21-33 (Ernesto Zedillo ed., 2008). It is true that significant scientific uncertainties remain, such as the nature and extent of feedback effects of cloud formation and the biogeochemistry of the oceans. See, e.g., Amy C. Clement, et al., *Observational and Model Evidence for Positive Low-Level Cloud Feedback*, 325 *SCIENCE* 460 (2009); Greg O’Hare, *Reviewing the Uncertainties in Climate Change Science*, 32 *AREA* 357 (2000); I. Marinov, et al., *Response of Ocean Phytoplankton Community Structure to Climate Change Over the 21st Century: Partitioning the Effects of Nutrients, Temperature and Light*, 7 *BIOGEOSCIENCES* 3941 (2010); Andrew J. Watson & Peter S. Liss, *Marine Biological Controls on Climate via the Carbon and Sulphur Geochemical Cycles*, 353 *PHIL. TRANSACTIONS: BIOLOGICAL SCI.* 41 (1998). Scientific uncertainty, however, cuts both ways for “while it is certainly conceivable (though, at present, unlikely) that the climate change problem will turn out to be chimerical, it is also possible that global warming will turn out to be much worse than anyone has yet anticipated.” Gardiner, *supra* note 3, at 569. From a policy perspective, “the really vital issue does not concern the presence of scientific uncertainty, but rather how we decide what to do under such circumstances.” *Id.* The balance of the current scientific literature confirms at least that global climate change presents very serious long-term risks to human civilization which deserve similarly serious responses in terms of policy measures and investments in policy solutions as well as further scientific understanding.

success of the human species, which has become so adept technologically that its economic and cultural processes significantly alter the underlying climate of the entire planet. Primarily, the use of fossil fuels (*i.e.*, coal, oil, and natural gas) since the Industrial Revolution has begun to influence the fundamental dynamics of the atmosphere, oceans, ice packs, forests, land, and planet as a whole.⁵ The large-scale emissions of what have come to be called “greenhouse gases”—mostly carbon dioxide and methane, as well as some others such as nitrous oxide, various hydrocarbons, and black carbon (or soot)—cause an overall warming or heating of the mean temperature of the atmosphere, oceans, and planetary surface. This overall global heating very likely causes and has been predicted to cause major changes in climate patterns that will have serious long-term consequences, such rising sea levels, more frequent and more violent storms, water shortages, more droughts and forest fires, ocean acidification, and accelerated species extinctions.⁶ The climate effects of human activities in general are so massive that scientists have recently proposed naming the most recent geological era the Anthropocene to reflect the extent of humanity’s cumulative geophysical impact on the planet.⁷

The standard policy analysis of climate change describes it as a “tragedy of the commons” at the global level.⁸ This policy lens captures key features of many environmental problems. In Garrett Hardin’s famous article, a “commons” problem arises when the behavior of many individuals—who

⁵ Other human activities, such as the large-scale transformation of the face of much of the planet through the “earth-moving” construction of cities, housing, industrial sites, farms, dams, and transportation infrastructure, may also cumulatively affect global climate. See, *e.g.*, Virginia H. Dale, *The Relationship Between Land-Use Change and Climate Change*, 7 *ECOLOGICAL APPLICATIONS* 753 (1997) (examining interactive effects of climate change and land-use transformation).

⁶ IPCC, CLIMATE CHANGE 2007: SYNTHESIS REPORT 45-54, available at http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf. Some of these climate effects are more likely than others.

⁷ *E.g.*, Jan Zalasiewicz, et al., *The New World of the Anthropocene*, 44 *ENVTL. SCI. & TECH.* 2228 (2010).

⁸ For a critical discussion of the standard approach, see, *e.g.*, Katherine A. Trisolini, *All Hands on Deck: Local Governments and the Potential for Bidirectional Climate Change Regulation*, 62 *STAN. L. REV.* 669, 674, 680-82, 734-35 (2010). Economists also refer to this dilemma as a “common pool” or “common resource” problem. *E.g.*, Roy Gardner, Elinor Ostrom, & James M. Walker, *The Nature of Common-Pool Resource Problems*, 2 *RATIONALITY & SOC’Y* 335 (1990); Jonathan M. Karpoff, *Suboptimal Controls in Common Resource Management: The Case of the Fishery*, 95 *J. POL. ECON.* 179 (1987). Although economists tend to include only direct economic costs to humans, considerable damage to animal life more generally should also be included. Wayne Hsiung & Cass R. Sunstein, *Climate Change and Animals*, 155 *U. PA. L. REV.* 1695 (2007).

who look mostly to their own self-interests when making decisions—adversely affects the overall collective resources on which they all depend.⁹ The classic example is the “common field” used by many shepherds. When each shepherd rationally decides to increase his or her flock, the environmental “load” increases. An “overshoot” of the “carrying capacity” of the land occurs—and all of shepherds lose when the common land becomes overgrazed and barren.¹⁰

For Hardin—who applies this logical analysis to the problem of human population growth, among other examples—the only available solution is what he refers to as “mutual coercion, mutually agreed upon.”¹¹ He claims that the shepherds—or, the relevant substitute here, everyone who emits greenhouse gases—will pursue their own self-interests and add to an increasingly greater burden to the commons, unless they collectively agree to be “coerced” to control their behavior. On most interpretations of Hardin’s thesis, this means that the government (preferably a democratic one, assuming the “mutually agreed” part of the formulation) must impose laws that regulate behavior in order to solve the collective commons problem. A number of regulatory solutions are possible.¹² All of them involve the adoption of a regulatory framework to address the commons problem, and the

⁹ Garrett Hardin, *The Tragedy of the Commons*, 162 *SCIENCE* 1243 (1968). See also James Salzman & Barton H. Thompson, Jr., *ENVIRONMENTAL LAW AND POLICY* 19-22 (3d ed. 2010) (describing the basic paradigm).

¹⁰ Hardin, *supra* note 9, at 1244. “Overshoot” describes the situation when the population of a *species* surpasses the natural basis required for its survival. “Carrying capacity” refers to the natural processes supporting a species. For an early application of these concepts, see WILLIAM R. CATTON, *OVERSHOOT: THE ECOLOGICAL BASIS FOR REVOLUTIONARY CHANGE* (1980). These basic principles are helpful in understanding the underlying dynamics of many environmental problems. With respect to overfishing, for example, see Eric W. Orts, *The Tragedy of the Tuna* (version 2.0) (teaching simulation developed with Alfred F. West Jr. Learning Lab), available at <http://beacon.wharton.upenn.edu/learning/management/tragedy-of-the-tuna/>.

¹¹ Hardin, *supra* note 9, at 1247.

¹² For example, in the famous commons illustration of shepherds and their sheep, the following options may be available: (1) regulate the behavior of each individual shepherd, such as by imposing a quota on the addition of new sheep to each flock, (2) impose a tax on each shepherd for each new sheep added and adjust the overall tax level to assure that the maximum load of the commons is not exceeded (in other words, raise the tax if the commons is threatened and lower the tax if the commons is safe or underutilized), or (3) divide the commons into private property plots that each shepherd will have an incentive to preserve. Different generic regulatory options apply different solutions to commons problems in the environmental context. See, e.g., DAVID M. DRIESEN, *THE ECONOMIC DYNAMICS OF ENVIRONMENTAL LAW* 49-71, 123-201 (2003); SALZMAN & THOMPSON, *supra* note 9, at 46-52; Carol M. Rose, *Rethinking Environmental Controls: Management Strategies for Common Resources*, 1991 *DUKE L.J.* 1 (1991).

choice then becomes one of selecting the most efficient, most effective, and otherwise best regulatory solution.¹³

The Hardinian logic of the tragedy of the commons and its prescription of “mutual coercion” informs the leading recommended policy approach to the problem of global climate change.¹⁴ This approach maintains that the global scope of the problem requires a comprehensive global regulatory solution.¹⁵ The Kyoto Protocol embodies the main attempt to achieve this global solution, however, and it has failed. In its design, the Kyoto approach follows the standard model of public international law: Each country commits to “reduction targets” for the emission of greenhouse gases. The Kyoto scheme allows for emissions permit trading both within and among countries (such as the so-called Clean Development Mechanism and other “offset” trading). But overall, the idea is that each country commits to reductions, total greenhouse gas emissions will decline in response to these controls, and the threats of major climate change will be reduced.¹⁶ With respect to the various methods of regulation, Kyoto represents a complex version of “cap and trade”—with each country deciding on its

¹³ Considerations of economic efficiency should include dynamic as well as static efficiency, and political dimensions of normative and systemic legitimacy should also be included in the analysis. Paul R. Kleindorfer & Eric W. Orts, *Informational Regulation of Environmental Risks*, 18 RISK ANALYSIS 155, 166-68 & fig. 4 (1998). See also DRIESEN, *supra* note 12 (emphasizing the importance of dynamic efficiency in environmental policy).

¹⁴ See, e.g., *Developments in the Law: International Environmental Law*, 104 HARV. L. REV. 1484, 1534-39 (1991) (describing global commons problems such as climate change and the difficulty of addressing them).

¹⁵ For a leading example among many arguing for a global comprehensive solution as the only viable approach to climate change, see Jonathan B. Wiener, *Think Globally, Act Globally: The Limits of Local Climate Policies*, 155 U. PA. L. REV. 1961 (2007). Wiener specifically targets state or local regulations as suboptimal as compared with national regulation designed to fit within an international treaty regime. *Id.*, p. 1962. See also Cary Coglianese & Jocelyn D'Ambrosio, *Policymaking Under Pressure: The Perils of Incremental Responses to Climate Change*, 40 CONN. L. REV. 1411, 1414-15 (2008) (“Perhaps not all global problems require a comprehensive, global solution—but reversing the trajectory and effects of [greenhouse gas] emissions most assuredly does.”). Cf. Jonathan Baert Wiener, *Global Environmental Regulation: Instrument Choice in Legal Context*, 108 YALE L.J. 677 (1999) (arguing that regulatory approaches to global environmental problems, including climate change, should be sensitive to legal institutional constraints, but limiting the alternatives to comprehensive ones).

¹⁶ For an overview of the legal structure of the Kyoto Protocol, see, e.g., SALZMAN & THOMPSON, *supra* note 9, at 129-34; Clare Breidenich, et al., *The Kyoto Protocol to the United Nations Framework Convention on Climate Change*, 92 AM. J. INT’L L. 315 (1998).

own methods of control within the global “cap” on total emissions.¹⁷ A variation is a comprehensive global regime of “harmonized carbon taxes.”¹⁸ In theory, these comprehensive approaches sound good. In practice, however, they have failed to make progress now for more than fifteen years. Total greenhouse gas emissions have *increased* by more than seventeen percent since the Kyoto approach began, following a Framework Convention negotiated at the Earth Summit in Rio de Janeiro in 1992.¹⁹ Most recently, Kyoto’s dream for a comprehensive global solution crashed in Copenhagen in December 2009. The Copenhagen conference resulted in a widely publicized failure to extend the Kyoto framework.²⁰ Many environmentalists felt great disappointment and even despair over the failure to expand and deepen the Kyoto approach (a status quo that has continued following the most recent international conference in Cancún in December 2010).²¹ As I argue here, however, the great

¹⁷ For an influential argument for a “cap-and-trade” regime to address climate change at the global level, see RICHARD B. STEWART & JONATHAN B. WIENER, *RECONSTRUCTING CLIMATE POLICY: BEYOND KYOTO* (2003).

¹⁸ For proponents of this approach, see WILLIAM NORDHAUS, *A QUESTION OF BALANCE: WEIGHING THE OPTIONS OF GLOBAL WARMING POLICIES* (2008); Reuven S. Avi-Yonah & David M. Uhlmann, *Combating Global Climate Change: Why a Carbon Tax Is a Better Response to Global Warming than Cap and Trade*, 28 *STAN. ENVTL. L.J.* 3 (2009); Richard N. Cooper, *The Case for Charges on Greenhouse Gas Emissions* in *POST-KYOTO INTERNATIONAL CLIMATE POLICY: SUMMARY FOR POLICY MAKERS* 72-74 (Joseph E. Aldy & Robert N. Stavins eds., 2009). The term “carbon tax” is shorthand for charges imposed on all greenhouse gases which are assigned a “carbon equivalent” measure in terms of their estimated climate-warming effects.

¹⁹ This figure of an aggregate increase of global greenhouse gas emissions of 17 percent is calculated from the base year of 1990 (selected under Kyoto) to 2003. SCOTT BARRETT, *WHY COOPERATE? THE INCENTIVE TO SUPPLY GLOBAL PUBLIC GOODS* 92 (2007). See also Gardiner, *supra* note 3, at 594-95 (describing the Kyoto approach as “a failure” and “debacle”). One of my Penn colleagues, Robert Giegengack, is fond of pointing out that the cumulative jet fuel used by diplomats to travel to various climate change conferences of parties (COPs) has contributed an overall net addition to global emissions with no net gain of reductions achieved through the treaty. Important reasons for the failure of Kyoto were that the United States failed to ratify the treaty, and fast-growing developing countries such as China, Brazil, and India were not bound to targeted emissions limits. Taking a longer view suggests that interventions at the global level have had little cumulative impact. The IPCC estimates that greenhouse gas emissions increased by 70 percent from 1970 to 2004, and overall growth in emissions have accelerated since 2000. IPCC, *CLIMATE CHANGE 2007: SYNTHESIS REPORT*, *supra* note 6, at 36 & fig. 2.1.

²⁰ For a recent account describing the Copenhagen negotiations moderately as “a useful disappointment,” see WILLIAM ANTHOLIS & STROBE TALBOTT, *FAST FORWARD: ETHICS AND POLITICS IN AN AGE OF GLOBAL WARMING* 46-75 (2010).

²¹ For example, Bill McKibben described Copenhagen to have “failed spectacularly” and resulted in a “huge disappointment” to many environmentalists. Bill McKibben, *Heavy Weather in Copenhagen*, N.Y. REV. OF BOOKS, Mar. 11, 2010, at 32-33. For an account of progress in Cancún, if one adopts a more humble view of the appropriate role of international law advocated here, see *infra* text accompanying notes 66-67.

hopes for a comprehensive solution at the global level—though perhaps beautiful in theory—are not practicable under present circumstances. The necessary international legal governance machinery is not yet in place and not anywhere close to being in place. I therefore recommend that those who care about this issue should focus on less grand, but more practical “second-best solutions.”²² These are the various kinds of “climate contracts” described in Part II below. But first, because I am arguing against standard views about effective climate regulation, Part I undertakes the burden of showing the weaknesses of the single global comprehensive regulatory solutions that have been proposed to date and why alternative approaches are necessary.

I. The Weaknesses of Global Comprehensive Approaches to Climate Change

In theory, a global and comprehensive approach to climate change makes sense. It is arguably the “first-best” solution to the problem of climate change because it selects that proper level of regulation applicable to the scale of the problem.²³ The emission of greenhouse gases can be seen as a negative economic externality, and assuming that problems with respect to measurement of costs and desirable time periods needed to address climate change can be solved, then “prices” on the externalities can be set either through a cap-and-trade regime or taxes. These prices would estimate the costs of the externalities and include an appropriate “discount rate” for investment in long-term

²² For an economic argument supporting “second-best” solutions to environmental problems, see Lori Snyder Benneer & Robert Stavins, *Second-Best Theory and the Use of Multiple Policy Instruments*, 37 ENVTL. RESOURCE ECON. 111 (2007). Cf. also R. G. Lipsey & Kelvin Lancaster, *The General Theory of Second Best*, 24 REV. ECON. STUD. 11 (1956) (providing a general economic theoretical account of this idea).

²³ In environmental law, one should begin with the problem context and problem features when selecting the type and level of regulation, and then consider other economic and political aspects of the issue. Kleindorfer & Orts, *supra* note 13, at 168 & fig. 4. According to the “Matching Principle” introduced by Professors Butler and Macey, “the size of the geographic area affected by a specific pollution source should determine the appropriate governmental level for responding to the pollution.” Henry N. Butler & Jonathan R. Macey, *Externalities and the Matching Principle: The Case for Reallocating Environmental Regulatory Authority*, 14 YALE L. & POL’Y REV. 23, 25 (1996). They argue that the characteristics of many environmental problems (though not including climate change) often recommend more decentralized and local regulatory regimes based on economic considerations. *Id.* However, policy makers can make serious mistakes if they consider *only* the scale of the problem and not the available institutional capacities needed to address it. This is the fundamental mistake committed by those who argue exclusively for comprehensive solutions to climate change.

corrective action.²⁴ The problem of global climate change would thus be elegantly solved, and an “optimal” amount of climate change would then occur.²⁵ In practice, however, there are many real-world complications that reduce the appeal and workability of these first-best comprehensive solutions.²⁶

First, there are too many people and too many countries for a comprehensive solution to work. Everyone on the planet emits carbon dioxide and methane (and other greenhouse gases) every day through their own economic and biological activities. The scale of the problem in this respect is

²⁴ Discount rates refer to the economic tendency for value of investments to increase over time. On discount rates in environmental law and policy, see, e.g., Daniel A. Farber & Paul A. Hemmersbaugh, *The Shadow of the Future: Discount Rates, Later Generations, and the Environment*, 46 VAND. L. REV. 267 (1993). There is a good argument, given the possibility of severe long-term climate consequences, that a discount rate of zero (or a very small positive one) should apply. See Nicholas Stern, *The Economics of Climate Change*, 98 AM. ECON. REV. 1, 12-15 (finding debates about discount rates with respect to climate change policy “disappointing” and arguing for a very low positive rate). See also Martin L. Weitzman, *Review of “The Stern Review on the Economics of Climate Change,”* 45 J. ECON. LIT. 703 (2007) (arguing on different grounds for a zero or even negative discount rate for climate policies given the very high consequences of severe climate change in the future, even if only a low probability for such a change is assumed).

²⁵ In addition to the more general problems with comprehensive regimes discussed in the text, there are significant technical problems that comprehensive regimes would have to solve. Two of them regard setting the regulatory “price” of greenhouse gas emissions and determining the “optimum” amount of climate change to be tolerated. Given the uncertainty involved in setting targets for “optimum” amounts of emissions, price-based comprehensive regimes (i.e., taxes or a nicer word for taxes) may make more sense than the complicated regulatory cap-and-trade scheme that has evolved within the framework of the Kyoto Protocol. See, e.g., William D. Nordhaus, *Economic Analysis of the Kyoto Protocol: Is There Life after Kyoto?* in GLOBAL WARMING: LOOKING BEYOND KYOTO, *supra* note 3, at 91-100 (making the case for taxes instead of cap-and-trade). Greenhouse gas taxes or charges, in other words, would fit more comfortably with the flexible approach of non-comprehensive solutions recommended here because they may be assessed at different levels of government and at different rates. Taxes may also effectively target practices that cause other environmental harms as well as greenhouse gas emissions, such as urban air pollution from motor vehicles.

²⁶ Even in theory, there are significant problems with comprehensive approaches. Whether in the form of Kyoto-style cap-and-trade or global taxes, these approaches assume that one can target an “optimal” amount of climate change (as measured by global temperature increases). However, this “optimal” or “safe” amount of climate change is based on highly uncertain predictions generated by computer models. “Abrupt” or even “catastrophic” climate change is also possible. See, e.g., BARRETT, *supra* note 19, at 86-88; see also JAMES LOVELOCK, *THE VANISHING FACE OF GAIA* (2009) (predicting a significant high-consequence probability of a radical upward shift in global mean temperature); R. B. Alley, et al., *Abrupt Climate Change*, 299 SCIENCE 2005 (2003) (discussing this possibility in the context of similar occurrences in the geological past). If so, then one might argue for a larger number of responses (including the consideration of radical proposals such as geoengineering for mitigation and other approaches to adaptation) rather than the constrained and cautious measures recommended on the basis of highly uncertain and widely divergent computer projections. Controlling emissions to hit an “optimum” target appears impossible in light of current scientific understanding.

massive. To propose that it is somehow possible to establish a comprehensive solution of “mutual coercion, mutually agreed upon” at this scale is mind-boggling. International law has been used effectively to address some global environmental problems, such as the phase-out and banning of ozone-layer-depleting chemicals or reserving Antarctica against mineral or other exploitation (at least for the present).²⁷ But the idea that international law can regulate and “coerce” the behavior of billions of individual people, millions of individual business firms, and hundreds of nation-states is virtually a non-starter by definition.²⁸ An international legal framework may play a helpful role in terms of coordination, the assembly of scientific knowledge, and the provision of information, but it is incapable as a practical matter of adopting and implementing a far-reaching comprehensive regulation of the problem—precisely because of the problem’s scale, depth, and complexity.²⁹

Second, the economic interests of different countries are too much in direct competition, making an agreement to sacrifice short- or medium-term economic benefits for the long-term global common good unlikely. The recent economic global downturn caused by the financial crisis

²⁷ See, e.g., BARRETT, *supra* note 19, at 75-84. One reason for the success of ozone layer protection is that the costs are relatively low in comparison with the large benefits (e.g., preventions of skin cancer, etc.). *Id.* at 94-95. See also SALZMAN & THOMPSON, *supra* note 9, at 113-21.

²⁸ As of this writing, the global population is nearing seven billion people, and there are about 195 nation-states in the world. As a close observer of the international scene observes, international legal regimes that work best are usually composed of relatively few signatory members. Thomas Heller, *Climate Change: Designing an Effective Response*, in GLOBAL WARMING, *supra* note 25 at 130. Larger international approaches usually follow two different paths, neither one of which attempts to impose comprehensive and detailed rules on the entire planet. The first general path is the foundation and expansion of an international organization with self-governing capacities, such as the European Union or the World Trade Organization. The second path focuses on the development of voluntary standards and non-mandatory “soft law” recommendations. *Id.* at 130-31. These paths might be considered as less ambitious alternatives at the international level to comprehensive Kyoto-style regulation. They may also combine with other non-comprehensives approaches reviewed in Part II.

²⁹ The main argument in favor of a comprehensive approach therefore leads to a counterintuitive result. Many policy makers assume that the correct level for intervention to address the problem of global climate change is international because of the scale of the problem. But a closer analysis reveals that the very scale of the problem renders effective practical intervention at the global level impossible. “Think globally, act locally” turns out to be a maxim that makes sense analytically as well as parochially. Elinor Ostrom, *A Polycentric Approach for Coping with Climate Change* 4 (World Bank Policy Research Paper 5095) (Oct. 2009).

highlights the dominant importance of short-term economic considerations globally.³⁰ Efforts to regulate climate change comprehensively at the global level will inevitably interfere with different kinds and sources of national competitive advantage that will lead to dissent. Under current social conditions and technological circumstances, significant reductions of greenhouse gas emissions are often expensive.³¹ As a result, the political interests expressed at the level of many nation-states will defeat any serious attempt at a single comprehensive regulatory solution to climate change patterns at the global level. China and the United States, which are now the two leading emitters of greenhouse gases (as determined by a national measure of total current volume), provide good examples.³² The political legitimacy of the current Chinese government depends largely on maintaining continued economic growth. Significant increases in the expense of energy, manufacturing, and transportation would impose costs that Chinese leadership is unwilling to bear because it would risk radical political change.³³ In the United States, it may appear that open democratic processes would enable a

³⁰ See, e.g., Mark Rice-Oxley, *Financial Crisis Threatens Climate-Change Momentum*, CHRISTIAN SCI. MONITOR, Nov. 13, 2008, available at <http://www.csmonitor.com/Environment/Global-Warming/2008/1113/financial-crisis-threatens-climate-change-momentum>.

³¹ Not all climate-friendly reforms are expensive. A now-famous study has identified many changes that would save money over a reasonable time frame, particularly through energy-efficiency buildings and retrofitting. Per Anders-Enkvist et al., *A Cost Curve for Greenhouse Gas Reduction*, MCKINSEY Q. 38, exh. 1 (Feb. 2007). Absent technological breakthroughs (especially in energy production), however, other mitigation measures are likely to be costly. Depending on various assumptions, the McKinsey study estimates that meeting a greenhouse gas reductions to achieve a stabilized goal of 450 parts per million of carbon in the atmosphere by 2030 would cost between 0.6 to 1.4 percent of global GDP. *Id.* at 44. Other global cost estimates differ widely given the large number of variables involved in making economic predictions on this scale. One might even suggest that these kinds of predictions are intractable given the large number of empirical assumptions and large amount of economic and scientific data required to make estimates (which must then be combined with the economic uncertainties of the costs that climate change may itself impose on human productivity).

³² Currently, China emits 17 percent of total global greenhouse gases, and the United States emits 16 percent. The European Union emits 12 percent. SALZMAN & THOMPSON, *supra* note 9, at 127. Per capita emissions tell a different story. For example, the average U.S. citizen emits four times as much as the average Chinese citizen – and seventeen times as much as the average Indian citizen. *Id.* at 126-27.

³³ See, e.g., Eric Li, *A Color Revolution in China? Keep It Red*, N.Y. TIMES, Dec. 10, 2010, (online ed.), available at <http://www.nytimes.com/2010/12/07/opinion/07iht-edli.html>. For an account of the massive ecological problems in China and the difficult tradeoffs that its leaders must make with economic growth imperatives, see, e.g., ELIZABETH C. ECONOMY, *THE RIVER RUNS BLACK: THE ENVIRONMENTAL CHALLENGE TO CHINA'S FUTURE* (2d ed. 2010).

conversion to general acceptance among the population to see climate change as a high priority. However, the true record of democratic politics in most places including the United States is that economic stability and growth (at least for the majority of people) come first.³⁴ At most, for example, President Obama was elected in 2008 with only a partial mandate to tackle climate change as a priority. Yet it is safe to predict that if climate change regulation were adopted and perceived to effect the economic situation of most people adversely, then the tides of political opinion would shift against meaningful regulation—and, like China, polls would swing toward reasserting economic stability and growth as the main priorities.³⁵ A similar analysis extends to most if not all other countries. Even in Europe, climate change usually takes second place (at a minimum) to economic considerations.³⁶ Adding consideration of the politically difficult “north-south” divide between rich and poor countries to the economic and political dynamics of climate negotiations at the international level gives strong

³⁴ For evidence supporting the common observation that the political popularity of leaders hinges significantly on economic conditions or at least perceived economic conditions, see, e.g., Donald R. Kinder, *Presidents, Prosperity, and Public Opinion*, 45 PUBLIC OPINION Q. 1 (1981); Henry C. Kenski, *The Impact of Economic Conditions on Presidential Popularity*, 39 J. POL. 764 (1977).

³⁵ In fact, the severe economic recession beginning in 2008 seems to have stifled any political will to adopt comprehensive climate change regulation in the United States and elsewhere. This result surprised many observers after both U.S. Presidential candidates in 2007 stumped for national climate legislation. For the argument that climate legislation at both global and national levels is in the long-term best economic interests of the United States and its citizens, see Jody Freeman & Andrew Guzman, *Climate Change and U.S. Interests*, 109 COLUM. L. REV. 1531 (2009). Cf. also Eric A. Posner & Cass R. Sunstein, *Climate Change Justice*, 96 GEO. L.J. 1565, 1581 (2008) (noting that some estimates suggest that the U.S. and China would actually lose little in terms of economic costs from a 2.5°C global temperature increase, and Russia may actually gain in terms of economic productivity). Even if so, some other issues raised here relating to leakage and feasibility that a sufficient number of other countries will agree to intervene effectively would remain. See Freeman & Guzman, *supra*, at 1542-43 (observing that “the futility thesis,” “the leakage thesis,” and the “fairness thesis” remain impediments to the options of effective policy measures). For further discussion of the “leakage” and “fairness” arguments, see *infra* text accompanying notes 37-41, 48-49.

³⁶ Recent polls in Britain, Germany, and the U.S. have found declining concern among average citizens that climate change as a serious problem. Elizabeth Rosenthal, *Climate Fears Turns to Doubts Among Britons*, N.Y. TIMES, May 25, 2010, at A1, A8. More seriously, one recent study estimates that 40 percent of the world’s population remains entirely unaware of global climate change as an issue. Anthony Leiserowitz, *Climate Change in the Public Mind*, Yale Project on Climate Change Communication (Dec. 3, 2010) http://environment.yale.edu/climate/files/Leiserowitz_Cancun4.pdf (COP 16 presentation in Cancún, Mexico). In the U.S., general knowledge about the details of climate change science is also quite low. See Anthony Leiserowitz & Nicholas Smith, *Knowledge of Climate Change Across Six Americas* (2010), available at http://environment.yale.edu/climate/files/Knowledge_Across_Six_Americas.pdf.

reason for skepticism about the viability of a comprehensive global scheme that would impose significant and differential economic costs on many countries.

Third, difficult ethical claims about fairness and justice in climate change policy reduce the likelihood of an effective comprehensive agreement. The general structure of this argument involves claims about both *historical* and *per capita* responsibility for climate change. Developing countries in particular feel a strong sense of injustice in being asked to limit their own economic development in order to address a problem that has been caused, historically, by actions that have primarily benefitted rich countries.³⁷ The result has been international negotiations about economic side payments, which are funnelled through noble-sounding institutions such as the Clean Development Mechanism.³⁸ Also, China, India, and other developing countries emphasize goals of significantly lowering per capita rather than aggregate national emissions.³⁹ Without going into detail here or attempting to

³⁷ There is an emerging literature on these ethical issues. For an introduction, see, e.g., Gardiner, *supra* note 3, at 578-89; Dale Jamieson, *Comments and Reports: The Philosophers' Symposium on Climate Change*, 34 CRITICAL INQUIRY 612 (2008). If one begins with attributions starting in 1890, then rich/developed countries have a significantly greater responsibility for total emissions than poor/developing ones, but the relative responsibility as a share of total emissions shrinks over time. See Michel G. J. Den Elzen, et al., *Differentiating Future Commitments on the Basis of Countries' Relative Historical Responsibility for Climate Change*, 71 CLIMATIC CHANGE 277 (2005). According to one recent estimate, European countries and the United States accounted for more than half of cumulative emissions since 1850, but China and other emerging economies are gaining quickly. Posner & Sunstein, *supra* note 35, at 1579 & tbl. 4.

³⁸ In a nutshell, the Clean Development Mechanism (CDM) is supposed to allow rich countries to purchase emission reduction credits by sponsoring certified emissions reduction projects in poor countries. SALZMAN & THOMPSON, *supra* note 9, at 133. Although certification procedures are included in the scheme, the CDM has been criticized on various grounds of reliability, geographical imbalance, and negative effects (namely, allowing rich countries to buy out of their Kyoto constraints). For a review of some of these criticisms, see, e.g., Michael Wara, *Measuring the Clean Development Mechanism's Performance and Potential*, 55 UCLA L. REV. 1759 (2008) (reviewing many flaws in the CDM but recommending its retention and reform); Bharathi Pillai, Note, *Moving Forward to 2012: An Evaluation of the Clean Development Mechanism*, 18 N.Y.U. ENVTL. L.J. 357 (2010) (similar analysis and conclusions). With respect to geographical disparity, more than 60 percent of CDM project have occurred in India and China. Only two percent have been certified in Africa. Pillai, *supra*, at 383.

³⁹ In Copenhagen, for example, China and India (joined by Brazil and South Africa – a group known as BASIC) argued in favor of targets to improve their “carbon intensity” (emissions per unit of economic output) rather than overall emission reduction targets in order to accommodate continued economic growth. See, e.g., ANTHOLIS & TALBOTT, *supra* note 20, at 55-57. For a critique of the per capita approach on both pragmatic and ethical grounds, see Eric A. Posner & Cass R. Sunstein, *Should Greenhouse Gas Permits Be Allocated on a Per Capita Basis?* 97 CAL. L. REV. 51 (2009). My point here is not to take sides in this debate on the merits but simply to point out that the debate itself reduces the likelihood of reaching a comprehensive international agreement.

resolve the serious ethical issues at stake, it is sufficient merely to indicate the gravity of the practical impediments raised by these tough issues to reaching a workable comprehensive global agreement.⁴⁰ Given a dynamic historical environment of ongoing changes in the relative economic status of different nation-states and large political shifts within them, financial compensation and technology-transfer mechanisms determined and implemented at the international level do not appear likely to resolve these thorny ethical questions.⁴¹

Fourth, the extremely long time horizon for serious consequences predicted for climate change compared with the relatively short-term attention spans of human beings leads to motivational issues that are especially problematic at the global level. The hard truth is that most people do not care to look very far into the future—beyond their own deaths (and even the prospect of one’s own death is often avoided or denied).⁴² The mismatch between the long-term scientific diagnosis of the likely consequences of climate change and the short-term perspectives of most people presents

⁴⁰ For a compelling argument challenging the traditional focus on nation-states (and their aggregated collective wealth) rather than individuals as the source of ethical responsibility for climate change, see Sholbol Chakravarty, et al., *Sharing Global CO₂ Emission Reductions Among One Billion High Emitters*, 103 PROC. NAT’L ACAD. SCI. 11884 (2009). Perhaps an individualized emissions cap or tax might be applied to the wealthiest individuals, regardless of nationality or citizenship, rather than allocated to countries and thus penalizing poor people in rich countries who have arguably been least responsible for the problem. In any event, the substantive argument seems persuasive that the wealthiest individuals, regardless of their citizenship or nationality, bear the greatest ethical responsibility for economic activity in the past that has been responsible in the aggregate for climate change. This focus on individuals rather than nation-states might help to loosen the rhetorical lock-up in international discussions and, though less likely, diplomatic negotiations. It also supports on ethical grounds an argument that comparatively wealthy individuals should make selections from the menu of non-comprehensive approaches to address climate change given in Part II.

⁴¹ This is not to say that relatively rich countries and, perhaps even more so, rich individuals do not have a greater ethical responsibility to address climate change than poor countries and individuals. See *supra* note 40. The claim here is only that this ethical responsibility is not likely to get resolved very quickly (if at all) in the forum of international negotiations and treaties. As discussed in Part II, I believe that there are many more effective avenues to act on the moral obligation to address climate change. For a recent discussion of issues of environmental justice raised with respect to climate change, see Mark Stallworthy, *Environmental Justice Imperatives for an Era of Climate Change*, 36 J. L. & SOC’Y 55 (2009).

⁴² See ERNEST BECKER, *THE DENIAL OF DEATH* (1973). Cf. Adam Babich, *Too Much Science in Environmental Law*, 28 COLUM. J. ENVTL. L. 119, 148 (2003) (observing that “the potential of our own deaths may be so upsetting that we avoid considering it seriously enough to keep day-to-day risks in perspective”).

another difficult practical issue when it comes to achieving a large-scale comprehensive agreement.⁴³ The long time horizon of expected harm from climate change imposes also a serious risk of political “backlash” against the present costs of climate-related regulation.⁴⁴ Related problems include a general public ignorance about science and the proclivity of human beings to make decisions based on heuristics (including emotional appeal) rather than rational estimations of the probability of risks.⁴⁵ A well-known human failing is to underestimate the risk of low-probability, high-consequence events even in their own lifetimes, a feature of human irrationality that is likely only to increase when the burdens of the risks are removed to future generations.⁴⁶ This psychological mismatch exacerbates the political and economic conflicts identified above. For most people, the challenge in addressing climate change is to make the issue as concrete and practical for them as possible.⁴⁷ Abstracting the problem to one managed by far-away global scientific experts and political bureaucrats increases the psychological distance that most people already experience with respect to contemplating climate change and its consequences.

Fifth, the institutional means to effectively monitor and enforce a comprehensive solution to climate change are absent. Even if the practical barriers listed so far were overcome, resulting in the construction of a comprehensive international agreement, serious doubts would remain about how

⁴³ See, e.g., Dale Jamieson, *The Post-Kyoto Climate: A Gloomy Forecast*, 20 GEO. INT’L ENVTL. L. REV. 537 (2008).

⁴⁴ Eric Biber, *Climate Change and Backlash*, 17 N.Y.U. ENVTL. L.J. 1295 (2009).

⁴⁵ E.g., Barton H. Thompson, Jr., *Tragically Difficult: The Obstacles to Governing the Commons*, 30 ENVTL. L. 255 (2000).

⁴⁶ See, e.g., Colin F. Camerer and Howard Kunreuther, *Decision Processes for Low Probability Events: Policy Implications*, 8 J. POL’Y ANALYSIS & MGMT. 565 (1989). It may also be true that some individuals – including policy makers of various kinds – may find greater motivation when contemplating the future. Anecdotally, for example, a number of top business managers have expressed concern about their grandchildren as a motivating factor to address climate change. This motivation is likely to dissipate, however, when transferred to the global level where any change or reform is likely to be perceived as diffuse and uncertain as compared with more direct and concrete steps reviewed in Part II.

⁴⁷ One recommended strategy in this connection is to tie climate-related policy measures to other more immediate considerations, such as health or economic benefit. In other words, “win-win” policies – such as the invention of a new climate friendly energy source that is also non-polluting locally (health benefit) or cheaper (economic benefit) – are preferable to policy choices that impose short-term costs for long-term benefits.

well it could be monitored and enforced. These issues presented perhaps the largest sticking point in the Copenhagen negotiations.⁴⁸ Questions along these lines include the following: What institutions are in place to effectively monitor reporting of emissions? Who will verify these monitors? What courts will hear cases against nation-states who do not comply? What police or military force will enforce violations of the state obligations of China and the United States—to pick the most difficult examples, which also happen to be the largest greenhouse gas emitters—and other nation-states? Accurate monitoring and effective enforcement are essential prerequisites for any comprehensive solution, and the institutional foundations of these needed features are as yet almost entirely missing.⁴⁹

Sixth, given economic globalization, significant economic “leakage” may be expected to occur within any comprehensive approach. This limitation relates to difficulties in monitoring and enforcement, as well as more general questions about basic governmental and legal capacity in many countries. Leakage refers to both (a) *location leakage* which occurs when industrial or other sources of emissions relocate from more heavily regulated places (such as northern Europe) to less regulated places (such as developing countries) and (b) *market or price leakage* which happens when regulation causes prices to increase for goods and services in more heavily regulated places, thus favoring production and sales in less regulated places.⁵⁰ Economic studies suggest that leakage under the

⁴⁸ At the Copenhagen negotiations, the Chinese and Indian delegations were strongly opposed to international monitoring and verification, but eventually agreed to adopt nonbinding language to this effect. See ANTHOLIS & TALBOTT, *supra* note 20, at 56, 60-61, 64-68. For reports submitted by the 141 countries who have agreed to the Copenhagen Accord, see the U.N. Framework Convention of Climate Change website, available at http://unfccc.int/meetings/cop_15/copenhagen_accord/items/5262.php.

⁴⁹ Given this analysis, the Obama Administration and other delegates were right to make the issues of monitoring and verification a priority. The Copenhagen Accord, though not legally binding, has the virtue of both including all major emitting countries and enshrining the principles of transparency and verification. Without good information, everything else in a comprehensive approach becomes close to worthless. More importantly, this role for international law complements other measures at other levels discussed in Part II that are more likely to make progress than comprehensive approaches.

⁵⁰ Mustafa H. Babiker, *Climate Change Policy, Market Structure, and Carbon Leakage*, 65 J. INT’L ECON. 421 (2005); Ostrom, *A Polycentric Approach for Coping with Climate Change*, *supra* note 29, at 29-30.

Kyoto-style framework has been significant.⁵¹ Leakage explains how holes in any comprehensive regulatory schemes are likely to be exploited by economically rational actors (who have incentives to avoid costly regulations). As a result, significant leakage will undermine the larger regulatory goals of the scheme.⁵² If leakage is large enough (as it arguably has been to date under the Kyoto Protocol regime), then the countries and their citizens who “opt in” to any comprehensive scheme will bear its transactional costs (and perhaps real costs in terms of decreased economic competitiveness) without achieving any real corresponding environmental benefits. The ghosts of Hardin’s self-interested shepherds, whom we might call “climate pirates,” will reap their economic rewards, disregarding normative pleas for them to stop in the name of the common good.

If all of these problems with comprehensive global approaches could be fixed, then it would make sense to redouble efforts at the global level of international treaty negotiations. Because they cannot be fixed easily if at all within the foreseeable future, however, it makes sense instead to look beyond the global regulatory perspective to consider other options. Refusing to do so puts one in an uncomfortable straightjacket of real-world constraints that limit one’s freedom of action to address a serious problem. Given the major weaknesses limiting any basic agreement on a comprehensive approach, as well as its subsequent effectiveness (even if agreed) with respect to monitoring and

⁵¹ Babiker, *supra* note 50 (estimating that the relocation rates of energy-intensive industries out of the OECD may be as high as 130%).

⁵² One of the foremost proponents of a comprehensive global approach recognizes that leakage poses a formidable challenge. See Wiener, *Think Globally, Act Globally*, *supra* note 15, at 1967-73 (citing various studies and suggesting also that the acceleration of China’s greenhouse gas emissions in recent years might be traced to economic leakage, especially from the European Union). His conclusion from this analysis, though, is surprising: “Effective global environmental regulation [with respect to climate change] will therefore require universal or nearly universal coverage of present and potential future source locations [for greenhouse gas emissions].” *Id.* at 1972-73. It is precisely this imperial dream of *universal coverage* of global regulation that renders a comprehensive approach fatally flawed under present practical institutional realities.

enforcement, the “first-best” theoretical solution should be supplemented—and perhaps even largely replaced—with “second-best” non-comprehensive approaches that I will dub “climate contracts.”⁵³

II. Non-Comprehensive Climate Contracts

Climate contracts refer to a series of different approaches to climate problems that do not aspire to imperial comprehensiveness.⁵⁴ They combine public and private solutions to climate change adopted at different scales—from the global to the transactional. I do not mean that efforts to achieve international agreements should be abandoned. An important role remains for international law and international organizations, especially in terms of reporting, gathering information, increasing scientific knowledge, verifying information, and establishing international standards of various kinds. But my thesis is that “second-best” or secondary-level institutional solutions may provide a better roadmap for actual success in the long run than hoping in vain for the highly unlikely negotiation and subsequent enforcement of a comprehensive global treaty.

As discussed below, the scope and purpose of different climate contracts will depend on the context. An overall objective or aspiration is that many “climate contracts” working together, growing, and evolving will provide a means by which to seriously address climate change. The resulting complexity of regulatory and market experimentation will tend to provide robust and

⁵³ For an argument listing some of the same problems with comprehensive global regulation of climate change recounted here and recommending second-best options, see Christopher D. Stone, *Beyond Rio: “Insuring” Against Global Warming*, 86 AM J. INT’L L. 445, 468-74 (1992). See also Ronald D. Brunner, *Science and the Climate Change Regime*, 34 POL’Y SCI. 1 (2001) (arguing for “no regrets” policy alternatives rather than insisting on either comprehensive regulatory solutions or a “do nothing” alternative). In general, the critique offered here of comprehensive global solutions applies as well to proposals that justify non-comprehensive approaches primarily as an instrumental method to achieve the ultimate goal of comprehensive global regulation. However, a “bi-directional” conception of climate regulation that emphasizes local as well as national (and global) levels of regulation is arguably consistent with the multiplicity of “bottom up” as well as “top down” approaches recommended here. See Trisolini, *supra* note 8. Cf. J.B. Ruhl & James Salzman, *Climate Change, Dead Zones, and Massive Problems in the Administrative State: A Guide for Whittling Away*, 98 CAL. L. REV. 59 (2010) (arguing for a “whittling away” approach to the problem of climate change involving the involvement and coordination of many administrative agencies and levels of government).

⁵⁴ See *supra* note 2 (describing origins and limitations of the idea of “climate contracts”).

resilient responses to climate change. Learning and adjustments will occur over time.⁵⁵ Some climate contracts may be found to be useless or troublesome; other approaches may cause complicating problems that will require superseding legislation to “preempt” them (legally and figuratively) with more rational legal interventions at national or international levels. But a bottom-up process of law and market formation is more likely to achieve success than continuing to put all efforts for reform into the failed top-down approach of Kyoto-style comprehensiveness.⁵⁶ The primary mistake of comprehensive approaches is to assume that the global scale of climate change means that all aspects of this complex problem should be addressed at the international level. Instead, it is more useful to divide parts of the problem and responses to it into different categories, and then to decide which regulatory strategies make sense at which jurisdictional level—or, in some cases, which responses should be left to the market or the open processes of civil society rather than regulated by law.⁵⁷

⁵⁵ On learning as an important feature of environmental law, see Daniel A. Farber, *Environmental Protection as a Learning Experience*, 27 LOY. L.A. L. REV. 791 (1994). Learning is also a component of strategies that follow methods of “reflexive environmental law.” See, e.g., GUNTHER TEUBNER, ET AL., ENVIRONMENTAL LAW AND ECOLOGICAL RESPONSIBILITY: THE CONCEPT AND PRACTICE OF ECOLOGICAL SELF-ORGANIZATION (1994); Dennis D. Hirsch, *Green Business and the Importance of Reflexive Law: What Michael Porter Didn't Say*, 62 ADMIN. L. REV. 1063 (2010); Eric W. Orts, *Reflexive Environmental Law*, 89 NW. U. L. REV. 1227 (1995); Richard B. Stewart, *A New Generation of Environmental Regulation?* 29 CAP. U. L. REV. 21, 127-51 (2001). One of the goals of reflexive law (by definition) is to encourage the adoption of reforms that encourage institutional reflection about environmental problems and how to solve them. A recent economic analysis of learning in the policy context also suggests by implication that avenues for experimentation should be left open in the complex and fast-changing context of climate change science and law. Yair Listokin, *Learning Through Policy Variation*, 118 YALE L.J. 480 (2008). See also Alejandro E. Camacho, *Adapting Governance to Climate Change: Managing Uncertainty Through a Learning Infrastructure*, 59 EMORY L.J. 1 (2009) (discussing learning as necessary for adaptive responses to climate change).

⁵⁶ For arguments from different perspectives supporting “bottom-up” or “pluralist” approaches to climate change, see William Boyd, *Climate Change, Fragmentation, and the Challenges of Global Environmental Law: Elements of a Post-Copenhagen Assemblage*, 32 U. PA. J. INT'L L. 457 (2010); Richard B. Stewart, *States and Cities as Actors in Global Climate Regulation: Unitary vs. Plural Architectures*, 50 ARIZ. L. REV. 681 (2008).

⁵⁷ If the argument advanced here for a pluralistic, decentralized approach to “climate contracts” is accepted, then the design of a more complex regulatory mosaic to address different parts of the climate change puzzle at different levels would be a logical next step for research. The principle of subsidiarity—regulation at the lowest feasible and effective level—may find a place in this exercise. For a primer on subsidiarity in Europe with translation to conceptions of federalism in the United States, see George A. Bermann, *Taking Subsidiarity Seriously: Federalism in the European Community and the United States*, 94 COLUM. L. REV. 331 (1994). For a related, more recent idea concerning the relationship between higher and lower legal orders, see Tom Ginsburg & Eric A. Posner, *Subconstitutionalism*, 62 STAN. L. REV. 1583 (2010).

In general, a successful mix of climate contracts will follow the basic principles for handling commons problems identified by Elinor Ostrom, who won the Nobel Prize for Economics in 2009. She recommends the following basic strategies: (1) *agreement* about the need to change behavior, (2) *sharing responsibility* for the future, (3) providing *information* that is reliable and easily available, (4) *monitoring* actual behavior, and (5) facilitating good *communication* among participants.⁵⁸ Effective *leadership* and *trust* among participants are also required.⁵⁹ An overarching, holistic appreciation of the global climate commons problem is needed, but the most useful actions will be less ambitious than proposed comprehensive solutions and will often focus at lower regulatory or market levels.⁶⁰ Importantly, these factors include the formation of social norms outside of the avenues of formal law.⁶¹ Although Ostrom agrees that global climate change is a “classic collective action problem,” it is one that should be “addressed at multiple scales and levels.”⁶² In this sense, her economic policy arguments support the legal prescriptions for “climate contracts” offered here. Proposed non-

⁵⁸ See Ostrom, *A Polycentric Approach for Coping with Climate Change*, *supra* note 29, at 12-13 (paraphrasing and emphasis added). See also ELINOR OSTROM, *GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION* (1990); LOCAL COMMONS AND GLOBAL INTERDEPENDENCE: HETEROGENEITY AND COOPERATION IN TWO DOMAINS (Robert O. Keohane & Elinor Ostrom eds., 1995).

⁵⁹ Ostrom, *A Polycentric Approach for Coping with Climate Change*, *supra* note 29, at 12.

⁶⁰ In this connection, one may usefully distinguish between “holistic” and “comprehensive” views of climate change. A holistic appreciation of climate change understands its global scale and the broad integration of the problem over many social activities. A comprehensive approach to reform recommends a particular method of dealing with the problem. Questioning *comprehensive reform* does not conflict with maintaining a *holistic view* of the problem. I thank Ram Vamuri for pointing out this distinction and sparing me from one at least one pitfall into misunderstanding. To be clear, I agree with holistic as well as interdisciplinary approaches to the problem of climate change.

⁶¹ For an introduction to the immense recent literature on social norms and their relation to law, see Symposium, *Law, Economics, & Norms*, 144 U. PA. L. REV. 1643 (1996); Symposium, *Social Norms, Social Meaning, and the Economic Analysis of Law*, 27 J. LEGAL STUD. 537 (1998); Symposium, *The Legal Construction of Norms*, 86 VA. L. REV. 1577 (2000). See also Andrew Green, *You Can't Pay Them Enough: Subsidies, Environmental Law, and Social Norms*, 30 HARV. ENVTL. L. REV. 407 (2009) (arguing that payments of positive subsidies under climate regimes may have long-term detrimental effects with respect to the formation of environmentally friendly norms). The point here is that the development of social norms regarding climate change must surely be part of any viable long-term solution. Even if one adopts an Hardinian skepticism about norms in a static economic equilibrium, they become essential when contemplating political will formation and the development of coercive legal solutions to social problems over time.

⁶² Ostrom, *A Polycentric Approach for Coping with Climate Change*, *supra* note 29, at 1. See also Thomas Dietz, Elinor Ostrom & Paul C. Stern, *The Struggle to Govern the Commons*, 302 SCIENCE 1907 (2003).

comprehensive solutions focus on both mitigation (slowing long-term trends threatening potential damage) and adaptation (responding to adverse consequences of climate change that are already occurring or are likely to occur) at different “scales and levels” of social intervention.⁶³

A. *Non-Comprehensive International Agreements*

Given the impossibly high hurdles of negotiating, monitoring, and effectively enforcing a comprehensive global climate change treaty, a better approach looks to attack the problem of climate change by taking smaller jumps to solve specific and manageable pieces of the overall problem.⁶⁴ A post-Copenhagen role remains for international law and organizations. For example, international standards for reporting, monitoring, and verification have already been mentioned as helpful. The formulation of technical standards and “best practices” relating to the energy efficiency of various products and services, “green building” technologies, effective regulatory formats, and other climate-related issues are often best accomplished at the level of international agreement.⁶⁵

Following Ostrom’s recommendations, a post-Copenhagen role for international organizations organized under international law, such as the U.N. Framework Convention for Climate Change (UNFCCC), should focus on facilitating communications and reporting about scientific,

⁶³ According to the best estimates of the problem, it is not known whether mitigation or adaptation will prove to be the best overall approach. Most likely, both responses will be required with an emerging balance between them over time, depending on the strength of early mitigation efforts as well as the severity and timing of future consequences. See, e.g., Naomi Oreskes, David A. Stainforth & Leonard A. Smith, *Adaptation to Global Warming: Do Climate Models Tell Us What We Need to Know?* 77 PHIL. SCI. 1012 (2010). The IPCC series now includes separate reports for strategies of both mitigation and adaptation. See IPCC, FOURTH ASSESSMENT REPORT, *supra* note 4 (Working Group II report on adaptation and Working Group III report on mitigation).

⁶⁴ This approach shares a similarity also with the “stabilization wedges” approach recommended by a pair of climate scientists, which focuses on specific policy “wedges” that would, when combined, reach overall policy goals of greenhouse gas emissions reductions. S. Pacala & R. Socolow, *Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies*, 305 SCIENCE 968 (2004). Different “climate contracts” may be adapted to particular “wedges,” focusing on substantive goals such as improving energy efficiency, inventing and improving renewable energy sources, and improving the efficiency of new and existing buildings. See *id.*

⁶⁵ See David Zaring, *Best Practices*, 81 N.Y.U. L. REV. 294 (2006) (discussing standards formed at the international level as an important source of law). For a discussion of the usefulness of government-supervised efficiency standards, see also Roger A. Pielke, Jr., *Let There Be More Efficient Light*, N.Y. TIMES, Mar. 11, 2011, at A23.

policy making, and lower-level legal developments. In December 2010, the conference of parties held in Cancún made progress in terms of global reporting and verification issues, though some countries such as China continue to be recalcitrant with respect to transparency.⁶⁶ For example, the UNFCCC set up a new website to track progress in different countries with respect to pledged performances under the Copenhagen Accord.⁶⁷ At the same time, the UNFCCC should step back from attempts to regulate climate change directly for the reasons discussed in Part I. The ambitions of international law in the climate change field should be downsized to coincide with its capacities and comparative strengths.

Another promising area for possible international agreement would focus on particular industrial and business sectors, facilitating international agreements and standards that would provide gains in chipping away at particular “stabilization wedges” identified to reduce greenhouse gas emissions.⁶⁸ The most important business sectors (with varying memberships) from this point of view include transportation (including automobiles, trucks, railroads, and airplanes), construction (including the development of more energy efficient materials and designs of buildings), and energy (including the invention and improvement of renewable and otherwise reduced greenhouse gas emitting sources of energy as well as innovative energy-efficiency techniques for use and delivery of energy).⁶⁹ Another important sector in climate change policy is insurance and reinsurance.⁷⁰ Sectoral

⁶⁶ John M. Broder, *U.N. Unveils Tool for Tracking Progress of Climate Talks*, N.Y. TIMES (Green blog), Feb. 28, 2011, available at <http://green.blogs.nytimes.com/2011/02/28/u-n-unveils-tool-for-tracking-progress-of-climate-talks/>.

⁶⁷ For the website, see <http://cancun.unfccc.int/>.

⁶⁸ See *supra* note 64.

⁶⁹ Pacala & Socolow, *supra* note 64, at 969-71 & tbl. 1; Akihiro Sawa, *Sectoral Approaches to a Post-Kyoto International Policy Framework*, in POST-KYOTO INTERNATIONAL CLIMATE POLICY, *supra* note 18, at 78-80; National Academies of Sciences, *Limiting the Magnitude of Climate Change* 144 & box 7.1 (prepublication report) (2010) [hereinafter *Limiting the Magnitude of Climate Change*].

⁷⁰ For an overview of insurance issues related to climate change, see Howard C. Kunreuther and Erwann O. Michel-Kerjan, *Climate Change, Insurance of Large-Scale Disasters, and the Emerging Liability Challenge*, 155 U. PA. L. REV. 1795 (2007). See also Stone, *supra* note 53, at 474-87 (arguing for a role of both conventional and government-supported insurance schemes to address climate change risks).

climate contracts may also be pursued at national, regional, state, or local levels—with potential aggregation of efforts to higher levels when appropriate, efficient, and effective.

This list of possibilities of useful engagement at the international level is not exhaustive. But a key feature of this approach is that it rejects the “unitary” or “comprehensive” fashion of Kyoto. Instead, thinking in terms of a non-comprehensive “portfolio of treaties” is likely to prove more useful than tilting toward the windmill of a single comprehensive agreement.⁷¹

B. Bilateral or Multilateral Climate Treaties

The difficulties of a global comprehensive treaty may be lessened by simply reducing the number of countries involved.⁷² As few as two countries may make a major difference. China and the United States, for example, currently account for more than forty percent of total greenhouse gas emissions. Bilateral treaties between them may result in progress, and some moves in this direction have been made, especially with respect to energy issues.⁷³ Only twenty nations account for seventy percent of total global emissions, suggesting progress might be made on narrower topics with fewer countries initially at the table.⁷⁴

Another promising suggestion is for “the Big Four”—namely, China, the United States, the European Union, and India—to negotiate a multilateral treaty which would form a template to lead

⁷¹ For this idea, see Scott Barrett, *A Portfolio System of Climate Treaties*, in POST-KYOTO INTERNATIONAL CLIMATE POLICY, *supra* note 18, at 81-83. See also Stewart, *supra* note 56, at 696-98 (describing “global pluralism”).

⁷² See *supra* note 28.

⁷³ White House, *U.S.-China Clean Energy Agreements* (Press Release, Nov. 17, 2009), available at <http://www.whitehouse.gov/the-press-office/us-china-clean-energy-announcements>. For substantive analysis and recommendations, see Kenneth G. Lieberthal & David B. Sandalow, *Overcoming Obstacles to U.S.-China Cooperation on Climate Change* (John L. Thornton China Center at Brookings monograph series) (2007); Steve Wolfson, *Gathering Momentum for U.S.-China Cooperation on Climate Change*, 1 TSINGHUA CHINA L. REV. 22 (2009). See also *Limiting the Magnitude of Climate Change*, *supra* note 69, at 143 (noting U.S. membership in a number of multilateral treaties relevant to climate change).

⁷⁴ See, e.g., Larry Parker & John Blodgett, *Greenhouse Gas Emissions: Perspectives on the Top 20 Emitters and Developed Versus Developing Nations 4* (Congressional Research Report) (updated Nov 28, 2008) (based on 2000 data). These countries include emerging economies such as Brazil, China, India, Indonesia, Mexico, South Africa, South Korea, and Russia, as well as the United States, Canada, Australia, and the European Union. *Id.* at 14, app. A.

the world forward on global-level issues such as reporting, monitoring, and verification. This four-member group currently represents sixty percent of greenhouse gas emissions, more than sixty percent of global GDP, and about half of the global population.⁷⁵

C. *National and Regional Climate Regulation*

Proponents of comprehensive global regulation worry that non-comprehensive approaches will result in piecemeal approaches that have nefarious side effects.⁷⁶ It is true that a plurality of different approaches will produce conflicts, dangers of over-regulation, and other problems. But given the strong likelihood that comprehensive regulation will not occur, there is no realistic alternative to proceeding on a less-than-comprehensive basis (unless one is simply to throw up one's hands and give up on an effective response).⁷⁷ As Elinor Ostrom argues, given the problems with the comprehensive approach and the seriousness of the issue, it does not make sense to wait. Although "many of the effects of climate change are global, the causes of climate change are actions that are undertaken by individuals, families, firms, and actors at a much smaller scale."⁷⁸ In this context, regulations at the national, regional, and state levels may be often justified, even though they are subject to free rider and other problems when considered from a global perspective.

Therefore, it makes sense to pursue regulatory options at the regional and state levels because they are more likely to have the ability to act.⁷⁹ State-level regulation has occurred, for example, in

⁷⁵ ANTHOLIS & TALBOTT, *supra* note 20, at 76-77.

⁷⁶ E.g., Coglianese & D'Ambrosio, *supra* note 15, at 1415, 1418-25; Wiener, *Think Globally, Act Globally*, *supra* note 15, at 1966-73.

⁷⁷ For another version of the counterargument, see Ostrom, *A Polycentric Approach for Coping with Climate Change*, *supra* note 29, at 27-28.

⁷⁸ *Id.* at 3-4.

⁷⁹ For arguments supporting this level of regulation on various grounds, including the potential for regional regulatory systems (such as emissions trading regimes) to cooperate with each other, see Kirsten H. Engel, *Mitigating Global Climate Change in the United States: A Regional Approach*, 14 N.Y.U. ENVTL. L.J. 54 (2005). See also J.R. DeShazo & Jody Freeman, *Timing and Form of Federal Regulation: The Case of Climate Change*, 155 U. PA. L. REV. 1499 (2007) (favoring regional and state approaches in the U.S. context, in part because of the knock-on pressures for the hoped-for stimulation of national solutions); Stewart, *supra* note 56, at 698-99 (favoring "domestic pluralism" approaches).

California, Colorado, Florida, New Jersey, and New York.⁸⁰ At least thirty states have adopted renewable portfolio standards to encourage the development and use of alternative energy sources and thereby reduce greenhouse gas emissions.⁸¹ Regional examples include the European Union Emissions Trading Scheme (covering thirty countries)⁸² and several regional initiatives in the United States and Canada, namely, the Regional Greenhouse Gas Initiative (ten northeastern U.S. states), the Midwest Greenhouse Gas Reduction Accord (nine U.S. states and three Canadian provinces), and the Western Climate Initiative (seven U.S. states and four Canadian provinces).⁸³ About half of U.S. states have enrolled in state or regional climate agreements.⁸⁴

⁸⁰ Ostrom, *A Polycentric Approach for Coping with Climate Change*, *supra* note 29, at 20; Timothy P. Duane, *Greening the Grid: Implementing Climate Change Policy Through Energy Efficiency, Renewable Portfolio Standards, and Strategic Transmission System Investments*, 34 VT. L. REV. 711, 712-19, 736-80 (2010) (describing California's initiatives); Daniel A. Farber, *Climate Change, Federalism, and the Constitution*, 50 ARIZ. L. REV. 879, 883-91 (2008) (describing state initiatives in energy and transportation sectors); Robert B. McKinstry, Jr., *Laboratories for Local Solutions for Global Problems: State, Local and Private Leadership in Developing Strategies to Mitigate the Causes and Effects of Climate Change*, 12 PENN ST. ENVTL. L. REV. 15, 26-54 (2004) (describing various state initiatives in California, Massachusetts, New Jersey, New Hampshire, New York, Oregon, and Wisconsin). *See also* David E. Adelman & Kirsten H. Engel, *Reorienting State Climate Change Policies to Induce Technological Change*, 50 ARIZ. L. REV. 835 (2008). For an updated index and descriptions of climate-related actions in all U.S. states and regions listed by state and by type of initiative (including sectors of energy, transportation, and buildings), see Pew Center on Global Climate Change, *Climate Action in U.S. States and Regions*, available at <http://www.pewclimate.org/states-regions>.

⁸¹ For a description and criticism of these programs, see Ivan Gold & Nidhi Thakar, *A Survey of State Renewable Portfolio Standards: Square Pegs for Round Climate Change Holes?* 35 WM. & MARY ENVTL. L. & POL'Y REV. 183 (2010).

⁸² The European Union's Emissions Trading Scheme includes thirty countries and covers large power plants, oil refineries, steel works, and other major industrial plants and factories. European Commission, *Emissions Trading Scheme*, available at <http://ec.europa.eu/clima/policies/ets/>.

⁸³ For descriptions, see, e.g., Cinnamon Carlarne, *Notes from a Climate Change Pressure-Cooker: Sub-Federal Attempts at Transformation Meet National Resistance in the USA*, 40 CONN. L. REV. 1351, 1367-78 (2008) (including California as a "region of its own"); Duane, *supra* note 81, at 726-35; Ostrom, *A Polycentric Approach for Coping with Climate Change*, *supra* note 29, at 20-22; Jeremy Lawrence, Note, *The Western Climate Initiative: Cross-border Collaboration and Constitutional Structure in the United States and Canada*, 82 S. CAL. L. REV. 1225 (2009). For updated websites, see Pew Center on Global Climate Change, *Regional Initiatives*, available at http://www.pewclimate.org/what_s_being_done/in_the_states/regional_initiatives.cfm. Although the U.S. Constitution forbids some varieties of state "compacts," the current regional greenhouse initiatives are most likely to be upheld if challenged. Note, *The Compact Clause and the Regional Greenhouse Gas Initiative*, 120 HARV. L. REV. 1958 (2007). Courts are also unlikely to find regional and state climate regulation to be preempted under the federal foreign affairs power. Note, *Foreign Affairs Preemption and State Regulation of Greenhouse Gases*, 119 HARV. L. REV. 1877 (2006).

⁸⁴ *Limiting the Magnitude of Climate Change*, *supra* note 69, at 149.

Leakage and other problems will occur, as it does currently at the global level.⁸⁵ One possible response to the problem of leakage is for nation-states (perhaps in concert through multilateral treaties) to adopt “border tax adjustments” (or “carbon tariffs”) subject to international trade restrictions. Although concerns about economic protectionism may arise (hidden in green cloaks of political rhetoric), an advantage of this approach to leakage is that national, regional, or state trade restrictions are more likely to prove effective in combating the problem than global-level sanctions because of the relative effectiveness of legal institutions at this level.⁸⁶

Comprehensive approaches anticipate regulation at national and regional levels as well. The overall argument here is not that various national and regional regulation schemes should replace or substitute for international interventions and coordination, but rather that many different levels of regulation can contribute to a necessary and effective response given the significant weaknesses of comprehensive global schemes.⁸⁷ Competing national and regional regimes are probably inevitable in this area, and if so then international regulation – both economic and environmental – may play a more manageable secondary role in terms of making judgments about permissible or impermissible

⁸⁵ See *supra* notes 50-52 and accompanying text.

⁸⁶ On the legitimacy of these proposed measures under international law, see, e.g., *Limiting the Magnitude of Climate Change*, *supra* note 69, at 97-98, 148 (citing WTO-UNEP report); Steve Charnovitz, *Reviewing Carbon Charges and Free Allowances under Environmental Law and Principles*, 16 ILSA J. INT'L & COMP. L. 395 (2010); Paul-Erik Veel, *Carbon Tariffs and the WTO: An Evaluation of Feasible Policies*, 12 J. INT'L ECON. L. 749 (2009); M. Benjamin Eichenberg, *Greenhouse Gas Regulation and Border Tax Adjustments: the Carrot and the Stick*, 3 GOLDEN GATE U. ENVTL. L.J. 283 (2010). Steven Nathaniel Zane, Note, *Leveling the Playing Field: The International Legality of Carbon Tariffs in the EU*, 34 B.C. INT'L & COMP. L. REV. 199 (2011).

⁸⁷ An analogy to this argument for diversity of regulation from a global point of view may be drawn from persuasive argument made for similar multi-level or “bidirectional” approaches to environmental regulation under federalism in the United States. See Daniel C. Esty, *Revitalizing Environmental Federalism*, 95 MICH. L. REV. 570 (1996); Trisolini, *supra* note 8. See also Kirsten Engel, *State and Local Climate Change Initiatives: What Is Motivating State and Local Governments to Address a Global Problem and What Does This Say about Federalism and Environmental Law?*, 38 URB. LAW. 1015 (2006) (discussing various motivations).

measures and practices justified on grounds of protecting global climate. Following a second-best iterative bottom-up process of regulation beats waiting for a God-like deliverance from above.⁸⁸

D. *Municipal Plans and Coordination*

More than half of the world's population live in cities, and the number of urban dwellers is projected to grow to seventy percent by 2050.⁸⁹ Municipal plans and regulations are therefore central to addressing the contributions of the built environment and transportation to climate change.⁹⁰ Adaptation planning, which tends to require highly specific local features, is also important at this level (such as effective response to urban heat waves and coastal sea level rise).⁹¹ New York City's plan provides a leading example in the United States.⁹² Other leading cities with climate plans in North America include Berkeley, Toronto, and Philadelphia.⁹³

Municipalities are also banding together internationally at another level of coordination. For example, more than 500 U.S. cities are members of the Cities for Climate Protection Campaign,

⁸⁸ Cf. Ann E. Carlson, *Iterative Federalism and Climate Change*, 103 NW. U. L. REV. 1097 (2009) (arguing in favor of an iterative process of climate regulation that will help to inform laws at the national level). The argument here favors an iterative conception of legal and other social responses to climate change at different levels globally.

⁸⁹ National Academies of Sciences, *Advancing the Science of Climate Change* 48, 252 (prepublication report) (2010) [hereinafter *Advancing the Science of Climate Change*] (citing UN estimates).

⁹⁰ For an extended description of municipal and other local climate change regulations and arguments supporting them as a "bidirectional" approach, see Trisolini, *supra* note 8. See also McKinstry, *supra* note 80, at 54-58; Ostrom, *A Polycentric Approach for Coping with Climate Change*, *supra* note 29, at 16-19.

⁹¹ For a description, see *Advancing the Science of Climate Change*, *supra* note 89, at 48-50, 252-59. For a summary of Philadelphia's plan to reduce deaths from heat waves, see National Academies of Sciences, *Adapting to the Impacts of Climate Change* 100-01, box 3.2. (prepublication report) (2010) [hereinafter *Adapting to the Impacts of Climate Change*]. On adaptation and mitigation strategies, see *supra* note 57 and accompanying text. See also Matthew D. Zinn, *Adapting to Climate Change: Environmental Law in a Warmer World*, 34 *ECOLOGY L.Q.* 61 (2007)

⁹² *Adapting to the Impacts of Climate Change*, *supra* note 91, at 110-38. For the current version of New York's plan, which targets a thirty percent reduction in greenhouse gas emissions by 2030, see PLANYC, available at <http://www.nyc.gov/html/planyc2030/html/plan/plan.shtml>. Adaptation plans are also done at the state level (e.g., California) or the national level (e.g., the U.K.'s Climate Impact Program). *Adapting to the Impacts of Climate Change*, *supra* note 91, at 150, box 5.3; 157-58, box 5.5. The point is that adaptation plans make sense at a number of different levels: it is nonsensical to wait for a larger comprehensive adaptation plan that may well never come.

⁹³ See Ostrom, *A Polycentric Approach for Coping with Climate Change*, *supra* note 29, at 17-18 (describing activities in Berkeley and Toronto). For Philadelphia's plan, see Office of Mayor, *Greenworks Philadelphia* (2009), available at http://www.phila.gov/green/greenworks/pdf/Greenworks_OnlinePDF_FINAL.pdf.

which is organized in turn under the auspices of the International Council for Local Environmental Initiatives, which counts over 1200 regional and local governments as members in more than seventy countries.⁹⁴ Forty of the largest cities in the world are also organized in the C40 Cities Climate Leadership Group sponsored by the non-profit Clinton Climate Initiative.⁹⁵ Municipal plans and the networks among them provide another example of an extensive network of “climate contracts” that bypass comprehensive international bureaucracies and inertia.⁹⁶

E. *Energy Efficiency Plans*

Probably the lowest-cost measure to achieve near-term greenhouse gas reductions is provided by currently available technologies to improve energy efficiency—in transportation, buildings, and various industrial sectors.⁹⁷ One study estimates available savings through the adoption of energy efficiency measures in the United States at approximately one trillion dollars.⁹⁸ Educational programs and incentives can increase the ability of individuals and companies to take advantage of these technologies, with additional motivation provided by increasing costs of carbon-intensive energy sources (namely, fossil fuels). Building codes, fuel efficiency standards, national renewable portfolio standards, and other technical standards mandating or encouraging energy efficiency are examples of complementary policies that can be adopted effectively at different regulatory levels.⁹⁹ These kinds of

⁹⁴ See Trisolini, *supra* note 8, at 676. For current information on the International Council for Global Environmental Initiatives and its members, see website available at <http://www.iclei.org/>.

⁹⁵ For current membership and other information, see the C40 Cities website, available at <http://www.c40cities.org/>.

⁹⁶ For a selection of essays exploring various innovations adopted by cities, see GROWING GREENER CITIES: URBAN SUSTAINABILITY IN THE TWENTY-FIRST CENTURY (Eugenie L. Birch & Susan M. Wachter eds., 2008). See also Engel, *supra* note 81; Kent Portney, *Civic Engagement and Sustainable Cities in the United States*, 65 PUB. ADMIN. REV. 579 (2005); Trisolini, *supra* note 8.

⁹⁷ See, e.g., *Limiting the Magnitude of Climate Change*, *supra* note 69, at 42-46; Per Anders-Enkvist et al., *supra* note 31, at 38 & exh. 1; Pacala & Socolow, *supra* note 64, at 970 & tbl. 1.

⁹⁸ Jon Creyts, et al., *U.S. Energy Savings: Opportunities and Challenges*, MCKINSEY Q. (June 2010), at 2.

⁹⁹ See, e.g., *Limiting the Magnitude of Climate Change*, *supra* note 69, at 88-94.

plans and sharing of best practices cut across traditional legal lines of regulation.¹⁰⁰ They can occur at global, national, regional, and local levels. They can also be adopted voluntarily, encouraged by regulatory incentives, or mandated.

F. *Subsidies for Technological Innovation*

Many scientists and policy makers believe that major technological breakthroughs, especially in energy, are necessary in order to address climate change at the necessary scale and politically acceptable economic cost.¹⁰¹ Traditional economic arguments against subsidies if “first-best” regulatory solutions apply may not hold if institutional realities compel “second-best” choices.¹⁰² Although increased taxes or other charges on fossil fuels provide incentives (i.e., the now-proverbial “price on carbon”), there are also strong arguments for structuring subsidies from government to “prime the pump” of research and development of new energy technologies.¹⁰³ (At the very least,

¹⁰⁰ For an approach to building standards, for example, see Rachael Rawlins & Robert Paterson, *Sustainable Buildings and Communities: Climate Change and the Case for Federal Standards*, 19 CORNELL J.L. & PUB. POL'Y 335 (2010).

¹⁰¹ See, e.g., BARRETT, *supra* note 19, at 41-43 (“Radical breakthroughs in technology will be needed if atmospheric concentrations of greenhouse gases are to be stabilized without reducing economic growth substantially.”). Google, for example, announced a goal of finding renewable energy sources cheaper than coal, which follows this intuition. *Google's Goal: Renewable Energy Cheaper than Coal* (Press Release, Nov. 27, 2007), available at http://www.google.com/intl/en/press/pressrel/20071127_green.html.

¹⁰² For an example of the common economic argument against subsidies as a policy choice, see Wiener, *Global Environmental Regulation*, *supra* note 15, at 726-27. Essentially, the argument (which is often compelling in many circumstances) is that the government cannot pick economic “winners” as well as competitive markets.

¹⁰³ For recent arguments suggesting that subsidies may make sense in this field, see Adam B. Jaffee, Richard G. Newell & Robert B. Stavins, *A Tale of Two Market Failures: Technology and Environmental Policy*, 54 ECOLOGICAL ECON. 164 (2005) (arguing in favor of a “portfolio of policies” to encourage technological innovation, including targeted subsidies). See also Carolyn Fischera and Richard G. Newell, *Environmental and Technology Policies for Climate Mitigation*, 55 J. ENVTL. ECON. & MGMT. 142 (2008) (arguing that subsidies may make sense in the electricity sector within a “portfolio of policies,” though other policy interventions such as taxes or price interventions are ranked more highly). Cf. Jason Scott Johnston, *Problems of Equity and Efficiency in the Design of International Greenhouse Gas Cap-and-Trade Schemes*, 33 HARV. ENVTL. L. REV. 405 (2009) (arguing that policies “targeted much more directly on encouraging both the development of new, energy efficient technologies and their adoption in the developing world” are superior to global cap-and-trade schemes). *But cf.* Green, *supra* note 61 (arguing that positive subsidies under climate change regimes may have perverse long-term effects with respect to the development of environmentally beneficial norms, but this concern may not apply to subsidies directed toward radical technological innovation).

“perverse subsidies” that encourage the production of greenhouse emissions should be eliminated.)¹⁰⁴

Calls have been made for governments to announce the equivalent of the Apollo mission to the moon to spark new climate friendly technologies.¹⁰⁵ Investment in “carbon capture” technologies, though as yet unproven, may also make sense.¹⁰⁶ Perhaps most controversially, funding for the research and development of geoengineering technologies to cool the planet might provide relatively inexpensive solutions to at least some parts of the climate change problem.¹⁰⁷ Subsidies targeting climate friendly technologies are ordinarily paid at the level of nation-states rather than at the international level.¹⁰⁸ But coalitions of government and private investors are also feasible. For example, governments might

¹⁰⁴ For an overview of this large problem, see Norman Myers and Jennifer Kent, *PERVERSE SUBSIDIES: HOW TAX DOLLARS CAN UNDERCUT THE ENVIRONMENT AND THE ECONOMY* (2001). President Obama, for example, called for an end to subsidies for oil companies in his State of the Union speech in 2011 and argued for reinvesting the savings in clean energy technologies. Barack Obama, *Remarks by the President in the State of the Union Address*, Jan. 25, 2011, available at <http://www.whitehouse.gov/the-press-office/2011/01/25/remarks-president-state-union-address> [hereinafter *State of the Union Address*]

¹⁰⁵ See, e.g., Obama, *State of the Union Address*, *supra* note 104.

¹⁰⁶ The Obama Administration, for example, has invested significant funds for research and development of new energy technologies, as well as carbon sequestration (so-called “clean coal” technologies). See, e.g., *Limiting the Magnitude of Climate Change*, *supra* note 69, at 101-20. Many environmentalists are skeptical about the prospects for truly “clean” coal in the near future, particularly with respect to carbon emissions. For a vociferous view against coal investments, see Friends of the Earth, *Coal*, available at <http://www.foe.org/coal>.

¹⁰⁷ “Geoengineering” refers to deliberate large-scale manipulations of the Earth’s environment designed to offset at least some of the harmful effects of climate change. Proposed interventions fall into two main categories: solar radiation management and carbon dioxide removal. For an overview, see *Advancing the Science of Climate Change*, *supra* note 89, at 291-99. See also Alan Carlin, *Global Climate Change Control: Is There a Better Strategy than Reducing Greenhouse Gas Emissions?*, 155 U. PA. L. REV. 1401 (2007). None of the currently proposed interventions would address increasing ocean acidification, and major scientific and ethical questions are raised by all of the proposed approaches. *Advancing the Science of Climate Change*, *supra* note 89, at 291-99. For example, unintended and unknown consequences of large-scale climate interventions may themselves run small risks of global catastrophe. In addition, earth-scale geoengineering raises questions of international equity and legitimacy at least as significant as those confronted by (and impeding) global Kyoto-style mitigation treaties. See *supra* notes 37-41 and accompanying text.

¹⁰⁸ China is a leader in subsidies for renewable energy technologies, though perhaps to the extent of violating global trade law. See, e.g., Keith Bradsher, *On Clean Energy, China Skirts Rules*, N.Y. TIMES, Sept. 9, 2010, at A1; Sewell Chan & Keith Bradsher, *U.S. to Investigate China’s Clean Energy Aid*, N.Y. TIMES, Oct. 16, 2010, at B1. Because of the direct connection between governments and businesses, subsidies may also increase the risks of corruption, which of course undermines the integrity and likely social benefit of the process.

award private subsidies for new climate friendly technologies on the basis of a tournament for “prizes” given for the best research or business ideas.¹⁰⁹

G. *Non-Governmental Organizations*

Large and small environmental non-governmental organizations (NGOs) play an important part not only in lobbying for environmental regulation or litigating in a manner that may affect climate change, but also in collaborating and interacting with governments, businesses, and individuals on specific climate-friendly projects.¹¹⁰ For example, NGOs such as Conservation International, the Nature Conservancy, the World Wildlife Fund, and others play a key role in efforts to preserve biodiversity around the world through direct aid and debt-for-nature swaps.¹¹¹ NGOs also participate in an increasingly muscular fashion in international institutions in defending their views of environmental interests.¹¹² Many of these NGOs are specifically concerned with climate change issues. Examples include Environmental Defense, Greenpeace, the Pew Center on Global Climate Change, Resources of the Future, and the World Resources Institute.¹¹³ Although the aggregate impact of these efforts with respect to climate change policy is difficult to measure with precision, observers confirm that the role of NGOs seems to be large and vital in terms of the long-run viability

¹⁰⁹ See Richard G. Newell & Nathan E. Wilson, *Technology Prizes for Climate Change Mitigation* (discussion paper, Resources for the Future) (June 2005). For a general business perspective on the topic, see also CHRISTIAN TERWIESCH & KARL ULRICH, *INNOVATION TOURNAMENTS: CREATING AND SELECTING EXCEPTIONAL OPPORTUNITIES* (2009).

¹¹⁰ Major players include the World Resources Institute, Environmental Defense, and the World Wildlife Fund. An example of the coordinated role of universities and colleges appears in the American College and University Presidents Climate Commitment (which now over 600 signatories). For the particular effort of my own university, see the Penn Climate Action Plan, available at <http://www.upenn.edu/sustainability/cap.html>.

¹¹¹ See, e.g., Bradley M. Bernau, Note, *Help for Hotspots: NGO Participation in the Preservation of Worldwide Biodiversity*, 13 IND. J. GLOBAL LEGAL ST. 617 (2006).

¹¹² See Kal Raustiala, *States, NGOs, and International Environmental Institutions*, 41 INT’L STUD. Q. 719 (1997). Countries that unduly restrict environmental NGOs are therefore likely to lag in terms of environmental protection. China is a case in point. See Eric W. Orts, *Environmental Law with Chinese Characteristics*, 11 WM. & MARY BILL RTS. J. 545, 562-66 (2003); Jonathan Schwartz, *Environmental NGOs in China: Roles and Limits*, 77 PAC. AFF. 28 (2004).

¹¹³ See, e.g., PAUL WAPNER, *ENVIRONMENTAL ACTIVISM AND WORLD CIVIC POLITICS* (1996) (describing the activities and different strategies and perspectives of Greenpeace, Friends of the Earth, and World Wildlife Fund).

of climate-related reforms.¹¹⁴ Increasing religious engagement with climate change issues also signals the potential strength of non-governmental organizations to influence social practices and policies in this area.¹¹⁵

Colleges and universities, which constitute educational NGOs on one hand and act on the scale of cities on the other, are also arguably involved in a role with global influence that one might describe as “climate contracts.” Many colleges and universities, for example, have developed the equivalent of the University of Pennsylvania’s “Green Campus Partnership” and “Climate Action Plan,” which involve local businesses as well the city of Philadelphia.¹¹⁶ In 2007, Penn’s President, Amy Gutmann, also signed a pledge to join the American College and University Presidents’ Climate Commitment, which now boasts over 650 signatories.¹¹⁷ In another example, the Rocky Mountain Institute entered into a coalition with twelve selected colleges to research climate change solutions.¹¹⁸

Business Coalitions and Alliances

Businesses play an important role in addressing climate change as well. The view that business firms are simply “entities to be regulated” is myopic and reductionist. In general terms, one can argue that business firms can play an affirmative and positive role (if inclined to do so) by

¹¹⁴ For accounts of the increasing general influence of NGOs at the international level, see, e.g., Chad Carpenter, *Businesses, Green Groups and the Media: The Role of Non-Governmental Organizations in the Climate Change Debate*, 77 INT. AFF. 313, 319-21 (2001); Steve Charnovitz, *Two Centuries of Participation: NGOs and International Governance*, 18 MICH. J. INT’L L. 183 (1997); P. J. Simmons, *Learning to Live with NGOs*, 112 FOR. POL’Y 82 (1998).

¹¹⁵ For a discussion of this theme from different perspectives, reviewing religious sources, see, e.g., Albert C. Lin, *Evangelizing Climate Change*, 17 N.Y.U. ENVTL. L.J. 1135 (2009); Holmes Rolston III, *Saving Creation: Faith Shaping Environmental Policy*, 4 HARV. L. & POL’Y REV. 121 (2010). For a collection of environmental statements by different religions, see also <http://greenfaith.org/religious-teachings>.

¹¹⁶ See Penn Green Campus Partnership, website available at <http://www.upenn.edu/sustainability/>; University of Pennsylvania, Climate Action Plan, available at <http://www.upenn.edu/sustainability/cap.html>. [hereinafter *Penn Climate Action Plan*].

¹¹⁷ *Penn Climate Action Plan*, supra note 107, at 10. For the institutional membership of American College and University Presidents Climate Commitment, see *Presidents’ Climate Commitment*, available at <http://www.presidentsclimatecommitment.org/>.

¹¹⁸ Brian Merchant, *12 Colleges Chosen to Fight Climate Change*, TREEHUGGER, Oct. 10, 2008, available at <http://www.treehugger.com/files/2008/10/12-colleges-chosen-fight-climate-change.php>.

engaging in “collaborative environmental law.”¹¹⁹ Progressive-minded businesses have joined coalitions to lobby in favor of national-level climate policy, such as through the U.S. Climate Action Partnership (USCAP).¹²⁰ (Others, however, appear to have more effectively lobbied against national climate legislation under the auspices of the U.S. Chamber of Commerce and other industry groups.)¹²¹ A group of businesses have also taken the lead in signing up for the Carbon Disclosure Project ahead of newly adopted regulations requiring this kind of public disclosure in the United States.¹²² A number of other important business-oriented organizations appear to take the challenges of climate change seriously.¹²³ Because many business firms today take climate change seriously, the idea of “climate contracts” includes them also as principal players in regulation at various levels.¹²⁴ Voluntary coalitions of businesses may also play a significant role in driving normative change, developing new technical standards and measures of performance, and lobbying for efficient climate

¹¹⁹ On this idea, see Eric W. Orts & Cary Coglianese, Debate, *Collaborative Environmental Law: Pro and Con*, 156 U. PA. L. REV. PENNUMBRA 289 (2007), <http://www.pennumbra.com/debates/collabenvlaw.pdf>. For other views favoring various forms of “collaborative” regulation or its equivalent, see Jody Freeman & Daniel A. Farber, *Modular Environmental Regulation*, 54 DUKE L.J. 795 (2005); Jody Freeman, *Collaborative Governance in the Administrative State*, 45 UCLA L. REV. 1 (1997); Bradley C. Karkkainen, *Collaborative Ecosystem Governance: Scale, Complexity and Dynamism*, 21 VA. ENVTL. L.J. 189, 193-94 (2002).

¹²⁰ See U.S. Climate Action Partnership, *A Blueprint for Legislative Action: Consensus Recommendations for U.S. Climate Protection Legislation* (Jan. 2009), available at www.us-cap.org.

¹²¹ See, e.g., John M. Broder, *Storm Over the Chamber*, N.Y. TIMES, Nov. 19, 2009, at F1 (recounting that some companies left the organization due to its position on climate change legislation).

¹²² See Carbon Disclosure Project, *available at* www.cdproject.net. For the EPA’s regulation, see Mandatory Reporting of Greenhouse Gases, Final Rule, 74 Fed. Reg. 56260 (Oct. 30, 2009). Arguably, this disclosure law is a form of reflexive environmental law (as well as a form of informational regulation) given its potential to have positive effects on businesses in terms of the attention they pay to greenhouse gas emissions. For examples of current business practices in this area from a strategic perspective, see ANDREW J. HOFFMAN, CARBON STRATEGIES: HOW LEADING COMPANIES ARE REDUCING THEIR CLIMATE CHANGE FOOTPRINT (2007).

¹²³ Philadelphia, for example, has the Small Business Network, website available at <http://www.sbnphiladelphia.org/>. Note that local businesses may also supply a multiplier effect on regional or municipal regulation when they have headquarters or major operations in the corresponding area. See, e.g., Victor B. Flatt, *Act Locally, Affect Globally: How Changing Social Norms to Influence the Private Sector Shows a Path to Using Local Government to Control Environmental Harms*, 35 B.C. ENVTL. AFF. L. REV. 455 (2008).

¹²⁴ Different motivations can lead businesses to take this position. One is that business leadership “gets it” and decides that addressing climate change is a managerial priority in terms of “doing the right thing” in terms of business ethics or social responsibility. Another view is that many businesses take a “long green” perspective in terms of their economic profitability, hedging political risks of regulation as well as catering to potentially growing consumer demands for climate-friendly products or services.

regulation. Another growing practice is business partnerships with large environmental NGOs (such as Environmental Defense Fund or World Wildlife Fund) to develop specific solutions to business sustainability problems, including climate change.¹²⁵

H. *Consumer Transactions*

A relatively new but potentially powerful force to encourage climate-friendly practices relates to the ability of consumers—and the businesses that cater to them—to choose to buy goods and services with environmental characteristics in mind. Some forward-thinking businesses that target “green consumers” in this manner include Timberland, which has adopted a carbon footprint label for its shoes, and Patagonia, which reveals a thumbnail sketch of the “life cycle” of its products.¹²⁶ Wal-Mart has made the biggest splash in this area by announcing a major sustainability initiative to cover all of its suppliers—and thus “green the supply chain” for its customers.¹²⁷ Good and reliable standards are required, and some questions remain concerning the need to distinguish between “greenwashing” claims and truly superior green products.¹²⁸ Governmental or NGO-certified eco-

¹²⁵ E.g., Neil Gunningham, *Environment Law, Regulation and Governance: Shifting Architectures*, 21 J. ENVTL. L. 179, 197 (2009); Press Release, McDonald's & Environmental Defense Fund Mark 10th Anniversary of Landmark Alliance, Dec. 21, 1999, available at <http://www.edf.org/pressrelease.cfm?contentID=1299>; ClimateChangeCorp.Com, Climate NGO Partnerships: WWF and Climate Group Team Up with Business, July 26, 2007, available at <http://www.climatechangecorp.com/content.asp?ContentID=4876>; see also Richard B. Stewart, *Administrative Law in the Twenty-First Century*, 78 N.Y.U. L. REV. 437, 456 (2003) (describing “an array of partnership arrangements among national governments, multinational businesses, and environmental, consumer, labor, developing country, and other nongovernmental organizations (NGOs) in order to achieve international regulatory and development goals”).

¹²⁶ Reena Jana, *Reading the New Eco-Labels*, BLOOMBERG BUSINESSWEEK, May 2, 2007; Patagonia, *The Footprint Chronicles*, available at <http://www.patagonia.com/us/footprint/> (tracing geographical sourcing for various products and describing general business philosophy of life cycle analysis and assessment).

¹²⁷ See Erica L. Plambeck, *The Greening of Wal-Mart's Supply Chain*, SUPPLY CHAIN MANAGEMENT REVIEW 18 (July/August 2007); Erica L. Plambeck & Lyn Denend, *The Greening of Wal-Mart*, STANFORD SOCIAL INNOVATION REVIEW 53 (Spring 2008). For another assessment, see Gwen Ruta, *When It's Wal-Mart, How Much Is Good Enough?* GREENBIZ.COM, June 6, 2009, available at <http://www.greenbiz.com/blog/2009/06/09/when-its-wal-mart-how-much-good-enough>.

¹²⁸ See, e.g., Heather Green & Kerry Capell, *Carbon Confusion*, BLOOMBERG BUSINESSWEEK, Mar. 6, 2008, available at http://www.businessweek.com/magazine/content/08_11/b4075052454821.htm; see also generally Richard Dahl, *Greenwashing: Do You Know What You're Buying?*, 118 Env'tl. Health Persp. A246 (2010).

labels, as well as the enforcement of environmental marketing claims, may prove helpful.¹²⁹ The Federal Trade Commission recently proposed a revision to its Green Guide to include reference to accurate references to “carbon offsets” and other environmental marketing claims. Independent third parties have also begun to spring up that rate the sustainability of consumer products.¹³⁰ At least potentially, increasing consumer demand combined with effective informational regulation and policing of what might be called “environmental fraud” may lead to the creation of a new realm of “micro” climate contracts at the level of individual transactions in the marketplace.¹³¹ The power of this consumer market, if successfully unleashed, could have a substantial collective impact on business practices and climate policies.

One can imagine that this sort of consumer movement might be supplemented by “carbon boycotts” of products or services that are shown to be particularly harmful environmentally or to have

¹²⁹ For a sample of the literature discussing eco-labels and environmental marketing regulation from different perspectives, see, e.g., E. Howard Barnett, *Green with Envy: The FTC, the EPA, the States, and the Regulation of Environmental Marketing*, 1 ENVTL. L. 491 (1995); John M. Church, *A Market Solution to Green Marketing: Some Lessons from the Economics of Information*, 79 MINN. L. REV. 245 (1994); Jamie A. Grodsky, *Certified Green: The Law and Future of Environmental Labeling*, 10 YALE J. REG. 147 (1993); Jeffrey J. Minneti, *Relational Integrity Regulation: Nudging Consumers Toward Products Bearing Valid Environmental Marketing Claims*, 40 ENVTL. L. 1327 (2010). The Federal Trade Commission has recently issued new proposed “green guides” that cover “carbon offsets” and other environmental marketing claims. Press Release, Oct. 6, 2010, available at <http://www.ftc.gov/opa/2010/10/greenguide.shtm>.

¹³⁰ Consumer Reports, for example, has entered this space. See Consumer Reports, Greener Choices, available at <http://www.greenerchoices.org/>. GoodGuide, founded by a former MIT professor, is another third-party organization that products on criteria include sustainability and includes a mobile application for consumers to use on cell phones when shopping. GoodGuide, How It Works, video available at <http://www.goodguide.com/>. Credit cards that have carbon offset or renewable energy “rewards,” such as one provide by Bank of America and Brighter Planet, provides another example. See <http://environment.bankofamerica.com/initiatives/products-and-services/brighter-planet.html>.

¹³¹ For an argument along these lines, see DANIEL GOLEMAN, *ECOLOGICAL INTELLIGENCE: HOW KNOWING THE HIDDEN IMPACTS OF WHAT WE BUY CAN CHANGE EVERYTHING* (2009). Another key feature of this potential consumer revolution lies in the increasing use of life cycle analysis and assessment to achieve what Goleman describes as the “radical transparency” of goods and services. *Id.* at 6-9, 14-28, 65-70. For further discussion of the business use of life cycle analysis and green supply chains, see also Initiative for Global Environmental Leadership & Knowledge@Wharton, *Green Evolution: Managing the Risks, Reaping the Benefits* 1-5 (Mar. 2010), available at http://knowledge.wharton.upenn.edu/papers/download/030310_green_evolution_ss.pdf. A “life cycle” approach argues for a focus on “process” of making, selling, and using a particular product or service. Cf. Douglas A. Kysar, *Preferences for Processes: The Process/Product Distinction and the Regulation of Consumer Choice*, 118 HARV. L. REV. 525 (2004) (arguing for general view that consumers may prefer to examine processes rather than simply the final physical characteristics of a product).

comparatively high carbon content. The export-driven and energy-intensive Chinese economy, for example, may become particularly vulnerable to this kind of a consumer boycott.¹³² Europeans might begin to boycott both American and Chinese goods. A recent trend among at least some individuals to measure their own “carbon footprints” may translate also to corresponding consumer pressures, as well as regulatory options aimed to encourage climate-friendly individual economic behavior.¹³³

Conclusion

Climate contracts provide a needed corrective to the long-standing tendency among many policy makers to insist on comprehensive international solutions to climate change. One can take two views of regulation in this respect. Comprehensive approaches tend to take a “top-down” approach. Elite scientists provide the diagnosis of the problem, and then an elite group of policy experts meeting together in a series of high-level international conferences recommend regulatory solutions. This approach has not worked out well—for some of the reasons outlined here. A “bottom-up” approach is also possible. This decentralized approach allows for a number of different kinds of solutions at different social and governmental levels and involving different kinds of participants (including lots

¹³² China’s share of total greenhouse gas emissions rose from 8% in 1981 to 21% in 2007, and approximately half of this increase (measured from 2002 to 2005) owed to increased net export production to other countries. Tao Wang & Jim Watson, *Who Owns China’s Emissions?* (Tyndall Center for Climate Change Research, Briefing Note, Oct. 2007); Dabo Guan et al., *Journey to World Top Emitter: An Analysis of the Driving Forces of China’s Recent CO₂ Emissions Surge*, 36 GEOPHYSICAL RESEARCH LETTERS L04709 (2009). See also Christopher L. Weber, et al., *The Contribution of Chinese Exports to Climate Change*, 36 ENERGY POL’Y 3572 (2008) (finding that one-third of Chinese greenhouse gas emissions in 2005 were driven by exports). As a result, unless China becomes more sensitive to its long-term greenhouse gas emissions trajectory, environmental activists may begin to target “high carbon” Chinese exports. Other countries, including the United States, may be vulnerable as well.

¹³³ For arguments supporting this line of thinking, see John C. Dernbach, *Harnessing Individual Behavior to Address Climate Change: Options for Congress*, 26 VA. ENVTL. L.J. 107 (2008); Holly Doremus, *Shaping the Future: The Dialectic of Law and Environmental Values*, 37 U.C. DAVIS L. REV. 233 (2003); Katrina Fischer Kuh, *Using Local Knowledge to Shrink the Individual Carbon Footprint*, 37 HOFSTRA L. REV. 923 (2009); James Salzman, *Sustainable Consumption and the Law*, 27 ENVTL. L. 1243 (1997); Michael P. Vandenberg and Anne C. Steinemann, *The Carbon-Neutral Individual*, 82 N.Y.U. L. REV. 1673 (2007). Relying on social norms and individual behavior alone is not likely to prove sufficient. See, e.g., Ann E. Carlson, *Recycling Norms*, 89 CAL. L. REV. 1231 (2001) (finding that legal and financial incentives are needed to reinforce social norms for “large-number, small-payoff” collective action problems). It may provide a piece to the larger puzzle, however, of non-comprehensive climate contract solutions.

of regular folks). It is true that this approach can become complex and even messy. Conflicts may develop, and inconsistencies may render long-range planning difficult, especially for large institutions. As these difficulties arise, however, one can adopt a third and more balanced intermediate approach: rationalizing standards at national or international levels when needed and coordinating (and perhaps also catalyzing) bottom-up ideas and solutions for new challenges.¹³⁴ An enduring strength of approaches that allow for bottom-up pressures on regulation and business practices refers also to the potential role of social movements—in other words, the power of grassroots environmentalism to transform social norms and orientations.¹³⁵

Increasingly, policy makers and scholars are beginning to recognize that the imperial dreams of Kyoto for a global-level comprehensive solution to climate change are not realistic. These dreams crashed in Copenhagen. More modest progress appears to have begun in Cancún. The argument for a less grand alternative of climate contracts made here is consistent with calls for more non-comprehensive approaches. As one group of scholars observes: “the global climate regime has begun to move from a top-down command approach, exemplified in the Kyoto Protocol, to a more flexible bottom-up approach and assume a more plural, decentralized, and even fragmented character.”¹³⁶ Climate contracts allow for one way to conceive of this more flexible, wide-gauged approach.

¹³⁴ This intermediate approach is recommended in *Adapting to the Impacts of Climate Change*, *supra* note 91, at 5-6.

¹³⁵ For accounts of the environmental movement and its social and political as well as legal effects, see, *e.g.*, PAUL HAWKEN, *BLESSED UNREST: HOW THE LARGEST MOVEMENT IN THE WORLD CAME INTO BEING AND WHY NO ONE SAW IT COMING* (2007); PHILIP SHABECOFF, *A FIERCE GREEN FIRE: THE AMERICAN ENVIRONMENTAL MOVEMENT* (rev. ed. 2003); Cary Coglianese, *Social Movements, Law, and Society: The Institutionalization of the Environmental Movement*, 150 U. PA. L. REV. 85 (2001); Jedediah Purdy, *The Politics of Nature: Climate Change, Environmental Law, and Democracy*, 119 YALE L.J. 1122 (2010). See also Christopher D. Stone, *Is Environmentalism Dead?*, 38 ENVTL. L. 19 (2008) (answering this question in the negative). For another perspective, arguing for a need to reconstitute the environmental movement on a less politically constrained footing, see Mark van Putten, *Toward a New Environmental Insurgency*, 55 BIOSCIENCE 789 (2005).

¹³⁶ Richard B. Stewart, Benedict Kingsbury & Bryce Rudyk, *Climate Finance for Limiting Emissions and Promoting Green Development*, in CLIMATE FINANCE: REGULATORY AND FUNDING STRATEGIES FOR CLIMATE CHANGE AND GLOBAL DEVELOPMENT 7 (Richard B. Stewart et al. eds., 2009). See also Daniel Bodansky, *The Future of Climate Governance: Creating a More Flexible Architecture*, in CLIMATE FINANCE, *supra*, at 48-52.

One objection to taking a non-comprehensive approach is that it does nothing to assure that a plurality of fragmented policies, regulations, and market practices will achieve the end of significant reductions in greenhouse gas emissions. It is true that there are no guarantees. At the same time, this alleged virtue of comprehensive approaches, namely, a certainty of targeted reductions, has also proven false. As a result, there are no other alternatives. It is quite possible that the current structure of human civilization will not permit a deviation from a catastrophic long-term fate with respect to our planetary climate.¹³⁷ Yet even if mitigation fails, then adaptation solutions (or at least partial solutions) will be required, and decentralized climate contracts of various kinds may provide a way forward on this dimension as well.

If science continues to confirm the likelihood of significant climate damage, a hopeful conclusion is nevertheless warranted. A climate contracts approach allows for people in many walks of life—including consumers and business owners, as well as everyday citizens—to get engaged and to see themselves as becoming “part of the solution.” Although it is not possible to foretell the aggregate impact of potentially increasing interest and engagement of people as both citizens and consumers, it is at least possible that enough people working on enough different parts of the overall problem will make a difference in the end—and collectively deliver a sustainable climate future. Without false assurances offered by the dreams of comprehensive global regulation, one may nevertheless follow the vision of the French philosopher Michel Serres at a more human scale:

For what reasons must I behave in one way and not in another? So that the Earth can continue, so that the air remains breathable, so that the sea remains the sea. What are the reasons for some other necessity? So that time continues to flow, so that life continues to propagate itself, with comparable chances of multiplicity. Quite simply and objectively.¹³⁸

¹³⁷ For a well-known historical and archeological warning, see JARED DIAMOND, *COLLAPSE: HOW SOCIETIES CHOOSE TO FAIL OR SUCCEED* (rev. ed. 2011). For a good critical assessment of Diamond’s thesis with respect to climate change, see also Scott E. Page, *Are We Collapsing?* 43 *J. ECON. LIT.* 1049 (2005) (book review).

¹³⁸ MICHEL SERRES & BRUNO LATOUR, *CONVERSATIONS ON SCIENCE, CULTURE, AND TIME* 175 (Roxanne Lapidus trans., 1995).