

# Subglobal Regulation of the Global Commons:

## The Case of Climate Change

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*In this Article, the authors challenge the conventional wisdom in the legal, economics, and policy literature that unilateral (as opposed to collective) action by individual countries to restrain despoliation of the global commons is presumptively irrational. The conventional view flows from Garrett Hardin's classic "Tragedy of the Commons" analysis, in which commons preservation, though collectively desirable, is economically irrational when undertaken by individuals, hence the tragedy. Motivated by the unexpected actions of many individual nations and states to address climate change (a classic global commons problem) even in the absence of an unambiguous global framework, the authors show that the market imperfections that characterize some global commons problems, including those of climate change, can diverge from those underpinning the standard "Tragedy of the Commons." The authors argue that this divergence makes room for significant rational unilateral action towards commons preservation, and that this has been underappreciated by many scholars who instinctively disparage unilateral action.*

*In place of the conventional wisdom, the authors suggest that short of the ideal "full glass" of optimal collective action, there exists a "glass half full" of suboptimal unilateral action by larger subglobal governments that is better than no regulation (and hence no benefits) at all, and, indeed, the evidence shows that some larger subglobal governments, the United States in particular, should actually be doing more to address climate change. Furthermore, action*

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*by both large and small subglobal governments may function as a mechanism by which individual governments can help trigger the implementation of the preferred solution of an international framework for collective action.*

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#### INTRODUCTION

Throughout the world, subglobal actors<sup>1</sup> are emerging as leaders in addressing climate change, perhaps the foremost global commons problem facing the world today. In the United States, the world's largest emitter of greenhouse gases,<sup>2</sup> this movement is decidedly from the bottom up, with at

1. We use the term "subglobal" to refer to all governing jurisdictions other than those established through an international agreement. Hence subglobal governments include national governments, regional governing bodies, and state and local governments.

2. Energy-related carbon dioxide emissions in the United States in 2001 totalled 5,692 million metric tons, or approximately 24 percent of an estimated world total of 23,899 million metric tons. Carbon dioxide emissions from the United States represented about 49 percent of the energy-related

least half the states addressing global warming through legislation,<sup>3</sup> executive-initiated programs,<sup>4</sup> or litigation.<sup>5</sup> While approximately one-third of the states have implemented new legislation or executive orders expressly intended to reduce greenhouse gases generated within their own borders,<sup>6</sup> other states, often in concert with environmental organizations, are seeking to establish nationally applicable programs for emissions reductions<sup>7</sup> or regional emission trading markets.<sup>8</sup> This activity at the local level extends beyond the United

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carbon dioxide emissions from the industrialized world in 2001; the remaining 51 percent came from developing countries and the former Soviet Union and Eastern Europe. U.S. Dept. of Energy, Energy Information Agency, Emissions of Greenhouse Gases in the United States 2003, <http://www.eia.doe.gov/oiaf/1605/ggrrpt/emission.html> (last visited May 24, 2005).

3. See, e.g., A.B. 1493 (Cal. 2002) (California legislation requiring greenhouse gas emission standards for mobile sources). The automobile industry has challenged the regulations promulgated by the California Air Resources Board pursuant to A.B. 1493, claiming that the standards constitute de facto fuel economy standards and, because fuel economy is regulated by the federal government under the National Highway Transportation Safety Act, the California standards are preempted. See Carolyn Whetzel, *Climate Change: Automakers, Dealers Challenge Regulation in California to Limit Vehicle Carbon Dioxide*, DAILY ENV'T RPT. NEWS, 235 DEN A-12 (Dec. 8, 2004) (citing *Central Valley Chrysler-Jeep Inc. v. Witherspoon*, No. CV-F0466663 (E.D. Cal. Dec. 7, 2004)).

4. For instance, under New Jersey's green power purchasing program, New Jersey is meeting 15 percent of the energy needs of its state agencies with renewable energy. New Jersey estimates that the program has avoided 168,948 metric tons of carbon dioxide emissions, a greenhouse gas "which has helped the state achieve its goal of reducing its greenhouse gas emissions to 3.5 percent below 1990 levels." See <http://www.state.nj.us/dep/dsr/bscit/CleanEnergyMain.htm> (site visited Mar. 23, 2005).

5. See Pamela Najor, *Climate Change: 12 States Seek Remand of EPA Decision on Controlling Carbon Dioxide from Vehicles*, BNA ENV'T RPT., 36 ER 741 (Apr. 15, 2005) (citing *Massachusetts v. EPA*, No. 03-1361 (D.C. Cir. oral arguments Apr. 8, 2005), a lawsuit by Massachusetts and other states against the EPA for failure to regulate greenhouse gas emissions from mobile sources). For an overview of state climate change initiatives, see generally BARRY G. RABE, STATEHOUSE AND GREENHOUSE: THE EMERGING POLITICS OF AMERICAN CLIMATE CHANGE POLICY (2004); John Dernbach, *Moving the Climate Change Debate from Models to Proposed Legislation: Lessons from State Experience*, 30 ENVTL. L. REP. 10933 (2000).

6. RABE, *supra* note 5, at 3-6. For example, in 2002, California adopted a law that will lead to the "maximum feasible" reductions of greenhouse gas emissions from motor vehicles. A.B. 1493 (Cal. 2002). Massachusetts and Oregon have enacted statutes requiring the reduction of carbon dioxide from in-state power plants. For further discussion of these and other state greenhouse gas emission measures, see Part III.

7. See Najor, *supra* note 5; Complaint, *Massachusetts v. Whitman* (Conn. 2003), *dismissed without prejudice* (Oct. 2003) (suit to compel EPA to list carbon dioxide as a "criteria pollutant" under Section 108 of the Clean Air Act), available at <http://www.ago.state.ma.us/sp.cfm?pageid=1613>; see also Bureau of National Affairs, *Climate Change: Three New England States Sue EPA over Regulation of Carbon Dioxide*, 34 E.R. 1262 (June 6, 2003). This lawsuit was dismissed by the state plaintiffs without prejudice in favor of the states' lawsuit against EPA for failure to regulate greenhouse gas emissions from mobile sources in *Massachusetts v. EPA*. See Press Release, Mass. Office of Atty. Gen., *Massachusetts, Connecticut and Maine to Challenge EPA's Refusal to Regulate Greenhouse Gas Emissions* (Sept. 3, 2003), available at <http://www.ago.state.ma.us/sp.cfm?pageid=986&id=1074>.

8. Initiated by Governor Pataki in New York, nine northeastern states (Connecticut, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont) have agreed to develop a cap and trade program to reduce carbon dioxide emissions from power plants. Joel Stashenko, *Ten States May Limit Greenhouse Gas Emissions*, PITTSBURGH POST-GAZETTE, July 25, 2003, at C7.

States to many other countries, where local governments, in addition to national governments, are active on climate change.<sup>9</sup>

In the United States, these efforts at the state and local level stand in stark contrast to the lack of regulatory action at the federal level; the federal government has eschewed substantive regulation in favor of voluntary reduction efforts and a continuation of scientific research on climate.<sup>10</sup> But even more interesting, state and local governments are taking action on climate change despite the United States' decision not to participate in an international climate change agreement establishing fixed emissions reduction targets. While Russia's recent ratification enabled the Kyoto Protocol<sup>11</sup> to come into force,<sup>12</sup> the Bush Administration has refused to reverse its 2001 decision not to participate, meaning that climate initiatives of state and local governments in the United States continue to occur in the absence of legally binding international standards.

This plethora of unilateral, subglobal-government actions to address the global commons problem of climate change, even in the absence of an unambiguous international regulatory framework with a global scope, poses a clear and pressing question that so far has not been addressed by the growing number of commentaries on the subject:<sup>13</sup> why are subglobal governments

9. Local action on climate change is now a global phenomenon of increasing significance. As part of the Cities for Climate Protection Campaign sponsored by the International Council for Local Environmental Initiatives, more than 500 cities worldwide, and more than 150 in the United States have adopted a greenhouse gas emissions reduction target similar to that contained within the Kyoto Protocol. See <http://www.iclei.org/us/ccp/> (last visited June 30, 2005). In the United Kingdom, under the Nottingham Declaration on Climate Change, seventy-five cities and counties have agreed to develop plans to address the causes and effects of climate change and to achieve significant reductions in emissions from their own authority's operations. See <http://www.warwickshire.gov.uk/Web/corporate/pages.nsf/Links/1A904765E5F352D780256F330043E694>.

10. Office of the White House Press Secretary, Fact Sheet: President Bush Announces Clear Skies & Global Climate Change Initiatives (Feb. 14, 2002), available at <http://www.whitehouse.gov/news/releases/2002/02/20020214.html>.

11. Kyoto Protocol to the United Nations Framework Convention on Climate Change, Dec. 10, 1997, 37 I.L.M. 22 (1998).

12. See Seth Mydans & Andrew C. Revkin, *With Russia's Nod, Treaty on Emissions Clears Last Hurdle*, N.Y. TIMES, Oct. 1, 2004. The Protocol entered into force on February 1, 2005.

13. For commentaries and studies of subglobal action on climate change, see, e.g., Laura Kosloff & Mark Trexler, *State Climate Change Initiatives: Think Locally, Act Globally*, 18 NAT. RES. & ENV'T 46 (2004); 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 (2004); David R. Hodas, *State Law Responses to Global Warming: Is it Constitutional to Think Globally and Act Locally?*, 21 PACE ENVTL. L. REV. 53 (2003); RABE, *supra* note 5; John Dernbach, *Moving the Climate Change Debate from Models to Proposed Legislation: Lessons from State Experience*, 30 ENVTL. L. REP. 10933 (2000). State and local climate change initiatives have also attracted a fair amount of attention in the popular press and in scientific journals. See, e.g., Jennifer Lee, *The Warming is Global but the Legislating, in the U.S., is All Local*, N.Y. TIMES, Oct. 29, 2003, at A21, col. 1; Margaret Kriz, *Warm-Up Drills*, NATIONAL J., 906 (Mar. 26, 2005). See also Letter to the Editor, *People Power Against Climate Change*, 430 NATURE 15 (2004); Sarah Ferriter, *While Administration and Congress Balk on Kyoto Many U.S. States Move Forward on Greenhouse Emission Efforts*, available at <http://www.climate.org/topics/localaction/grnhs.shtml>.

acting at all? Standard economic theory on commons problems—Garrett Hardin's 1968 "tragedy of the commons" parable is perhaps the most famous exposition<sup>14</sup>—suggests that individual exploiters of a commons have little individual incentive for commons preservation. Only an enforceable collective agreement, binding on all or most commons users, should be able to motivate members of the collective to take effective action to preserve the commons. Absent such an agreement, the theory suggests that unilateral action by individual users to restrain despoliation of the global commons is presumptively irrational.

This conclusion from the general theory of commons problems has often been cited in the context of climate change to suggest that individual nations and states should not be taking unilateral action.<sup>15</sup> This reasoning also forms the basis in the environmental-law literature for the so-called "matching principle," a rule suggesting that the level of jurisdictional authority (local, regional, national, global) that should properly take action to correct environmental externalities is the entity whose geographic scope most closely "matches" the geographic scope of the externalities of the environmental problem at hand.<sup>16</sup> With respect to global environmental problems such as global climate change or ozone depletion, the "matching principle" calls for an international framework of response, as opposed to unilateral subglobal action.

While we agree that an international framework is almost certainly necessary for achieving optimal solutions to a global commons problem such as climate change, in this Article we challenge the conventional wisdom that unilateral action by individual countries—at least those that are larger

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14. Garrett Hardin, *Tragedy of the Commons*, 162 SCIENCE 1243 (1968).

15. In the legal literature, see Robert Stavins, *Policy Instruments for Climate Change: How can National Governments Address a Global Problem?*, 1997 U. CHI. LEGAL F. 293

(On the domestic level, even the most cost-effective greenhouse policy instrument will be desirable only if the national target it seeks to achieve is part of an accepted set of international mandates.... Because unilateral action will invariably be highly inefficient, any domestic program requires an effective international agreement, if not a set of international greenhouse policy instruments.);

Daniel C. Esty, *Toward Optimal Environmental Governance*, 74 N.Y.U. L. REV. 1495, 1555 (1999) ("[f]alling back to national-scale intervention... invites free riding, holdouts, and inefficient spending of limited resources—and thus structural regulatory failure.... At least from a theoretical viewpoint, inherently global problems demand concerted worldwide action"); Sean T. Fox, *Responding to Climate Change: The Case for Unilateral Trade Measures to Protect the Global Atmosphere*, 84 GEO. L. J. 2499, 2503, 2507-08 (1996) (using the "tragedy of the commons" analogy to criticize unilateral country measures to reduce climate change, but suggesting the need for unilateral trade measures to facilitate the development of multilateral environmental agreements).

16. Henry N. Butler & Jonathan R. Macey, *Externalities and the Matching Principle: The Case for Reallocating Federal Authority*, 14 YALE J. ON REG. 25 (1996). See also William Buzzbee, *Recognizing the Regulatory Commons: A Theory of Regulatory Gaps*, 89 IOWA L. REV. 1, 13 (2003) ("Global warming also confronts no matching or commensurate political or legal regime that, due to the regime's geographical turf, subject responsibilities, or political constituency, is logically situated to take the lead and address global warming's causes and anticipated harms.").

contributors to the commons' degradation—to restrain despoliation of the global commons is always presumptively irrational.

Our argument proceeds in several parts. First, in Part I we argue that, in general, the intuitions derived from idealized economic models (including the "tragedy of the commons") are a poor guide to understanding how far theoretically presumed inefficiencies, e.g., free-riding, will extend in reality. To determine the extent of such inefficiencies for a particular problem, including subglobal action to address climate change, the relevant empirical evidence on the real-world workings of the commons must be brought to bear. Thus, also in Part I, we draw on empirically driven, non-cooperative, game-theoretic economic modeling studies to argue that the actual market imperfections that characterize some global commons problems—including that of global climate change—diverge from those underpinning the standard "tragedy of the commons" model. We argue that this divergence leaves room for significant, economically rational, unilateral action by individual actors towards commons preservation, at least in the case of global climate change. This conclusion has been underappreciated by many scholars who disparage unilateral action.

Thus, our conclusion from Part I is that, rather than the too-simple, yes-or-no question presumed by the pure tragedy of the commons model: "is unilateral regulation of a commons resource by a user of the commons efficient?", the proper question is: "can unilateral regulation of a commons resource bring some benefits relative to no regulation at all, even if those benefits are less than the optimum that could be achieved by a binding agreement among all commons users?" In other words, to paraphrase the old distinction between the pessimist, who only sees the glass as half empty, and the optimist, who sees the glass as half full, when we are presented with the glass of climate change, and find it—not filled to the brim by a concerted global response, but only partially filled by subglobal actions—we ask, along with the optimist, "is half a glass better than none?"

Then in Part II, we examine the level of emissions reductions being achieved through unilateral actions, and compare them to the levels that should be expected if subglobal governments acted to achieve the economically efficient, unilateral regulation predicted by the non-cooperative economic models. Our examination shows that some large countries that have committed to the Kyoto international framework, such as Great Britain and Germany,<sup>17</sup> appear to be acting, as expected, at levels beyond those predicted for unilateral action. But others that are not participating in Kyoto—the United States in particular, despite the climate change initiatives being pursued by state and local governments<sup>18</sup>—do not appear to be heading towards even those lower levels of reductions that non-cooperative, game-theoretic models suggest are in fact economically efficient for a unilateral actor. At the same time, the

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17. See *infra* text accompanying notes 79-80.

18. See *infra* text accompanying note 83.

phenomenon of regulatory action by very small subglobal units within the United States—states, and even municipalities—also appears inconsistent with model predictions that very small actors should do little or nothing. Thus, it appears that the question we started with: “why would subglobal governments act to address a global commons problem?”, should actually be split in two: (1) “why do (some) large-actor subglobal governments do too little?”, and (2) “are small-actor subglobal governments doing too much?”

In Part II we also suggest several possible answers to this question. One of the most important follows from public choice analysis, which holds that politicians pursue special interests to the detriment of the general interest. With respect to climate change, politicians can take advantage of a global phenomenon with uncertain impacts on an uncertain timeframe, factors that can be used to obscure the degree to which they are responding to special interests with vested stakes in the energy status quo. The search for political advantage may also explain many of the climate change initiatives of smaller entities, such as state and local governments in the United States.

Finally, Part III is devoted to exploring the means by which subglobal regulation can help trigger regulatory action by the federal government or greater participation in a multilateral agreement at the international level. We discuss mechanisms that have historically helped trigger regulation by larger jurisdictions upon the enactment or promulgation of regulation by smaller jurisdictions. We argue, analogously, that such mechanisms could allow subglobal climate regulation to induce a “domino effect,” triggering regulation at ever larger geographic levels. Thus, in addition to being economically rational in the real-world, subglobal, unilateral regulation is a good policy choice. By changing the local regulatory landscape, it has the potential to help bring about fully optimal, global regulation. Interestingly, the end-result of such local regulation could quite possibly satisfy the “matching principle,” thus suggesting that the road to optimality has many regulatory routes.

In our Conclusion, we discuss the implications of our analysis for real-world policy prescriptions. Our purpose in challenging the conventional wisdom is not to disparage international efforts to address climate change, but to prevent the current lack of a truly comprehensive international climate treaty from being used as a rationale for chilling the efforts of subglobal governments to fill the void. We agree that globally optimal solutions to global commons problems undoubtedly require concerted collective action. However, in place of the conventional wisdom holding that subglobal action on climate change is always irrational, we argue that short of the ideal “full glass” of global optimality, there is a “glass half full” in which subglobal governmental regulation can bring some benefits. Such rational, subglobal action is (a) better than no regulation—and hence no benefits—at all, and (b) can prepare individual governments for participation in a global framework, when and if it comes into being.

## I. THE TRAGEDY OF THE COMMONS AND GLOBAL CLIMATE CHANGE

A commons, that is, a “common pool” or “open access” resource, has been defined as a resource where the prevention of over-exploitation through physical or institutional means is particularly costly and one user’s exploitation of the resource limits the availability of the resource to others.<sup>19</sup> Most aspects of the environment—the air we breathe, oceans, rivers, and lakes—are commons, in that they are freely accessible to the public. The commons at issue in this examination, the atmosphere, is global, freely accessible to the entire world population. While not the first to expound the thesis, Garrett Hardin popularized the “tragic” explanation for why private markets will underprovide public goods such as common pool resources.<sup>20</sup> In his “tragedy of the commons,”<sup>21</sup> Hardin posits an open pasture as his hypothetical commons, and a cattle herder as the prototypical rational actor. Because each herder receives direct benefits from each head of cattle he raises but only a fraction of the costs attributable to overgrazing, his rational response is to add more and more animals. The resulting despoliation of the common pasture is the remorseless “tragedy” of each herder blindly following his self-interest.<sup>22</sup>

Most scholars agree that the problem of climate change is an excellent example of the commons problem illustrated by Hardin’s tragedy.<sup>23</sup> Climate change results in part from the build up of greenhouse gases in the atmosphere, a classic commons. Like the herders of Hardin’s pasture, the atmosphere is “used” by a great many nations, which each contribute some measure of greenhouse gases as a byproduct of natural and anthropocentric activities, such as the burning of fossil fuels and deforestation.<sup>24</sup> This use leads inexorably to the degradation of the atmospheric commons as the build up of greenhouse gases traps the earth’s outgoing infrared radiation, contributing to climatic changes around the globe, such as warmer temperatures, more frequent and more violent storms, drought, and disruption of ecosystems and habitats.<sup>25</sup> As with Hardin’s herders, no single nation has an incentive to reduce its emissions because such reductions will only decrease their own benefits from the

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19. Elinor Ostrom, Joanna Burger, Christopher B. Field, Richard B. Norgaard & David Policansky, *Revisiting the Commons: Local Lessons, Global Challenges*, 284 *SCIENCE* 278 (1999).

20. Hardin’s observation of the tragedy inherent in an open access commons was not original; similar observations were made previously by others, dating back to Aristotle. See ELINOR OSTRUM, *GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION* 2-3 (1990) (citing Aristotle, *POLITICS*, Book II, ch. 3); H. Scott Gordon, *The Economic Theory of a Common-Property Resource: The Fishery*, 62 *J. POL. ECON.* 124 (1954).

21. Hardin, *supra* note 14.

22. *Id.*

23. See, e.g., Barton H. Thompson, Jr., *Tragically Difficult: The Obstacles to Governing the Commons*, 30 *ENVTL. L.* 241, 253 (2000); Richard B. Stewart, *Environmental Regulation and International Competitiveness*, 102 *YALE L. J.* 2039, 2099 (1993).

24. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *CLIMATE CHANGE 2001: THE SCIENTIFIC BASIS*, at 4.1.

25. *Id.*

commons without successfully preventing the commons' degradation, at least to any appreciable extent.

The standard economic solution to the "tragedy of the commons" is to either privatize the commons<sup>26</sup> or to subject the use of the commons to a centralized governing authority.<sup>27</sup> Although not all scholars agree that this presents the full spectrum of solutions,<sup>28</sup> and there is considerable variation even within these strategies,<sup>29</sup> privatization and collective governance still dominate the debate. Policy proposals in the case of climate change have included both ends of this spectrum: privatizing the atmospheric disposal of carbon dioxide emissions via tradeable permits and globally allocated emission limits enforced by regulatory oversight. The actual Kyoto framework is a mixture of approaches, with binding limits on signatory countries<sup>30</sup> that can be met through trades of emission allowances with other signatory countries or through the financing of emissions reductions in signatory countries or nonsignatory developing countries.<sup>31</sup>

This same solution is reached by applying the "matching principle," an oft-cited jurisdictional rule in the legal literature that calls for the "matching" of the level of government responding to a given pollution problem with the geographic scope of the problem itself.<sup>32</sup> The matching principle is based upon

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26. Harold Demsetz, *Towards a Theory of Property Rights*, 57 AM. ECON. REV. 347 (1967); W.P. Welch, *The Political Feasibility of Full Ownership Property Rights: The Cases of Pollution and Fisheries*, 16 POLICY SCI. 165 (1983). See also Robert J. Smith, *Resolving the Tragedy of the Commons by Creating Private Property Rights in Wildlife*, 1 CATO INST. 467 (1981) ("the only way to avoid the tragedy of the commons in natural resources and wildlife is to end the common-property system by creating a system of private property rights"); see James Boyle, *The Second Enclosure Movement and the Construction of the Public Domain*, 66 LAW & CONTEMP. PROB. 33, 35-36 (2003) (discussing traditional view that the fifteenth-century enclosure movement in Great Britain, which privatized what had previously been village commons used by villagers to graze their livestock, prevented a "tragedy of the commons").

27. Hardin, *supra* note 14; OSTRUM, *supra* note 20, at 9 (1990). See DAVID EHRENFELD, *CONSERVING LIFE ON EARTH* 322 (1972) (if "private interests cannot be expected to protect the public domain, then external regulation by public agencies, governments, or international authorities is needed").

28. See, e.g., OSTRUM, *supra* note 20, at 13-28 (arguing that more solutions exist to commons degradation than privatization and government ownership based on empirical research showing local self-organization to protect common pool resources).

29. See Thompson, *supra* note 23, at 253 (suggesting a variety of obstacles and solutions to commons environmental problems, including climate change); Carol M. Rose, *Rethinking Environmental Controls: Management Strategies for Common Resources*, 1991 DUKE L.J. 1 (suggesting generic strategies for the management of commons resources).

30. See The Kyoto Protocol, *supra* note 11, at Art. 3(1); *id.* at Annex B (establishing target emissions reductions to be achieved by developed countries by the time period 2008-12).

31. *Id.* at Art. 17 (authorizing emissions trading between signatory countries to meet their emission reduction targets); Art 6 (authorizing joint implementation); Art. 12 (authorizing the Clean Development Mechanism). See David Driesen, *Free Lunch or Cheap Fix? The Emissions Trading Idea and the Climate Change Convention*, 26 B. C. ENVTL. AFF. L. REV. 1, 34 (1998) (discussing the textual basis for emissions trading proposals, including the Clean Development Mechanism, under the Kyoto Protocol).

32. Butler & Macey, *supra* note 16.

economic models designed to maximize interjurisdictional regulatory competition,<sup>33</sup> and is essentially the same as the assumption of standard economic theory that the jurisdiction of the regulating entity must be at least large enough to ensure that all of the costs of the activity are internalized within the jurisdiction so as to prevent the free-riding and hold-outs associated with externalities. Such regulatory internalization of cost is the underlying basis of cost-benefit analysis.

Legal scholars, applying the logic of the tragedy of the commons to global environmental problems such as climate change argue, consistent with the matching principle, that unilateral regulation by subglobal governments is irrational.<sup>34</sup> This application of the tragedy of the commons logic in an effort to discourage subglobal governments from regulating global environmental problems is not limited to the academic context. When California recently proposed to regulate greenhouse gas emissions from mobile sources, commenters questioned the State's rationale, arguing that because California cars constitute only a fraction of global emissions, regulatory "measures adopted in California will have no discernable effect on global climate change" and hence "California vehicle owners will bear the cost of the regulation but the benefits will accrue globally."<sup>35</sup>

Similarly, policymakers in the United States have used tragedy of the commons logic, at least implicitly, to justify the United States' failure to consider ratifying the Kyoto Protocol. The Administration of President George W. Bush has argued that the Protocol's strategy of delaying, until a later time, the requirement that developing countries adhere to emission reduction targets and timetables<sup>36</sup> renders the treaty ineffective in combating climate change.<sup>37</sup> Greenhouse gases from developing industrial countries with large populations, such as China and India, are increasing so rapidly, the United States argues,

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33. Butler and Macey attribute the Matching Principle to an early public choice analysis of the optimal size of government. See Butler & Macey, *supra* note 16, at 25 n. 4 (citing JAMES M. BUCHANAN & GORDON TULLOCH, *THE CALCULUS OF CONSENT: LOGICAL FOUNDATIONS OF CONSTITUTIONAL GOVERNMENT* 113-16 (1962)). The origin of the idea in models of fiscal federalism is unmistakable, however. See RICHARD A. MUSGRAVE, *THE THEORY OF PUBLIC FINANCE* (1959); WALLACE E. OATES, *FISCAL FEDERALISM* (1972).

34. See *supra* legal scholars cited in note 15.

35. CALIFORNIA AIR RESOURCES BOARD (CARB), INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING, PUBLIC HEARING TO CONSIDER ADOPTION OF REGULATIONS TO CONTROL GREENHOUSE GAS EMISSIONS FROM MOTOR VEHICLES 144-45 (Aug. 10, 2004), available at <http://www.arb.ca.gov/regact/grnhsgas/grnhsgas.htm> (hereafter CARB INITIAL STATEMENT).

36. The Protocol's GHG reduction targets and timetables currently apply only to the world's 38 developed nations. The United States, for instance, is obligated to reduce emissions of GHGs by 7 percent below 1990 levels averaged over the period 2008 to 2012, the equivalent of a 20 - 30 percent reduction below projected levels of GHG emissions during that same timeframe. See Kyoto Protocol, *supra* note 11, at Art. 3, para. 1 and Annex B.

37. Letter from President George W. Bush to Senators Hagel, Helms, Craig and Roberts (March 13, 2001) ("I oppose the Kyoto Protocol because it exempts 80 percent of the world, including major population centers such as China and India, from compliance, and would cause serious harm to the U.S. economy."), available at <http://www.whitehouse.gov/news/releases/2001/03/20010314.html>.

that they will soon outstrip the emissions of developed nations.<sup>38</sup> Hence, the United States is in essence asserting that the scope of the Protocol's emissions reduction targets and timetables must be sufficiently broad so as to encompass all future significant emitters of greenhouse gases; otherwise, the ensuing free-rider problems will undermine the basis of the agreement.<sup>39</sup>

The search for a "match" between the scope of those contributing to climate change and the physical boundaries of the climate problem accounts for much of the history of international diplomacy on climate change to date. Such diplomacy has yielded two international agreements: the 1992 United Nations Framework Convention for Climate Change, to which the United States and 188 other signatory countries<sup>40</sup> are subject, and the Kyoto Protocol to that Convention, which recently entered into force without U.S. participation.<sup>41</sup> While many see this as clear progress, others question the Protocol's effectiveness in the absence of the United States' involvement given that the United States is the biggest contributor of greenhouse gases.<sup>42</sup> Of course, because the Protocol does not include rapidly industrializing nations in its most important emission reduction targets, critiques of its effectiveness cannot be limited to the lack of the United States' participation alone. However, U.S. non-participation is a clearly dominant factor—it is as if the herders in Hardin's parable have agreed to abide by collectively established limits on herd size, but the biggest herder of all has refused to participate.

The nations of the world thus find themselves in something of a quandary with respect to what is considered perhaps the gravest environmental problem to threaten the planet. Having correctly analyzed climate change as a tragedy of the commons and having subsequently embarked upon the classic commons solution, building an international treaty, the nations of the world are now stalled. While we wait and hope for a solution to the international logjam, the question arises whether any other actions will contribute to reducing climate change? Reflecting the growing importance of the local aspects of global climate change, attention is shifting away from international diplomacy as the only means of attaining the mitigation goal.

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38. See SUSAN R. FLETCHER, CONGRESSIONAL RESEARCH SERVICE REPORT FOR CONGRESS 98-2: GLOBAL CLIMATE CHANGE TREATY: THE KYOTO PROTOCOL (updated Mar. 6, 2000), available at <http://www.ncseonline.org/NLE/CRSreports/Climate/clim-3.cfm> (reporting the Bush Administration's position in 2000 that, until developing countries also make commitments to participate in greenhouse gas limitations, the Administration would not submit the protocol to the Senate for advice and consent, thereby delaying indefinitely any possibility of ratification).

39. Kyoto Protocol, *supra* note 11, at Art. 25, para. 1.

40. According to the Conference of the Parties, this count is accurate as of May 24, 2004. See [http://unfccc.int/files/essential\\_background/convention/status\\_of\\_ratification/application/pdf/ratlist.pdf](http://unfccc.int/files/essential_background/convention/status_of_ratification/application/pdf/ratlist.pdf).

41. In 2001, President Bush announced that the United States would not seek ratification of the Protocol. March 13, 2001 letter, *supra* note 37.

42. See, e.g., Kosloff & Trexler, *supra* note 13, at 46; *Dismay as U.S. Drops Climate Pact*, CNN.COM, Mar. 29, 2001 (remarks of Yasuko Ishii of Japan's environment ministry), available at <http://edition.cnn.com/2001/world/Europe/italy/03/29/environment.kyoto>.

Within this context, the increasing number of examples of regulation of greenhouse gases by subglobal actors—nations, states and local governments—outside the framework of an international regime, is noteworthy, both because it runs counter to conventional assumptions with respect to rational commons behavior, and because it comes at a time when there is doubt about the efficacy of the standard global solution.

Indeed, this plethora of unilateral subglobal actions responding to global climate change in the absence of an international framework raises the following question: are such actions economically rational? Of course, we recognize that decisions by most subglobal actors are political and thus may develop for reasons that have little to do with national economic interests broadly defined, but much to do with serving the particular interests of influential constituencies. But by analyzing the rationality of subglobal action to protect the global commons, we are responding to critics who contend that unilateral action by a subglobal actor is presumptively irrational. In Part III of this Article, we bring the political perspective to bear on why subglobal actors are or are not responding to the global climate change threat.

*A. Non-cooperative Game Theory and the "Glass Half Full" Conceptual Model: Is Half a Glass Better Than None?*

Despite its prominence as a model for understanding commons problems, the pure, classic "tragedy of the commons" is not the only possible model for what can happen in the circumstances of a common pool resource being exploited by multiple users. To illustrate another conceptual possibility, consider the simple hypothetical case of a global polity consisting of only two identical subglobal actors, each emitting industrial byproducts into a single global atmospheric commons. Two nations emitting greenhouse gases would be an example of this situation. Left unchecked, suppose that the emissions will despoil the commons, ultimately reducing the welfare of both nations. Such is the case with respect to climate change, where the build up of greenhouse gases in the atmosphere is expected to cause serious, environmentally related economic and physical damage. For either nation, taking action to reduce emissions will result in costs and benefits. Thus, for example, reducing greenhouse gases will result in economic costs of reducing emissions, and economic and physical benefits in the form of avoided global warming. The economic problem facing both nations in our simplified model is to choose the globally optimal level of emissions reductions—i.e., that level which will maximize the global net social benefits, the benefits minus the costs, of regulation. The political problem facing each nation is how to coordinate its activities in such a way as to achieve that globally optimal emissions reduction standard.

We focus first on the economic problem, initially considering the case where the global polity can be treated as monolithic, with a unitary global

environmental regulator, and then considering the effect of dividing that global polity into two autonomous subglobal actors.

### 1. Unitary Global Regulation

For the global case, the net benefit from regulatory action is the direct benefit of regulation (in damages avoided) minus the costs of regulation:

**Net Benefit = benefit of regulation (avoided damages) – cost of regulation**

This can plausibly be expressed (using standard economic formulations of simple cost and benefit functions) in more precise form for the whole global polity as:

$$\text{Net Benefit} = \underbrace{s \cdot d \cdot E}_{\{\text{global benefit}\}} - \underbrace{c \cdot s^2}_{\{\text{global cost}\}} \quad (\text{Equation 1})$$

where  $E$  is uncontrolled emissions (in tons of  $\text{CO}_2$ );  $d$  is the amount of damage (in dollars/ton  $\text{CO}_2$  emitted) caused by the emissions-induced global warming;  $d \cdot E$  would then be the total damage from the uncontrolled emissions (in dollars);  $s$  is the environmental emissions standard, expressed as a fractional reduction in uncontrolled emissions, i.e.,  $s$  ranges from 0 (no reductions) to 1 (a complete elimination of all emissions);  $s \cdot d \cdot E$ , then, is the value (in dollars) of damage avoided because of the standard, i.e., the environmental benefit of the standard (note that as  $s$  approaches 1, emissions are eliminated and the environmental benefit approaches the whole value of all damages from global warming which will be entirely avoided);  $c \cdot s^2$  is the total cost of imposing the standard (expressed as a quadratic to allow marginal costs of compliance to increase as the standard becomes more stringent—so that, for example, the first 10 percent of emissions reductions will cost only 1 percent of  $c$ , but the last 10 percent will cost almost 20 times as much).<sup>43</sup>

Once Equation 1 is known, the solution for a global environmental regulator with global enforcement authority is straightforward: choose the globally optimal standard, i.e., that level of control,  $s$ , which maximizes the net benefit.<sup>44</sup>

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43. We make no strong assumptions here that the functional form of this simple conceptual model rigorously represents the real-world costs and benefits of global climate change, and indeed, expect that the reality will be somewhat different – e.g. it is likely that the marginal damage function will not be linear with the level of control but that the marginal damage will be higher at low levels of control and lower at high levels. Our purpose here is a conceptual exercise: to show how standard cost and damage functions typically employed in simple economic models can lead to outcomes other than a full-fledged tragedy of commons.

44. Mathematically, a global regulator chooses the value of  $s$  that makes the global marginal costs and benefits equal. From equation 1, this is: *marginal benefit* =  $d \cdot E$ ; and *marginal cost* =  $2 \cdot c \cdot s$ . Setting these equal gives  $s$  (*optimal*) =  $\frac{1}{2} d \cdot E / c$ .

## 2. *No Global Regulation*

Now consider the same hypothetical economic problem in the case of two different sovereign actors, but with no global environmental regulator. With two actors, each will have to choose its own best-possible solution without being able to compel the other actor to do likewise. If the economies and environments of two actors are situated identically, so that each actor contributes half the global emissions, and the damage and benefit functions are the same in each country, then the global benefits and costs are straightforward: when actors behave the same, each individual actor's costs and benefits are exactly half the global costs and benefits. For actor A, they may be written as:

$$\text{Cost to Actor A} = \frac{1}{2} c \cdot s_A^2 \quad (\text{Equation 2})$$

$$\text{Benefit to Actor A} = \frac{1}{2} s_{\text{mean}} \cdot d \cdot E = \frac{1}{2} (\frac{1}{2} s_A + \frac{1}{2} s_B) \cdot d \cdot E$$

where  $s_A$  and  $s_B$  are the individual control levels set by each actor. If the actors are identical, then the costs and benefits are the same for Actor B. The global costs and benefits are the simple sum of each actor's individual costs and benefits (note that if A and B set the same control level,  $s$ , then this sum gives costs and benefits identical to the global case described by Equation 1).

There is a key asymmetry between costs and benefits that arises in the case of individual actors (as seen in Equation 2): although each actor's cost depends only on the level of emissions reductions that actor itself chooses to undertake, i.e., costs to A depend only on  $s_A$ , the benefits to each actor in terms of avoided global warming will depend on total global emissions reductions, meaning that individual benefits will depend *jointly* on the emissions reductions of both of them (costs to A depend on *both*  $s_A$  and  $s_B$ ). Since in our simple model the actors are economically and environmentally identical, the benefits to each actor will be the same. This sets up a classic opportunity for "free-riding"—one actor takes steps to reduce emissions, but does not obtain all the resulting benefits since some (in this simple example exactly half) will go to the other actor, whether or not it reduces its emissions.

## 3. *Subglobal Strategic Behavior*

In the absence of unitary global regulation, the asymmetry between costs and benefits explained above makes the standard-setting problem for subglobal environmental regulators into a strategic interaction: each actor's welfare depends in part on what other actors do. This kind of problem is amenable to the analytic tools of "game theory,"<sup>45</sup> and the game-theoretic payoffs to each

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45. "Game theory" refers to the study of strategic interactions between individual actors, or "games." According to one contemporary game theorist, "[a] game is being played by a group of individuals whenever the fate of an individual in the group depends not only on his own actions but also on the actions of the rest of the individuals in the group." KEN BINMORE, *ESSAYS ON THE FOUNDATIONS*

actor generated by the simple model presented here (Equation 2) are shown in Table 1. The spectrum of choices facing each actor are listed along the top and left edges of Table 1, and can be summarized as follows: (1) engage in business as usual, i.e., set no emissions reduction standard; or, at the other extreme, (2) set the globally optimal standard; or (3) set the optimal, non-cooperative standard. The optimal non-cooperative standard is the best that an individual actor can do in the absence of a global enforcement agreement, and in the case of this simple model, is exactly one-half the globally optimal standard.<sup>46</sup>

**Table 1. Payoff matrix for “Glass Half Full” conceptual model**

		Choices for Subglobal Actor B		
		Globally optimal standard	Non-cooperative standard (half global optimum)	No standard: Business as usual
Choices for Subglobal Actor A	Globally Optimal standard	<b>Mutual Cooperation (full glass)</b> <i>A B</i> C: (-50, -50) <u>B: (100, 100)</u> <i>N: (50, 50)</i> <b>100%</b>	<i>A B</i> C: (-50, -12.5) <u>B: ( 75, 75)</u> <i>N: ( 25, 62.5)</i> <b>87.5%</b>	<i>A B</i> C: (-50, 0) <u>B: ( 50, 50)</u> <i>N: ( 0, 50)</i> <b>50%</b>
	Non-cooperative standard (half global optimum)	<i>A B</i> C: (-12.5, -50) <u>B: ( 75, 75)</u> <i>N: ( 62.5, 25)</i> <b>87.5%</b>	<b>Non-cooperative (Nash) Equilibrium (half-glass)</b> <i>A B</i> C: (-12.5, -12.5) <u>B: ( 50, 50)</u> <i>N: ( 37.5, 37.5)</i> <b>75%</b>	<i>A B</i> C: (-12.5, 0) <u>B: ( 25, 25)</u> <i>N: (12.5, 25)</i> <b>37.5%</b>
	No standard: Business as usual	<i>A B</i> C: ( 0, -50) <u>B: ( 50, 50)</u> <i>N: ( 50, 0)</i> <b>50%</b>	<i>A B</i> C: ( 0, -12.5) <u>B: ( 25, 25)</u> <i>N: ( 25, 12.5)</i> <b>37.5%</b>	<b>Tragedy of the Commons (empty glass)</b> <i>A B</i> C: ( 0, 0) <u>B: ( 0, 0)</u> <i>N: ( 0, 0)</i> <b>0%</b>

Note: Actor A’s action is chosen from the choices arrayed along the left edge, Actor B’s action is chosen from the choices arrayed along the top edge, and the resulting payoffs are listed in the cell where these actions intersect. Payoffs in each cell (generated by the model of equation 2) are quantified as the percent of the maximum possible global net social benefit obtainable (i.e., of the fully cooperative globally optimal standard), and are listed as C=costs, B=benefits, and N=Net (benefits less costs), with net benefits in *italics*. Each cost/benefit component is partitioned between actors as: (value to Actor A, value to Actor B). For the net social benefit, global benefits (the sum of the net benefit to A and B) are also listed in **bold** outside the parentheses.

OF GAME THEORY I (1990). The birth of modern game theory is traced to JOHN VON NEUMANN & OSKAR MORGENSTERN, THEORY OF GAMES AND ECONOMIC BEHAVIOR (2d ed. 1947).

46. Mathematically, a subglobal regulator chooses the standard which maximizes the difference between the costs and benefits to an individual actor (equation 2), e.g., for Actor A, the value of  $s_A$  that makes marginal costs and benefits equal: *Actor A marginal benefit* =  $\frac{1}{4} d \cdot E$ ; *Actor A marginal cost* =  $c \cdot s_A$ . Setting these equal gives  $s_A(\text{optimal}) = \frac{1}{4} d \cdot E / c$ , exactly one-half the global optimum derived in note 44.

This payoff matrix (Table 1) illustrates the outcomes in terms of global benefits and costs and how they are partitioned to each actor for all 9 permutations corresponding to the 3 choices facing each subglobal actor. The condition where both parties continue to engage in business as usual is represented by the lower right cell: zero percent of the possible benefits are realized—a lose-lose outcome reminiscent of the tragedy of the commons. The global optimum is represented in the upper left cell, where global benefit is maximized (reaching 100 percent) and the benefits are equally divided between the two subglobal actors. This matrix has several key features characteristic of the atmospheric commons problem:

- (1) the benefits of avoiding damage in a given cell (line B in each cell of Table 1) are always equally shared by the two actors, a consequence of the “public goods” nature of the commons;
- (2) any increase in regulation by either actor below the global optimum, i.e., any move in the matrix up or to the left, always results in a net increase in *global* welfare, but the net welfare to any *individual* diverges from this global trend;
- (3) the nature of this divergence is such that costs increase faster than benefits for any individual increase in regulation stringency above half of the globally optimal standard, and thus individual benefits are maximized at the half-global-optimum, and fall as the global optimum is approached; and finally
- (4) the rational choice for each actor is always to choose the half global-optimal standard no matter what the other actor does.

For example, if actor A chooses the globally optimal standard (thereby confining the outcomes to the top row of Table 1), actor B can gain more than an equal share of benefits by setting its standard to only half-optimum (the center cell in top row of Table 1) and free-riding. Such a move would increase Actor B's net benefits from 50 percent in the global optimum case (upper left cell) to 62.5 percent, at expense of Actor A, whose benefits would be only 25 percent. At this point Actor A would have an incentive to cut its standard in half (a move to the second row of Table 1), thereby recouping some benefits (increase from 25 percent to 37.5 percent) by moving to the center-cell payoff. Similar arguments apply for all other permutations. Thus, characteristic (4) meets the definition of a pure “Nash equilibrium”: the probability of playing a particular strategy is 1 for each player.<sup>47</sup> Thus, the only stable equilibrium in the non-cooperative case is to set a standard that is more stringent environmentally than “business as usual,” but only half that of the global optimum. We call this the “glass half full” equilibrium model.

The political problem associated with this game-theoretic model is how to overcome this situation in which the best outcome globally is also economically irrational for the individual actors acting individually. It is the

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47. HAL R. VARIAN, MICROECONOMIC ANALYSIS 266 (1992).

subject of voluminous literature generally, including the classic example of the "prisoner's dilemma," a subset of the game outlined here: the upper-left 2x2 choice matrix within the full 3x3 matrix of Table 1.<sup>48</sup> Indeed, it is this "prisoner's dilemma"-like aspect of the global commons problem that has been the focus of much of the debate about global climate change, and is the basis for the oft-heard assertion that individual action in the absence of a global cooperative framework is irrational. While we do not deny the character of this part of the problem, the purpose of this Article is to draw attention to the possibility a dynamic like that illustrated in the lower-right portion of Table 1. This is a dynamic in which some individual subglobal action is rational, because "half a glass" is better than none.

*B. Key Assumption Distinguishing the Tragedy of the Commons from the Glass Half Full Model*

Thus two different conceptual models that might be applied to the problem of global climate change stand in contrast to each other. According to the "tragedy of the commons" model, any attempt to regulate greenhouse gas emissions is doomed to failure, because no one actor is sufficiently large to have any significant effect on the global climate change problem. In contrast, under our "glass half full" model, individual actors can be rationally expected to take globally suboptimal steps to limit global warming, even in the absence of an international framework. The question naturally arises as to which of these two models is right. Or, rather, since all models are at best only approximations, it is better to ask: which comes closest to capturing the real-world economics of global climate change? But in order to answer this question, we first consider another, i.e., what accounts for the different outcomes predicted by these two models?

One key difference is the number and size of subglobal actors involved in the interaction. In the "glass half full" model presented here, it is two, while in the standard "tragedy of the commons," it is an unspecified number that is assumed to be large. The assumption of a large number of actors in the standard scenario means that (a) the weight of each actor's actions is small in comparison to the collective action of all the users of the commons, and (b) even what small benefit there is from any individual actor's good acts is itself diluted by division among the many.

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48. The prisoner's dilemma takes its name from a story in which Actor A and Actor B represent two prisoners who jointly participated in a crime before being picked up for separate questioning by the police. Each prisoner is confronted with the choice either to cooperate with the other (refusing to give evidence to the police), or to defect and give evidence in exchange for a lighter sentence (*see id.* at 261). The essential feature of the prisoner's dilemma payoff structure (the dilemma) is that each player has an incentive to defect (or set the half global optimal standard, in the case of the upper 2x2 of Table 1), regardless of what the other player does, even though their combined welfare would be better if they cooperated.

Additionally, it is worth taking a step back to review the basics of what kinds of private market failures cause what kinds of commons problems, and which of them can be corrected by governmental actions. In particular, we are interested in what level of public governmental authority—local, national or global—is needed to address a given private market failure. In the taxonomy of economic assumptions, the assumption of large number of actors (or, equivalently, negligibly small influence on the market) is one of four key conditions generally recognized as necessary for markets to generate efficient outcomes.<sup>49</sup> It is generally referred to as the “competitiveness condition,” i.e., no single market participant can have enough market power to affect the price of a good.<sup>50</sup> The other three conditions for efficient markets are: (1) the goods or services traded must be private goods, the most important requirement of which is that non-buyers must be excluded from enjoying the good; (2) consumers must have accurate and complete information about the market prices and product quality; and (3) there are no externalities—all of the value of the good to potential consumers must be contained within the good’s demand curve, and, similarly, all of the costs of producing the good must be reflected in the supply curve.<sup>51</sup>

Importantly, a classic “tragedy of the commons” is generated, not by a failure of the competitiveness condition, but by the failures to meet conditions one and three: the commons is a public, not private, good (a violation of one), which prevents all the value of a good—commons preservation—from being reflected in the good’s demand curve (a violation of condition three), even if the full costs of producing the good may be reflected in the supply curve. A “tragedy of the commons” does not require the violation of the competitiveness condition; indeed, it is the existence of the competitiveness condition, which effectively dilutes the value of the good for any individual actor, that drives the violation of condition three. The more competitive the market, the more negligible the value of the good of commons preservation becomes, and the more tragic the resultant tragedy of the commons.

As discussed above, a standard solution to a pure “tragedy of the commons” is to seek governmental regulation in order to address the problem.<sup>52</sup> But not all commons tragedies will necessarily require concerted action by a *global* authority. In cases where the global commons can be thought of as the sum of a patchwork of local commons—that is, where there is no spillover externality in which commons degradation in one area also causes degradation in another<sup>53</sup>—it may be the case that the sum of local actions,

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49. VARIAN, *supra* note 47, at 219.

50. *Id.* at 219, 224.

51. JOE STEVENS, *ECONOMICS OF COLLECTIVE CHOICE* 57-59 (1993).

52. *See supra* text accompanying notes 26-28.

53. Some of the largest environmental/public health problems faced today may be classified this way: the problems of lack of clean drinking water and of indoor air pollution are without question top-

taken by *local* jurisdictions, each deciding individually to set economically rational standards in the face of competing jurisdictions around them, can provide a sufficient solution. The possibility of such an outcome is the basis of the previously discussed "matching principle," and has been previously explored in the legal literature by Richard Revesz,<sup>54</sup> drawing on a conceptual economic model formulated by Wallace Oates and Robert Schwab, who described conditions under which competition in the public sphere between governmental jurisdictions could lead to efficiency-enhancing regulatory outcomes for addressing commons-type market failures.<sup>55</sup> Under the conditions of the Oates and Schwab model, which includes the competitiveness condition and the absence of any inter-jurisdictional spillovers, interstate competition among environmental regulators does not lead to a race-to-the-bottom. A tragedy of the commons can be averted by the resort to government regulatory action at the local level only, with no need to appeal to regulatory authority at a higher level.

In the case of greenhouse gases causing global warming, however, the commons is truly global, i.e., there is no barrier to inter-jurisdictional spillovers. Instead of predicting an efficient control of pollution, the Oates and Schwab model—with global inter-jurisdictional spillovers included—predicts the expected, full-fledged global tragedy of the commons. Moreover, consistent with contemporary commons arguments, it predicts that no individual subglobal jurisdiction will have any incentive to expend any regulatory effort for remediation.<sup>56</sup>

A summary taxonomy of interactions between pollutant types and market character is presented in Table 2. Column 1 suggests that the competitiveness condition can be conducive to efficient environmental regulation in some cases, but to a "tragedy of the commons" in others, depending on the character of the commons being considered. The more difficult question, and the subject of our inquiry, is: what happens as we move in Table 2, from column 1 to column 2, and the "competitiveness condition" is relaxed? Under these circumstances, we move closer to real-world interactions that may not be well represented by the simplistic idealizations in standard, economic textbook models. We have previously explored the implication of relaxing the competitiveness condition when the problem at hand was protecting a patchwork of local commons, and in particular whether individual states of the United States may engage in a

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ranking environmental problems at the global scale (in terms of total human morbidity and mortality), even though they are manifested everywhere locally.

54. Richard L. Revesz, *Rehabilitating Interstate Competition: Rethinking the "Race-to-the-Bottom" Rationale for Federal Environmental Regulation*, 67 N.Y.U. L. REV. 1210 (1992).

55. Wallace E. Oates & Robert M. Schwab, *Economic Competition Among Jurisdictions: Efficiency Enhancing or Distortion Inducing?*, 35 J. PUB. ECON. 333 (1988).

56. With the introduction of global inter-jurisdictional spillovers, but with the competitiveness condition retained, the Oates and Schwab model predicts that any imposition by any jurisdiction of a local emissions limit will chase away capital from that jurisdiction (lowering benefits from wages) without any compensating improvement in environmental quality. *See id.*

welfare-reducing “race to the bottom” when they seek to protect their local environments from local pollution.<sup>57</sup> Here, though, we consider the implications of relaxing the competitiveness condition when the problem is one of protecting a global commons in the case of greenhouse-gas induced global climate change. We now ask: how full is the partially empty glass in the context of real-world climate change? In our simple, game-theoretic conceptual model of climate change with two equal participants (*see* Table 1), the glass was exactly half full, i.e., the individually rational standard was half that of the global optimal standard. But what standard can we rationally expect in the more complex case of a world with approximately 200 countries with many disparities in country size and economic influence?

**Table 2. Outcomes of subglobal regulation of commons problems as a consequence of pollutant types (rows) and market character (columns)**

	Market Character	
	Ideally Competitive	Strategic interaction
Local Pollutant (no inter-jurisdictional spillovers)	<p>A. <u>“Competitive efficiency”</u></p> <p>Competition among jurisdictions leads to optimal regulation of within-jurisdiction pollution, even in absence of cooperative enforcement.<sup>58</sup></p>	<p>B. <u>“Race-to-the-bottom.”</u> <u>among other possibilities.</u> (No general prediction, game theoretic analysis required.)</p> <p>“Race-to-the-bottom” among jurisdictions leads to sub-optimal regulation in absence of cooperative enforcement.<sup>59</sup></p>
Global Pollutant	<p>C. <u>“Tragedy of the Commons”</u></p> <p>Free-riding and leakage prevents individual jurisdictions from capturing any benefit of pollution cutbacks: no regulation in absence of cooperative enforcement.<sup>60</sup></p>	<p>D. <u>“Glass half full” model (Table 1),</u> <u>among other possibilities.</u> (No general prediction, game theoretic analysis required.)</p> <p>“Glass half full” means suboptimal regulation in the absence of cooperative enforcement, but greater payoffs than in the complete absence of regulation under ideal competition (square C).</p>

57. See Kirsten H. Engel, *State Environmental Standard-Setting: Is There a “Race” and is it “to the Bottom”?*, 48 HASTINGS L. J. 271 (1997); Daniel C. Esty, *Revitalizing Environmental Federalism*, 95 MICH. L. REV. 570, 603 (1996); Scott R. Saleska & Kirsten H. Engel, *“Facts are Stubborn Things”*: *An Empirical Reality Check in the Theoretical Debate over the Race-to-the-Bottom in State Environmental Standard-Setting*, 8 CORNELL J. L. & PUB. POL’Y 55 (1998).

58. See Revesz, *supra* note 54; Oates & Schwab, *supra* note 55.

59. See Engel, *supra* note 57; Saleska & Engel, *supra* note 57.

60. The Oates and Schwab model, *supra* note 55, predicts a full-fledged “Tragedy of the Commons” (with zero regulatory effort expended by any jurisdiction) when the “local pollutant” condition is relaxed and the pollutant is assumed to be truly global (as in the case of greenhouse gases driving global warming).

C. *Noncooperative Equilibria in Complex Models of Real-World Climate Change*

In order to determine which of the two conceptual models ("tragedy of the commons" or the "glass half full") best captures the dynamics of how actual national economies are likely to operate under the predicted environmental threat presented by global warming, we turn to recent economic literature.

Only in the last decade or so, with the development of integrated-assessment models, have economists begun to seriously analyze the dynamic economics of global warming.<sup>61</sup> The development of computers and sophisticated analytical techniques has allowed modelers to tackle the complex problem presented by computing the individually pareto-optimal strategies of many different nations, interacting strategically in a complex global economy, in the face of a highly complex, long-term environmental externality like global climate change. With these more complex models, the competitiveness condition is not assumed to hold; rather, the degree of "competitiveness," and its influence on the outcome, emerges as a consequence of the empirical economic conditions that are used as inputs to the model.

The first comprehensive example of a model that both considers multi-country, game-theoretic interactions, and purports to realistically address real-world climate change, is the Regional Integrated mode of Climate and the Economy (RICE) model, developed by Nordhaus and Yang.<sup>62</sup> In RICE, the world is divided into 10 regions: (1) the United States, (2) Japan, (3) China, (4) the European Union, (5) the former Soviet Union, (6) India, (7) Brazil and Indonesia, (8) 11 large countries, (9) 38 medium sized countries, and (10) 137 small countries. These ten regions were chosen so that the model would be numerically tractable but also nearly equivalent to the full, real-world game with all 200-plus countries included separately. To this end, the country groupings were selected to ensure that, for countries within each group, the national benefits and costs from slowing climate change are roughly equal. Each country or country group is initially endowed with an empirically determined initial stock of capital, initial population size, and technological base. Population grows and technology improves exogenously according to simple extrapolations from empirically observed historical trends, while capital accumulation is predicted in the model by optimizing the sum of discounted utility from per-capita consumption over time, where utility consumption is logarithmic in per capita consumption so that marginal utility of consumption

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61. For a survey of recent developments in Integrated Assessment models, see INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *CLIMATE CHANGE 1995: ECONOMIC AND CROSS-CUTTING ISSUES*, Ch. 10 (1995).

62. William D. Nordhaus & Zili Yang, *A Regional Dynamic General-Equilibrium Model of Alternative Climate-Change Strategies*, 86 *AMER. ECON. REV.* 741 (1996).

declines as the amount of consumption increases. The RICE-modeled business-as-usual global economy includes substantial growth in economic output (and hence CO<sub>2</sub> emissions) from China, India, and the third world generally – somewhat larger than conventional models of economic development, due to an assumption of partial convergence of per capita incomes between rich and less rich countries.

In order to link economic activity with climate change, the RICE model includes carbon cycle and climate components – parameterized to reproduce median estimates of warming consistent with the IPCC reports – explicitly linking energy sector economic activity to greenhouse gas emissions to atmospheric stocks of these gases over time, and thence to the degree of global warming caused. Thus, policies that cause changes in global emissions also cause changes over time in the amount of global warming.

Within the model, the major economic choices faced by each nation or nation-group are: (1) the level of consumption of goods and services versus investment in productive capital, and (2) the rate at which to slow climate change via reductions in CO<sub>2</sub> emissions. The trade-off of consumption versus investment is the trade-off between a larger fraction of present-day economic output consumed now (if investments are foregone) versus the potential of more consumption later (if more current output is instead invested in productive capital, thereby expanding future output so that more consumption is possible in the future).<sup>63</sup> Slowing climate change, in this context, is best thought of as a particular kind of public investment—in greenhouse gas emissions abatement—that prevents future climate change that would otherwise reduce future economic output, and would, hence, otherwise reduce future consumption. Thus, the choice about the rate of slowing climate change is, in essence, also a tradeoff choice between present and future levels of utility-generating consumption.

Based on these choices, the RICE model generates trajectories of economic output and greenhouse gas emissions for each nation or group, the amount of global climate change that results, and damages from climate change within each nation. Nordhaus and Yang used the RICE model to compute three different policies and their consequences which correspond to the diagonal of our much simpler conceptual model of Table 1: (1) “business as usual,” in which there are no controls of greenhouse gases implemented (corresponding to lower right cell of our Table 1); (2) globally optimal policies, in which countries and regions cooperate to achieve the collectively efficient outcome for all (corresponding to upper left cell of Table 1); and (3) non-cooperative policies, in which nations undertake policies that are defined only in terms of

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63. This trade-off between present-day consumption on the one hand, and investment which can allow for increased future consumption, on the other, is at the heart of macroeconomic models of how economies grow. A classic review of economic growth theory can be found in ROBERT M. SOLOW, *GROWTH THEORY: AN EXPOSITION* (1970).

maximizing their national net benefit, and which ignore any spillovers of their actions on other nations (corresponding to the middle cell of Table 1). The results of these three policy model runs allow determination of what level of climate policy nations will adopt if truly acting in their own best interest in a non-cooperative framework (i.e. in the absence of an international treaty), and how close this will be to a globally optimal climate policy.

The results of these RICE model runs (Table 3, scenario I) show that the consequences of non-cooperative policies, relative to globally optimal ones are as follows:

- (a) present-day emissions reductions for the whole world (in percent reduction of annual CO<sub>2</sub> emissions relative to business-as-usual growth trajectories) in the non-cooperative run are 24 percent of the reductions in the globally optimal run,<sup>64</sup> and
- (b) these reductions lead to a global warming abatement (measured in terms of how much the global mean temperature rise between 2000 and 2100 is reduced) in the non-cooperative run that is 40 percent of that achieved in the globally optimal run.<sup>65</sup>

We note that emissions reductions are relative to growing business-as-usual baselines, and in no country do modeled emissions reductions in response to global warming result in an absolute decline in the amount of greenhouse gas emitted, only in a slowing of the growth rate. Thus even the most aggressive globally optimal policies do not, in the standard RICE model, result in significant global warming abatement.<sup>66</sup>

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64. The aggregate global emissions control rate in 2000 under the noncooperative model is 2.3 percent, as compared to average 9.7 control rate in the cooperative model (Table 3, bottom row for scenario I). Nordhaus & Yang, *supra* note 62, at 752.

65. *Id.* at 752-53. Global mean temperature is predicted to increase by 3.06°C over pre-industrial levels by the year 2100 in the business-as-usual case. Global optimum emissions reductions decrease this warming by 0.22°C, and noncooperative emissions reductions decrease it by 0.086°C (40 percent of 0.22°C). It is worth noting (although it is not our primary focus here) that even global optimum emissions reductions are extremely small relative to the total global warming under business as usual – much less than called for by environmentally oriented policy makers around the world, and much less than foreseen by the Kyoto treaty. The discrepancy between mainstream economic studies (which tend to call for at best extremely modest emissions reductions that reduce warming by an amount far smaller than the uncertainty of the climate model predictions) and the level of control called for by many policy analysts and climate scientists is the focus of an extended debate. The outcome of this debate, though very important for determining the amount of climate change experienced, is of second order for the problem we consider here, which is not what the level of emissions control should be in an optimal climate policy, but what fraction of the optimal policy (whatever that level may be) that can be achieved in the non-cooperative case.

66. Indeed, putting aside the results about inter-country dynamics, one might justifiably conclude that the main policy prescription of the RICE model is that global warming should, in effect, not be abated, except trivially. Given the concerns that the climate science suggests are possible, one may criticize economic modeling exercises like RICE (or its predecessor model, DICE, which analyzes unitary global policies for climate change abatement, *see* WILLIAM D. NORDHAUS, *MANAGING THE GLOBAL COMMONS: THE ECONOMICS OF THE GREENHOUSE EFFECT* (1994)) for not taking the threat of global warming sufficiently seriously – e.g., by systematically underestimating the possible damage from climate change, or by applying standard market discount rates which should not be applied to

When the assumptions about how benefits and costs are valued across time are modified in the RICE model so that more global warming abatement—compared to the abatement called for by the original RICE model—is efficient, the non-cooperative control rates are still a significant – indeed, even larger – fraction of the cooperative control rate (Table 3, scenario II).

More recently, economists Franz Hackl and Gerald Pruckner<sup>67</sup> developed a simpler framework, a static model, to analyze the same policy questions for 135 countries. According to their analysis, a 27.8 percent reduction is required to achieve globally optimal levels<sup>68</sup> while a 21.4 percent reduction is needed to achieve the non-cooperative, Nash equilibrium.<sup>69</sup> Thus, fully 77 percent of globally optimal emissions reductions are achieved in the non-cooperative equilibrium (Table 3, Scenario III).

In sum, according to these models, somewhere between one-quarter (Nordhaus and Yang) and three-quarters (Hackl and Pruckner) of the optimally desired emissions reductions can *rationally* be achieved even in the absence of an international framework. The breakdown of how this is distributed across nations is shown in Table 3.

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environmental goods. Our purpose in this Article was not to enter into the debate about what the optimal level of climate change mitigation should be, but to focus on the fraction of that optimum (whatever it might be) that would be addressed in non-cooperative solutions.

67. Franz Hackl & Gerald Pruckner, *How Global is the Solution to Global Warming?*, 20 ECON. MODELLING 93 (2002).

68. *Id.* at 101.

69. *Id.* at 107.

**Table 3. Efficient greenhouse gas emission reductions (relative to business as usual baseline, in percent) in different multi-country global modeling studies, under conditions of (a) global cooperation and (b) no-cooperation (the non-cooperative control rate, as a percent of the cooperative control rate, is shown in parentheses)**

Country/ Region	I. RICE model <sup>70</sup>		II. RICE model, with low time-discounting for environmental goods <sup>71</sup>		III. Hackl & Pruckner model <sup>72</sup>	
	(A) Cooperative	(B) Non- cooperative	(A) Cooperative	(B) Non- cooperative	(A) Cooperative	(B) Non- cooperative
U.S.	8.9	2.7 (30%)	10.3	3.4 (36%)	20.5	20.3 (99%)
E.U.	7.5	2.7 (35%)	8.7	3.3 (42%)	8.8	7.2 (82%)
Japan	6.6	1.5 (23%)	7.5	1.8 (26%)	14.2	14.1 (99%)
China	16.5	2.0 (12%)	19.2	2.1 (12%)	68.8	63.6 (92%)
World	9.7	2.3 (24%)	12.1	3.0 (25%)	27.8	21.4 (77%)

It is no surprise in these studies that nations will reduce their emissions more under the cooperative scenario. As Nordhaus and Yang explain, “[t]he reason is straightforward: when countries free-ride on the climate change policies of other countries, then they cut back on their own efforts substantially.”<sup>73</sup> What is a surprise—at least in the context of the prevailing consensus scholarship to the contrary—is that non-cooperative emissions reductions are as large a fraction of the global optimal reductions as they turn out to be.

By focusing on the first part of this finding, that cooperation produces greater reductions than non-cooperation, economists and other scholars have

70. Nordhaus & Yang, *supra* note 62 (efficient control rates in the year 2000).

71. Zili Yang, *Dual-Rate Discounting in Dynamic Economic-Environmental Modeling*, 20 *ECON. MODELLING* 941 (2003). Yang here re-parameterizes the RICE model using two separate discount rates for pure time preference, one for standard investments in capital markets, and a separate (lower) pure rate of time preference for environmental public goods. This allows Yang to investigate the consequences if people generally are willing to accept a lower rate of long-term return on investments in environmental preservation, and quantify the environmental discount rates implied by taking seriously the often-expressed preferences for substantial global warming abatement. In general, under this dual-rate discounting approach, non-cooperative emissions reductions are a higher fraction of the cooperative reduction than with the unitary discount rate used in of the original RICE model. Table 3 shows efficient control rates in 2000 for a 3 percent conventional discount rate combined with a 1 percent discount rate for environmental goods.

72. Hackl & Pruckner, *supra* note 67.

73. Nordhaus & Yang, *supra* note 62, at 752.

ignored the flip-side.<sup>74</sup> The implication of these economic studies is that countries acting on their own, in the absence of an international agreement have an economic incentive to reduce a sizable fraction of the world's total greenhouse gas emissions. In contrast to the focus in the mainstream literature on the need for an international agreement to overcome the problem of free-riding and leakage, these studies indicate that a significant fraction of the emissions reductions that are needed to achieve efficient levels should be made unilaterally by countries acting in their own, rational self-interest. Seen with this perspective, current research suggests that the lack of an international agreement is not an economic barrier for many countries, including the United States, to implementing a significant fraction of the globally optimal emissions reductions.<sup>75</sup>

What accounts, then, for the differences between the conclusions reached in the above studies by Nordhaus and Yang, and Hackl and Pruckner, and those that would predict that regulation of global environmental problems by subglobal governments would be crippled by free-riding and leakage? Quite simply, the choice of entering assumptions discussed in the previous section—the choice of non-cooperative, game-theoretic assumptions of the most recent

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74. Indeed, we should point out that Nordhaus and Yang interpret such findings very differently from the way Hackl and Prucker do. Hackl and Pruckner emphasize, as we do here, that a substantial fraction of climate change abatement can rationally be accomplished without a global framework. Hackl & Pruckner, *supra* note 67, at 94-95. Nordhaus and Yang, on the other hand, characterize their conclusions from the RICE model as follows: "[t]he central finding of this study is that the noncooperative policies produce significantly lower control rates and carbon taxes than does global cooperation." Nordhaus and Yang, *supra* note 62, at 751. One source of this difference in interpretation is that Nordhaus and Yang focus mostly on carbon taxes as the metric of control, whereas Hackl and Pruckner focus on degree of emissions reductions. The difference between non-cooperative and globally optimal carbon taxes is much larger (\$0.24 per ton carbon versus \$6.19 per ton carbon, a factor of 25 difference) than the difference between non-cooperative and globally optimal emissions reductions. This is due to the high marginal cost (= carbon tax) of emissions reductions for the last unit of reduction; thus the marginal cost, or equivalently, the carbon tax, increases dramatically between the non-cooperative and globally optimal cases, but the corresponding change in emissions reductions is much less. Because the emissions reductions (or degree of climate change experienced) is a variable more directly related to the outcome of concern (global warming), we adopt Hackl and Pruckner's approach, and focus on these.

75. One significant question is whether the authors' results hold true where the approximations of the reductions needed to achieve Pareto optimal levels is changed. For instance, many climate scientists and policy researchers have suggested that we may need to stabilize atmospheric carbon dioxide concentrations at some level in the range of a doubling to tripling relative to pre-industrial levels. If this is indeed the case, emissions will have to be reduced in an absolute sense, i.e. they will have to undergo zero or negative growth, whereas the main scenarios addressed in the Hackl and Pruckner and Nordhaus and Yang studies are those in which emissions growth rates are reduced to less positive values. Thus one question is, whether, if climate damages were such that the globally optimal path were to freeze or eventually lower absolute emissions rates, what fraction of this (much more drastic) optimal path might be achieved by nations acting in their rational self-interest and in the absence of an international framework? A partial answer to this question is provided by the subsequent study of Yang. Yang, *supra* note 71. Yang re-parameterizes the RICE model using a separate (lower) pure rate of time preference for environmental public (as opposed to private market) goods to examine conditions that would make substantial global warming abatement optimal. Under this parameterization, non-cooperative emissions reductions are a higher fraction (25 percent) of the global optimum than in the original RICE model (24 percent).

economic models, as opposed to the classic, ideally competitive assumptions that underlie the “tragedy of the commons,” the “matching principle,” and indeed, the whole suite of basic economic “toy models” which form the intuitive framework for many economically oriented policymakers and legal scholars. A key assumption of this latter neoclassical framework is that individual market participants have no market power; they are merely “price-takers.” The users of the natural resource commons have no incentive to limit their use since free-riding and leakage immediately wipe out any benefits that would accrue to an individual user. In contrast, the more realistic, game-theoretical models reviewed here presume that the market for emissions reductions by subglobal governments is not perfectly competitive, but rather is imperfect due to the excessive market power of some subglobal actors. Some countries that are large emitters, e.g., the United States, European Union, Japan, and China, are sufficiently large that they can actually affect the degree of climate change that occurs worldwide. Hence, under these models, emissions cutbacks by any large greenhouse gas emitter will have a measurable impact upon the degree of global warming that occurs. Hence, big emitters like the United States and China—contrary to the conclusions of the simple, classic model—have an incentive to reduce emissions even in the absence of an international agreement.

#### *D. Conclusions*

Because these non-cooperative reductions get us a significant part of the way toward the goal of optimal reductions, we argue that these results support the “glass half full” conceptualization of the global warming problem. As a consequence, individual state actions to reduce greenhouse gas emissions for global warming abatement cannot be presumptively labeled as irrational, or contrary to either local or global interests. Instead, the presumption, at least for large states, should be that some level of unilateral global warming abatement is economically desirable even in the absence of a global framework for greenhouse gas mitigation like the Kyoto treaty.

### II. REAL-WORLD BEHAVIOR OF GOVERNMENTS VERSUS THE PRESCRIPTIONS OF ECONOMIC THEORY

#### *A. Subglobal Government Initiatives Do Not Match Economic Model Prescriptions*

According to the results of the theory in Part I, the more greenhouse gases a country emits, the greater incentive it has to reduce the size of its emissions, a result that holds even in the absence of any international framework for cooperative emissions reductions. This result follows from the game-theoretic (non ideally competitive) nature of country-country interactions, in which at least some countries (like the United States, China, and country-blocks like the

E.U.) are sufficiently large that their policies will have an effect on the degree of climate change that occurs worldwide, regardless of what other countries do. In other words, to have a sufficient incentive to take action, the government must be able to reap at least some of the benefits of its emissions reductions in the local impact of global warming.<sup>76</sup> Thus, according to the model studies reviewed above, the world's largest emitters, the United States, China, and the European Union should be engaging in the largest unilateral greenhouse-gas reduction efforts.<sup>77</sup> On the other hand, the models confirm that it still would not be rational for a small developing country, such as Chad, which makes a minimal contribution to climate change, to unilaterally reduce its emissions by large amounts.<sup>78</sup>

However, data suggests that among the large countries that should have a significant, economic incentive to reduce greenhouse gas emissions—even in the absence of an international framework—only those countries that have already committed themselves to participate in the Kyoto treaty are doing so. Great Britain<sup>79</sup> and Germany,<sup>80</sup> in particular, have pledged to follow emissions

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76. Nordhaus & Yang, *supra* note 62, at 754 (“there are a few countries or regions (notably the United States, China, Japan and Europe) which are large enough so that it is in their own self interest to reduce CO<sub>2</sub> emissions even ignoring the benefits to other countries”).

77. *Id.* at 752.

78. *Id.* at 754 (“Were China to break up, were Europe to make decisions on a national level, or were the Republican Revolution in the United States to devolve environmental decision to the states, the predicted degree of cooperation would be even lower.”).

79. Overall EU trends are dominated by the two largest emitters, Germany and Great Britain, which together account for 40 percent of total EU emissions. EUROPEAN ENVIRONMENTAL AGENCY, ENVIRONMENTAL ISSUE REPORT NO. 36, GREENHOUSE GAS EMISSION TRENDS AND PROJECTIONS IN EUROPE 2003, 28-29. Within the European Union “bubble” agreement under the Kyoto Protocol, Great Britain is subject to a target of reducing the emissions of six greenhouse gases 12.5 percent below 1990 levels during the first commitment period of 2008-2012. See Climate Action Network (CAN), <http://www.climnet.org/aboutcne.htm> (compiling data from UNFCCC document FCCC/SBI/2001/13 (pages 58,59 - table B.5) and IEA ‘Key World Energy Statistics 2001 and 2002). In November 2000, Great Britain introduced a package of greenhouse gas emission reduction policies and measures in all sectors of the economy, from transport to agriculture. UNITED KINGDOM, SECRETARY OF STATE FOR TRADE AND INDUSTRY, ENERGY WHITE PAPER, OUR ENERGY FUTURE – CREATING A LOW CARBON ECONOMY (2003), available at <http://www.dti.gov.uk/energy/whitepaper/ourenergyfuture.pdf>. Based upon estimates that these measures could reduce greenhouse gas emissions by 23 percent below 1990 levels by 2010, a special commission to the British government advocates a domestic goal of reducing carbon dioxide emissions by 20 percent below 1990 levels by 2010 and 60 percent below current levels by 2050. *Id.* In its formal response to the commission, the British government agreed with both of the Commission’s goals. THE U.K. GOVERNMENT RESPONSE TO THE ROYAL COMMISSION ON ENVIRONMENTAL POLLUTION’S TWENTY-SECOND REPORT, ENERGY, THE CHANGING CLIMATE (Feb. 2003). To its credit, Britain’s policies are producing results: an in-depth review by an independent group of United Nation’s inspectors found in 2003 that the United Kingdom had succeeded in reducing greenhouse gas emissions by 12.8 percent below 1990 levels by the year 2000. UNITED NATIONS, UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND, REPORT: FCCC/IDR.3/GBR (May 8, 2003). This result may be less impressive than first appears. According to some commentators, Great Britain has succeeded in making these reductions relatively cheaply as a result of the country’s switch from coal to cleaner-burning natural gas for most of its energy needs. This, in turn, was made more easily by the former Prime Minister, Margaret Thatcher’s, success in breaking the country’s coal miner’s unions. See, e.g., Michael D. Lemonick, *Hot Air in Kyoto*, CNN.COM (Dec. 8, 1997). Similarly,

reductions policies that, if realized, will meet or, in the case of Great Britain, exceed Kyoto targets. But, just as the models predict, we should expect that countries that are making policies in the context of planned participation in a global treaty should take more action than those that are not planning to participate—like the United States—or not subject to binding emissions reductions—like China. The relevant question for the purposes of our inquiry is: should large-emitter countries that are not participating in an international cooperative emissions reductions plan nonetheless be taking steps to reduce their emissions at least to the less stringent, non-cooperative levels predicted by the game-theoretic economic models?

In the case of China, it is difficult to quantify an answer with certainty. Although it has dramatically reduced its emissions growth rate relative to historical trends (largely due to slower population growth, some efficiency improvements, and fuel-switching away from coal),<sup>81</sup> its potential for future emissions growth remains exceptionally large, particularly because it is expected to continue its dependence on coal, utilizing its large, domestic coal reserves as its energy base for future economic development.<sup>82</sup> Thus its status as a large-emitter is somewhat speculative.

Such is not the case regarding the United States. It is fairly clear that, considering the policies planned or anticipated at present, the sum of domestic efforts are unlikely to achieve even the non-cooperative emissions reductions predicted to be efficient by the original RICE model, i.e., 2.7 percent (*see* Table 3, scenario I.B). At the federal level, there is no significant program for mandatory reductions, and the voluntary emissions reductions program announced in 2002 by the Bush Administration to increase greenhouse gas

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Germany's success in reducing emissions has been attributed to its reunification with East Germany and subsequent success in upgrading the industrial infrastructure of East Germany whose inefficient factories had been a large source of greenhouse gas emissions.

80. Germany is following an even more aggressive approach, with goals of reducing carbon dioxide emissions by 25 percent of 1990 levels by 2005 and reducing the six greenhouse gases cited in the Kyoto Protocol by 21 percent between 2008 and 2012. DEPT. OF ENERGY, ENERGY INFORMATION AGENCY, COUNTRY ANALYSIS BRIEFS, GERMAN COUNTRY ANALYSIS (Sept. 2003), *available at* <http://www.eia.doe.gov/emeu/cabs/germany.pdf>. While the achievement of these goals has been made easier by the decreased consumption of energy overall in the former East Germany, the German government has also announced an impressive list of initiatives to promote renewable energy and energy efficiency. *Id.* For instance, Germany has passed laws designed to double the amount of electricity generated by renewable sources by 2010, to increase tax rates on fuel, gas and electricity for consumers, industry and agriculture, and to require new buildings to reduce energy consumption by 30 percent over current standards. *Id.* (describing Germany's Renewable Energy Act, Eco-tax, and Energy Saving Ordinance).

81. WILLIAM CHANDLER ET AL., CLIMATE CHANGE MITIGATION IN DEVELOPING COUNTRIES: BRAZIL, CHINA, INDIA, MEXICO, SOUTH AFRICA, AND TURKEY 19 (Pew Center on Global Climate Change 2002).

82. *See* MARC HUMPHRIES, CONGRESSIONAL RESEARCH SERVICE REPORT FOR CONGRESS, GLOBAL CLIMATE CHANGE: COAL USE IN CHINA AND OTHER ASIAN DEVELOPING NATIONS (1999), *available at* <http://www.ncsconline.org/nle/crsreports/climate/clim-20.cfm?&CFID=938395&CFTOKEN=35451670>.

intensity is unlikely to produce significant emissions reductions compared to business-as-usual technological progress.<sup>83</sup> At the state level, among the range of policies being implemented, two have the highest potential for producing significant greenhouse gas mitigations.<sup>84</sup> These are, first, California's newly proposed automobile emissions limits for greenhouse gases which, if implemented, may subsequently be adopted by states collectively amounting to up to one-quarter of the U.S. light-duty vehicle market,<sup>85</sup> and second, the collection of policies being implemented in smaller states for encouraging the development of non-carbon based renewable energy sources through such mechanisms as renewable portfolio standards and renewable energy subsidies. The effect of each of these is likely to be comparable in size: the collective impact of the California standard (if adopted by all the states that have expressed an intent to do so) should reduce total U.S. greenhouse gas emissions in 2020 by about 0.7 percent,<sup>86</sup> and the effect of renewable energy policies

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83. In 2002, the Bush Administration announced a voluntary goal of reducing the intensity of greenhouse gas emissions by roughly 18 percent by 2012. See The White House, Global Climate Change Policy, available at <http://www.whitehouse.gov/news/releases/2002/02.climatechange.html>. This means reducing greenhouse gas intensity from 183 metric tons carbon-equivalent emissions per million dollars of GDP in 2002 down to 151 metric tons of carbon-equivalent emissions per million dollars of GDP in 2012, a 17.5 percent reduction over ten years. By comparison, greenhouse gas intensity fell by almost exactly the same amount (17.4 percent) between 1990 and 2000 due to business-as-usual technological progress, suggesting that the Bush plan itself is no different from business-as-usual. Consequently, the Bush plan will lead to substantial growth in absolute emissions. The Bush plan anticipates economic growth of 38.3 percent, hence a 14.1 percent net increase in greenhouse gas emissions. Together with historical numbers from 1990, this implies that the Bush plan will result in U.S. emissions in 2012 that are 30 percent higher than they were in 1990. By comparison, Kyoto would have required that U.S. emissions in 2012 be 5 percent lower than 1990. See John P. Holdren, *U.S. Climate Policy Post-Kyoto: Scientific Underpinnings, Policy History, and the Path Ahead*, 18 Aspen Institute Congressional Program 7 (2003) (Appendix G), available at [http://bcsia.ksg.harvard.edu/BCSIA\\_content/documents/ClimatePostKyoto.pdf](http://bcsia.ksg.harvard.edu/BCSIA_content/documents/ClimatePostKyoto.pdf).

84. If successful, the litigation strategies being pursued by states and environmental groups against the U.S. Environmental Protection Agency to require the promulgation of nationwide greenhouse gas vehicle emission standards and the states' suit against certain large utilities, could also result in significant reductions in greenhouse gases. Given the uncertainty in the success of these lawsuits, however, we do not attempt here to quantify the emissions reductions they would produce.

85. See *supra* text accompanying note 35.

86. The California Air Resources Board estimates that their greenhouse gas emissions standards will reduce light-duty vehicle emissions in California by 17.5 percent in 2020 (8.75 MtC out of 50MtC/yr in Calif). CARB INITIAL STATEMENT, *supra* note 35. In 2000, light-duty vehicles (passenger cars and light trucks) were 55 percent of transportation greenhouse gas emissions, or 15 percent of all U.S. greenhouse gas emissions (1,907 million metric tons of carbon-equivalent). DAVID L. GREENE & ANDREAS SCHAFER, REDUCING GREENHOUSE GAS EMISSIONS FROM U.S. TRANSPORTATION 4, Table 4 (2003). Thus, if adopted nationally, California standards would reduce US greenhouse gas emissions by  $0.175 \times 0.15 = 2.6$  percent in 2020. In practice, 7 states (Rhode Island, Connecticut, Massachusetts, Vermont, Maine, New Jersey, and New York) have adopted the California automobile greenhouse gas standards. See CTR. FOR POLICY ALTERNATIVES, CLEAN CARS 205 (2004), available at <http://www.stateaction.org/publications/agenda/2005/pdf/cleancars.pdf>. These states collectively (together with California) amount to 25 percent of the U.S. light-duty vehicle market. <http://www.climateark.org/articles/reader.asp?linkid=36263>. Thus, that the expected impact of the California standard is a  $2.6 \text{ percent} \times 0.25 = 0.65$  percent reduction in U.S. greenhouse gas emissions by 2020.

should be to reduce greenhouse gas emissions by about 0.5 percent by about 2017.<sup>87</sup> Thus, together, these policies may be expected to have an effect of around 1–1.5 percent in the 2015–2020 timeframe, falling short of the 2.7 to 3.4 percent optimal non-cooperative reductions calculated for the United States by the RICE model (Table 3, scenarios I.B and II.B).

In sum, economic theory that accounts for the complexity of game-theoretic interactions predicts that large-state actors (United States, China) should take at least some steps to reduce their emissions, but that small-state actors should not. What we actually seem to find is just the opposite: a plethora of small-state players (in particular many individual states and even municipalities within the United States) are taking action, even though they should not, while some large-state subglobal governments, and the United States in particular, are failing to take as much action as they should. This raises the two obvious questions: (1) Why are big players like the United States not doing more to reduce emissions (since by not acting they are forgoing potential economic benefits), and (2) why are small governments doing anything at all (since they are not likely to gain any measurable economic benefit from them)? The following section explores possible answers to these questions.

#### *B. Why Are Large-Actor Subglobal Governments Doing Too Little?*

Any attempt to explain the behavior of subglobal governments in responding to the problem of climate change must be careful to distinguish the particular level of government concerned. In the United States, this is especially important because of the seeming divide between the federal government, on the one hand, and state and local governments on the other. To the outside observer, the two appear to be on very different tracks, with the federal government rejecting a regulatory role related to greenhouse gases and state and local governments actively pursuing a variety of strategies to mitigate greenhouse gas emissions. With this perspective, the United States would appear to exemplify behavior that is just the opposite of that which would be predicted by the non-cooperative game theory discussed above: action by larger governmental actors and inaction by smaller governmental actors. And such responses would seem to be irrational. Since an empirically tested explanation for this seeming irrationality would be outside the scope of this Article, we instead seek to offer several plausible explanations.

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87. A recent study estimates that state renewable energy policies in place now or soon to be implemented will achieve reductions of 12.7 million metric tons of carbon by 2017. UNION OF CONCERNED SCIENTISTS, *PLUGGING IN RENEWABLE ENERGY: GRADING THE STATES* 25 (2003). Baseline business-as-usual emissions are projected to be 1,917 million metric tons of carbon in 2015, or 2,364 million metric tons of carbon-equivalent greenhouse gases. DEPT. OF ENERGY, ENERGY INFORMATION AGENCY, *COMPLETE ANNUAL ENERGY OUTLOOK 2005*, 164, Table A18, available at <http://www.eia.doe.gov/oiaf/aeo/>. Hence, state renewable policies are projected to reduce greenhouse gas emissions by  $12.7/2364 = 0.54$  percent in the 2015–2017 timeframe. *See id.*

With respect to the federal government's failure to regulate greenhouse gases, a number of explanations are possible. The strongest rests on "public choice theory," which holds that government policies are dictated by "special-interest group" influence upon legislators.<sup>88</sup> Certainly the problem of climate change lends itself to the perversion of the public interest by special-interest industry groups with a vested economic stake in the United States' continued reliance upon fossil fuels.<sup>89</sup> While mitigation of greenhouse gas emissions portends clear and direct costs upon such industry groups, the benefits are much less certain and, in any case, are spread out over the entire population, present and future. While the legal literature is surprisingly thin on the public choice dynamics hampering climate change regulation on the national level,<sup>90</sup> commentators agree that the concentrated industry costs, on the one hand, and the information gaps and uncertainty inherent in the potential benefits of climate change mitigation on the other, constitute ideal conditions for preferential treatment by industry special interests.<sup>91</sup>

A second explanation might be that the payoffs presented in the empirically driven non-cooperative models discussed in Part I do not accord with policymakers' own understanding of these same payoffs. While the models predict that a high investment in greenhouse gas mitigation policies will result in relatively high payoffs (in terms of reduced impacts of climate change), policymakers may not trust that this is truly the case, especially given the perceived uncertainty of current predictions of the actual effects of climate change. Thus policymakers may not trust that reductions in the United States' output of greenhouse gases will actually prevent predicted climate changes, or that the science is not sufficiently certain to assure such a payoff.

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88. See MANCUR OLSON, *THE LOGIC OF COLLECTIVE ACTION: PUBLIC GOODS AND THE THEORY OF GROUPS* 28, 111-34 (1971).

89. This is not to say that the fossil fuel industry is monolithic. For instance, Bruce Yandle and Stuart Buck argue that, in order to thwart their competitors in the coal and oil industry, the natural gas and nuclear industry joined ranks with environmentalists to support the United States' ratification of the Kyoto Protocol. Bruce Yandle & Stuart Buck, *Bootleggers, Baptists and the Global Warming Battle*, 26 *HARV. ENVTL. L. REV.* 177, 211-12 (2002).

90. A notable exception is *id.* Nevertheless, the focus of Yandle and Buck's study is support for the Kyoto Protocol, as opposed to national programs to mitigate climate change even outside the context of efforts to craft a cooperative international agreement.

91. See Esty, *supra* note 15, at 1547-48 ("Special interests seem particularly adept at winning preferential treatment in situations in which other failures, especially information gaps, make the policy picture murky. The public choice failures . . . complicating climate change policymaking (marked by serious structural and information hurdles) illustrate this phenomenon."); Jonathan Baert Wiener, *On the Political Economy of Global Environmental Regulation*, 87 *GEO. L.J.* 749, 761 (1999) (Climate change regulation also involves potentially high costs to concentrated industry interests in the present. Public choice theory would therefore predict widespread free-riding by climate protection beneficiaries and potent opposition by concentrated industry interests.).

C. *Are Small-Actor Subglobal Governments Doing Too Much?*

The economic models discussed in Part I suggest that, in the absence of a global framework, small-actor subglobal governments should do little or nothing to combat global environmental problems. Virtually all states within the United States, even most big ones, are small in this global context. Does this mean their actions to address climate change are at odds with the economic model prescriptions? We will argue that, despite appearances, their actions are more consistent with the economic models than might initially seem the case. Indeed, while many state and local governments are making strides to combat climate change, with a few exceptions, most initiatives are non-regulatory and do not, at least at this point in time, constitute aggressive action to reduce existing emissions of greenhouse gases. In fact, a couple of states have enacted legislative prohibitions upon their governments taking any action to reduce greenhouse gases,<sup>92</sup> and of the states that are taking action, only a few are implementing regulatory measures that actually call for reductions in greenhouse gases. Of these, even fewer call for reductions in emissions from existing sources, as opposed to new sources. Many of the remaining initiatives being implemented represent a “no regrets” approach to reducing greenhouse gases.

Our suggestion that many of the state and local greenhouse gas initiatives, at least for now, are more show than substance draws from the literature on symbolic environmental legislation. In a seminal article, John Dwyer argued that the highly charged nature of toxic substance exposure has resulted in regulatory statutes for the control of toxic substances that are more symbolic than functional.<sup>93</sup> Legislators, sensing the deep public concern about the health risks of toxic air pollutants, could not resist the political benefits that accrue from supporting vague and sweeping regulatory prohibitions that ultimately proved impracticable to administer.<sup>94</sup> While the analogy between the toxic regulation discussed by Dwyer and state climate change initiatives is extremely rough—climate change does not evoke the public fear generated by toxic substances and state climate change initiatives have not proven administrative nightmares—we contend that the analogy is apt, insofar as, and with a few exceptions, such initiatives appear largely motivated by legislators’ symbolic desire to be seen as “doing something” about the pressing global problem of climate change. Such symbolic action produces policies that are unlikely to result in significant costs to industries within the legislator’s jurisdiction, or at least not costs that the jurisdiction must bear alone.

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92. See RABE, *supra* note 5 (Michigan, Colorado).

93. John P. Dwyer, *The Pathology of Symbolic Legislation*, 17 *ECOLOGY L. Q.* 233, 234 (1990). For the same basic thesis, elaborated over a decade earlier, see JAMES A. HENDERSON, JR. & RICHARD N. PEARSON, *IMPLEMENTING FEDERAL ENVIRONMENTAL POLICIES: THE LIMITS OF ASPIRATIONAL COMMANDS* (1978).

94. *Id.*, at 245-46.

Given the notoriety associated with adopting climate-related policies at the state and local level, politicians have much to gain from even a mostly symbolic measure. Since the 1970s, environmental policy in the United States has been dominated by the federal government which entered the field with a series of major environmental protection laws against the backdrop of the perceived state failure to adequately grapple with instate and interstate pollution and natural resource degradation.<sup>95</sup> Under the cooperative federalism model—the predominant model of federalism employed in U.S. environmental law—the federal government makes the major policy decisions while the states are left to carry out the program within their jurisdiction after proving themselves capable of administering the federal government's program.<sup>96</sup> Recently, the federal government's withdrawal from its role at the forefront of environmental policy has opened up opportunities for states to fill the vacuum.<sup>97</sup> And for no issue is the contrast between the current federal and state stance on environmental issues more stark than on climate change. Thus, states that attempt to fill this gap reap the extra rewards that accompany any state attempting to fill the shoes of the federal government. This novelty may be sufficient to overcome what might otherwise be predicted as considerable barriers to state action.

A good example of the foregoing is provided by "greenhouse gas inventories" and "greenhouse gas registries," the most popular forms of greenhouse gas initiatives presently being adopted by states. At present, at least thirty-eight states have greenhouse gas inventories,<sup>98</sup> which identify and quantify existing major greenhouse gas sources and sinks and hence provide a measure of baseline emissions from which future reductions can be measured.<sup>99</sup> Inventories provide regulators with a better understanding of which industries are the largest contributors of greenhouse gas emissions and

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95. See Esty, *supra* note 57, at 600-01 ("The state regulatory efforts of the 1950s and 1960s, however, did little to stem the flow of pollution, and by the mid-60s, the demand for more centralized regulation was growing."); *but cf.* Richard L. Revesz, *Federalism and Environmental Regulation: A Public Choice Analysis*, 115 HARV. L. REV. 553, 578-79 (2001) ("the view widely held in the legal literature that the states ignored environmental problems before 1970 is simply not correct").

96. See, e.g., Federal Water Pollution Control Act, 33 U.S.C. § 1342 (2000) (authorizing federal government to promulgate effluent limitations for pollutants but allowing states to apply to the EPA to administer a permit program authorizing sources to discharge pollutants within the effluent limits); Resource Conservation and Recovery Act, 42 U.S.C. §§ 6921, 6929 (authorizing EPA to promulgate standards identifying and listing hazardous wastes, but authorizing states to administer a permit program to treatment, storage and disposal facilities handling hazardous waste).

97. See, e.g., Ron Scherer & Alexandra Marks, *New Environmental Cops, State Attorneys General*, CHRISTIAN SCI. MONIT. (July 22, 2004).

98. RANDALL FREED, SUSAN BROWN, ANNE CHOATE & ANDREA DENNY, GREENHOUSE GAS INVENTORY TOOLS FOR STATES, available at <http://www.epa.gov/ttn/chief/conference/ci11/poster/freed.pdf> (last visited July 5, 2005).

99. Most inventories cover the most significant sources of greenhouse gases: carbon dioxide from fossil fuel combustion, nitrous oxide from agricultural soils, methane from landfills, methane from the digestive tracts of animals as a result of the fermentation of plant feed material, methane from manure management, and carbon flux from land use change and forestry. *Id.*

hence what future requirements will be the most effective. At the same time, inventories give industries within a jurisdiction a leg up on future regulatory requirements by providing those that are already reducing emissions an officially sanctioned baseline from which to claim credit for subsequent reductions.<sup>100</sup>

Greenhouse gas registries are similar to inventories, but go one step further, allowing regulators, industries and the public an opportunity to track emissions reductions being pursued voluntarily by certain industries.<sup>101</sup> States such as New Jersey, California,<sup>102</sup> New Hampshire,<sup>103</sup> and Wisconsin have adopted voluntary programs that enable companies to have their emissions reductions certified by a government entity.<sup>104</sup> In addition to the possibility of influencing future policy, such as the development of industry-specific protocols and accounting practices associated with greenhouse emission reporting,<sup>105</sup> companies that register their emissions hope that, by tracking reductions they are making today, they will get credit for these reductions later when a regulatory scheme capping emissions is put in place.<sup>106</sup> Indeed, many view greenhouse gas registries as a first step in the establishment of an emissions trading program.<sup>107</sup>

The important point for present purposes, however, is that neither an inventory nor a registry actually mandates the reduction of greenhouse gas emissions from industry. Instead, they are precursors to a possible future regulatory program. Until they ripen into such a regulatory program, they allow state politicians to claim credit for working on the problem of climate change without currently having to impose regulatory costs upon industries reliant upon fossil fuels. This is not to denigrate the importance of such registries and

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100. Thus many industries are themselves pushing inventories and registries to ensure that they receive credit for their early action if and when greenhouse gas reductions become mandatory. This will avoid the resentment felt by many electric power producers when the 1990 Clean Air Act Amendments established a company baseline of 1990 from which to credit excess emissions reductions in the Act's new sulfur emissions trading scheme. As a result of this baseline, companies were denied credit for reductions made prior to this baseline date. See *infra* text accompanying notes 103 & 106.

101. See Northeast States for Coordinated Air Use Management, Greenhouse Gas State Registry Collaborative, State Registry Programs Currently Running or Under Design (July 2001), available at [http://www.nescaum.org/Greenhouse/Registry/state\\_matrix.html](http://www.nescaum.org/Greenhouse/Registry/state_matrix.html).

102. California established a voluntary greenhouse gas emissions registry in 2001. See California Climate Action Registry, About Us, at <http://www.climateregistry.org/aboutus/>.

103. See New Hampshire Department of Environmental Services, Greenhouse Gas Registry, <http://www.des.state.nh.us/ard/climatechange/ghgr.htm>.

104. See Kosloff & Trexler, *supra* note 13, at 47; RABE, *supra* note 5, at 98-100.

105. California Climate Action Registry, *Why Register GHG Emissions?*, <http://www.climateregistry.org/HOWANDWHY/Why/>.

106. See Seth Shortlidge, *Getting Ready for Greenhouse Gas Regulation*, N.H. BUS. REV. (April 2003), available at <http://www.gcglaw.com/resources/enviro/greenhouse.html> (greenhouse gas registries can avoid "betrayal" experienced by firms that reduces sulfur dioxide emissions prior to 1990 when subsequent 1990 Clean Air Act Amendments allocated emission allowances based upon reductions from 1990 baseline).

107. New Hampshire Greenhouse Gas Registry, *supra* note 103 (listing the positioning of firms for potential international emissions trading as a reason for firms to register their emissions).

inventories, but instead simply to highlight that such programs, in and of themselves, are not regulatory and, by themselves, do not result in the actual reduction of greenhouse gas emissions.

Many state and local governments appear to be following a "no regrets" climate action strategy by adopting measures that will reduce greenhouse gases, but which can also be rationalized in pursuit of goals unrelated to climate change. For example, a growing number of states are enacting renewable portfolio standards, public benefit charges,<sup>108</sup> public purchasing requirements,<sup>109</sup> tax incentives,<sup>110</sup> and other mechanisms designed to mandate or encourage greater generation and use of renewable energy. Of these, renewable portfolio standards are among the most popular. Legislation putting in place a mandatory renewable portfolio standard has been enacted in 16 states,<sup>111</sup> while voluntary standards have been enacted in two states, and are being considered in nine more.<sup>112</sup>

The renewable portfolio standard is a market-based tool designed to enhance the percentage of energy being supplied by renewable resources. Under a renewable portfolio standard, a government regulator mandates that a specified percentage of the power supplied by each energy retailer or distributor to a particular market originate from renewable energy sources, such as wind, solar or biomass.<sup>113</sup> Such a standard ensures that a minimum amount of renewable energy is included in the portfolio of electricity companies serving a state or country, and, by increasing the required percentage over time, can gradually increase the presence of renewable energy in the region's overall

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108. See CTR. FOR CLEAN AIR POLICY, STATE AND LOCAL CLIMATE CHANGE POLICY ACTIONS 9-10 (Oct. 2002), available at [http://bronze.nescaum.org/greenhouse/CCAP-state\\_actions.pdf](http://bronze.nescaum.org/greenhouse/CCAP-state_actions.pdf) (discussing California and Connecticut's system benefit charge). The Massachusetts Renewable Energy Trust, a \$150 million trust used to encourage "green" projects, was established as part of the electrical industry restructuring in Massachusetts, and is funded by a charge on the electric bills of Massachusetts customers. To date, over 460 awards totaling \$110 million have been made from the Trust. See Massachusetts Technology Collaborative, The Renewable Energy Trust, <http://www.mtpc.org/renewableenergy/index.htm>.

109. For instance, in 2002, New Jersey agreed to purchase 12 percent of the energy purchased by state government through June 2003 from a renewable energy retailer, Green Mountain Energy. CTR. FOR CLEAN AIR POLICY, *supra* note 108, at 10. In New York, Governor Pataki committed state agencies to purchase, by 2005, 10 percent of their energy needs from renewable sources, such as wind, solar, biomass, geothermal, and 20 percent by 2010. *Id.* Maryland and Pennsylvania similarly agreed to purchase 6 and 5 percent of their energy needs respectively from renewable sources. *Id.* at 11.

110. ELIZABETH BROWN, PATRICK QUINLAN, HARVEY M. SACHS & DANIEL WILLIAMS, TAX CREDITS FOR ENERGY EFFICIENCY AND GREEN BUILDINGS: OPPORTUNITIES FOR STATE ACTION (Mar. 2002), available at <http://www.aceee.org/pubs/e021full.pdf>.

111. See <http://www.dsireusa.org/summarytables/reg1.cfm?&CurrentPageID=7>.

112. See AM. LEGISLATIVE EXCHANGE COUNCIL, RENEWABLE PORTFOLIO STANDARDS IN THE STATES, available at <http://www.alec.org/meSWFiles/pdf/Portfolio%20Standard%20Map%20update7103.pdf>.

113. For example, under the renewable portfolio standard just enacted by Hawaii, eight percent of the electricity supplied by the state's public utilities must come from renewable sources by December 31, 2005. This percentage rises to 10 percent in 2010 and by 1 percent every year thereafter, until it reaches a maximum of 20 percent in 2020. *Id.*

energy supply. The percentage of renewable energy required under renewable portfolio standards ranges from 1.1 percent by 2007 in Arizona to 24 percent by 2013 in New York, to 30 percent by 2000 in Maine.<sup>114</sup>

Strategies like renewable portfolio standards have the potential to be much more than mere symbolism, and could actually become effective levers for substantially reducing greenhouse gas emissions if the renewable portfolio percentage is set high enough. However, they are often justified on grounds other than mitigation of climate change—e.g., price stability, diversification of fuel sources, and protection of existing renewable electricity generators.<sup>115</sup> RPS measures can thus be integral to reducing greenhouse gases in the long run, as an increased reliance on renewables will displace fossil fuels. But the multiplicity of non-climate related benefits they bring may well compensate for the direct costs associated with the greenhouse gas emissions reductions component, again allowing regulators to take credit for taking action on climate change, but doing it in a way that does not incur sacrifice relative to other states.

Similarly, litigation to compel the federal government, or individual industrial facilities, to regulate greenhouse gas emissions—a strategy being pursued by numerous states—is a low-risk strategy, but in a different way. State governments are the leading plaintiffs in recently filed lawsuits seeking to compel federal regulation of greenhouse gases. This includes a lawsuit—later withdrawn—to compel the agency to list carbon dioxide as a criteria pollutant

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114. See Union of Concerned Scientists, *Renewable Electricity Standards at Work in the States*, [http://www.ucsusa.org/clean\\_energy/renewable\\_energy/page.cfm?pageID=47](http://www.ucsusa.org/clean_energy/renewable_energy/page.cfm?pageID=47). Most states that have enacted a renewable portfolio standard allow utilities to meet the requirement through a tradable credit system patterned after the tradable system for sulfur allowances under the federal Clean Air Act. See Clean Air Act, Title IV. Under this system, retailers demonstrate to regulators that their portfolio contains the requisite percentage of renewable power through their possession of renewable energy credits, which renewable generators sell to retailers either separately or bundled with their power. See NANCY RADAR & SCOTT HEMPLING, *THE RENEWABLE PORTFOLIO STANDARD: A PRACTICAL GUIDE* (Feb. 2001) (prepared for the Nat'l Ass'n of Regulatory Util. Comm'rs); RYAN WISER & OLE LAGNISS, *TECH. RPT. NO. LBNL-49107, THE RENEWABLES PORTFOLIO STANDARD IN TEXAS: AN EARLY ASSESSMENT* (Nov. 2001) (prepared for Lawrence Berkeley Nat'l Lab), available at <http://eetd.lbl.gov/ea/ems/reports/49107.pdf>. Well-designed renewable portfolio standards are credited with significantly increasing the market share of renewable power in the states that have adopted them. RYAN WISER, ET AL., *EVALUATING STATE RENEWABLE PORTFOLIO STANDARDS* (2003), available at <http://www.geocollaborative.org/publications/RPS.pdf>. A good example is Texas, which almost quadrupled its wind energy resources after passage of a state renewable portfolio standard. RABE, *supra* note 5, at 61, Table 2.2 (prior to enactment of its renewable portfolio standard, Texas generated 187.42 megawatts in wind energy; after, it generated 913.32 megawatts).

115. See U.S. DEPT. OF ENERGY, *ENERGY EFFICIENCY AND RENEWABLE ENERGY, STATE ENERGY ALTERNATIVES: POLICY ISSUES* (February 2005), available at [http://www.eere.energy.gov/state\\_energy/policy\\_content.cfm?policyid=27](http://www.eere.energy.gov/state_energy/policy_content.cfm?policyid=27)

(Most of the states that have enacted a portfolio standard have done so to encourage in-state power generation, and some states have done so to protect existing electricity generators in the state. . . . Most states have also enacted the portfolio standard to help ensure diversity in the state's fuel mix and to encourage an environmentally benign method of generating electricity.).

under the federal Clean Air Act,<sup>116</sup> and a pending lawsuit to compel EPA to regulate emissions of greenhouse gases from mobile sources.<sup>117</sup> By joining in such legal action, state politicians make a strong, public statement for the need to reduce greenhouse gases, but they do so without placing in-state local fossil-fuel producing industries at a disadvantage vis-à-vis industries in other states.<sup>118</sup> The relief requested—federal greenhouse gas regulations for mobile and stationary sources—would apply uniformly to the targeted industries regardless of their location. Thus such actions seek to compel mandatory regulation of greenhouse gases, but again, in a manner that takes advantage of the federal government's ability to impose uniform standards across industry, regardless of where located, thus preventing states from engaging in interstate competition through environmental standards.<sup>119</sup>

Two clear exceptions to the "symbolic" diagnosis deserve mentioning, however: California's adoption of greenhouse gas standards for new cars, trucks and vans<sup>120</sup> and the regulation of carbon dioxide from electric power

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116. See *Massachusetts v. Whitman*, *supra* note 7 (requesting an order requiring the EPA to regulate carbon dioxide as a Clean Air Act criteria pollutant under Section 108 of the Act). The suit was withdrawn without prejudice in 2003, following EPA's rejection of a petition for limits on greenhouse gases from vehicles based upon a determination that the Clean Air Act does not authorize the EPA to regulate to reduce climate change. *Id.* Massachusetts, Connecticut and Maine subsequently joined other states and numerous environmental organizations in appealing the EPA's determination regarding mobile vehicle emissions to the United States Court of Appeals for the District of Columbia Circuit under Section 307 of the Clean Air Act. *Id.* Had the states persevered and successfully compelled EPA to list carbon dioxide as a criteria pollutant under the Clean Air Act, their lawsuit would have triggered the Act's elaborate federal-state regulatory framework for ensuring that emissions of criteria pollutants do not exceed concentrations established to protect human health and welfare. See Clean Air Act §§ 108-110, 42 U.S.C. §§ 7408-10 (2000). According to this framework, states must write and implement plans to attain such concentrations within set timeframes or they risk EPA stepping in to develop and implement the plan for them. Clean Air Act, § 110, 42 U.S.C. § 7410. Hence the Act's process for regulating pollutants is like a game of dominoes; once a pollutant is listed, the Act mandates a series of steps that eventually lead to emission reductions. EPA would have been compelled to establish ambient air quality standards for carbon dioxide under Section 109 of the Act and states would have been compelled to develop plans to ensure the attainment of these standards under Section 110 of the Act. In pursuing a listing determination, the states were following the strategy of environmental groups to require federal regulation of ambient lead in the 1970s. See *NRDC v. Train*, 545 F.2d 320 (2d Cir. 1974).

117. In the mobile vehicle case, the EPA would be required to promulgate uniform standards for emissions of carbon dioxide and other greenhouse gases from all new cars and other mobile vehicles throughout the United States. Given that the transportation sector is the second largest portion of greenhouse gas emissions (27 percent), this is a nontrivial result. See INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990-2001, ES-7 (April 2003), available at <http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissionsUSEmissionsInventory2003.html>

118. This is also true of the lawsuit filed by New York and other northeastern states in July 2004 directly against five electric utilities claiming that the utilities' greenhouse gas emissions constitute a "public nuisance." None of the companies are located in the states that filed suit. See Scherer & Marks, *supra* note 97.

119. Uniform technology standards create a "level playing field" for geographically scattered industries and thereby reduce interstate competition in environmental standard-setting. See Engel, *supra* note 57, at 292-94.

120. The new standards are scheduled to go into effect in 2009. See RABE, *supra* note 5, at 141-45.

generators enacted by several states. Recently, the state authorized the implementation of regulatory limits upon greenhouse gas emissions from mobile vehicles.<sup>121</sup> Effective for the 2009 model year and later, the rules proposed by the California Air Resources Board (CARB) will require automobile manufacturers to reduce emissions of carbon dioxide and other greenhouse gases from new car models by 30 percent.<sup>122</sup> The standards will apply to automakers' fleet averages, rather than each individual vehicle, and automobile manufacturers are given the option of qualifying for credits through the use of alternative compliance strategies—such as the increased use of a less greenhouse gas intensive fuels (compressed natural gas, hydrogen or propane) in certain vehicles—which the manufacturer can then use to comply with the climate change regulation.<sup>123</sup> Despite this built-in flexibility in the regulations, the standards are currently being challenged by the automobile industry.<sup>124</sup>

At present, four states, Oregon, New Hampshire,<sup>125</sup> Massachusetts, and Washington, call for regulation of carbon dioxide from electric power generators. Under the recently enacted Washington law, for example, new power plants must offset twenty percent of their carbon dioxide emissions by planting trees, buying natural gas-powered buses or taking other steps to cure such emissions.<sup>126</sup> Only the laws of New Hampshire and Massachusetts apply to carbon dioxide emissions from existing power plants however. In 2001, Massachusetts adopted a “multi-pollutant” strategy to reduce carbon dioxide emissions from the State’s six largest existing fossil-fuel power plants.<sup>127</sup> Under the rules, total carbon dioxide emissions will be capped at current levels and the plants are subject to an emission standard 10 percent lower than the existing average carbon dioxide emission rate. To meet the new standard, the six plants must either increase energy efficiency or buy credits from approved carbon dioxide reduction programs.<sup>128</sup>

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121. A.B. 1493 (Cal. 2002).

122. California Air Resources Board (CARB), Rulemaking on the Proposed Regulation to Control Greenhouse Gas Emissions from Motor Vehicles, Proposed Regulation Order, Amendments to Sections 1900 and 1961, and Adoption of new Section 1961.1, Title 13, California Code of Regulations (released Aug. 6, 2004), available at <http://www.arb.ca.gov/regact/grnhsgas/grnhsgas.htm>; CARB INITIAL STATEMENT, *supra* note 35.

123. CARB INITIAL STATEMENT, *supra* note 35, at 129-36.

124. The Alliance of Automobile Manufacturers and a group of Central Valley automobile dealers sued the California Air Resources Board in December 2004, alleging the agency overstepped its authority in adopting the regulations. The Association of International Automobile Manufacturers joined the lawsuit in February 2005. Bureau of National Affairs, 46 DAILY ENV'T. REP., Mar. 10, 2005, at A-1.

125. In November 2001, the State of New Hampshire, Public Service of New Hampshire, the owner of three fossil-fuel electrical utilities in the State, and several environmental organizations signed an agreement to cap carbon dioxide emissions from PSNH plants. This agreement was later ratified by the New Hampshire legislature. [http://www.psnh.com/Energy/PSNH\\_Environment/FAQs.asp](http://www.psnh.com/Energy/PSNH_Environment/FAQs.asp)

126. David Ammons, *New Washington Law Boosts Emissions Standards*, Associated Press, Mar. 31, 2004.

127. MASS. REGS. CODE tit. 310, § 7.29 (2002).

128. *Id.*

Of the climate initiatives being pursued by state governments, regulation of greenhouse gas emissions from power plants and cars has the greatest potential to reduce emissions from business-as-usual levels.<sup>129</sup> Electric utilities account for 29 percent of the United States' total greenhouse gas emissions between 1990 and 1999.<sup>130</sup> Transportation activities accounted for 26 percent, most of which was generated by passenger cars and trucks.<sup>131</sup> However, few of these initiatives will apply to existing sources of greenhouse gas emissions, as most are prospective. The majority of relevant power plant standards apply to new electrical plants, and California's vehicle standards will apply only to newly manufactured cars. Regardless, significant gains are possible if other states adopt California's proposed car standards<sup>132</sup> (several states have committed to do so), potentially expanding its application to a quarter of the nation's car market.<sup>133</sup> Thus, assuming these standards survive legal challenge, they have great potential to reduce U.S. greenhouse gas emissions. In addition, it is quite possible they will be copied by regulators in neighboring countries.<sup>134</sup> However, even with this potentially larger impact, it is important to note that the adoption of such standards is predicted to require little local sacrifice. CARB actually estimates that the net effect of the regulation on the California economy will be small, but positive. This is because of the lower operating cost savings from the use of vehicles complying with the standard outweighs the increase in the price of the vehicles.<sup>135</sup>

Thus, at least in their present stage of development, state and local greenhouse gas initiatives may not be quite as out of step with the predictions of the economic models provided in Part I as may at first appear. With several important exceptions, few state and local climate initiatives currently impose mandatory emissions reductions from existing sources. Instead, many constitute preliminary steps toward eventual regulation, affording state and local politicians notoriety on an issue being largely ignored by the federal government without committing the locality to costly controls on in-state greenhouse gas sources. While the federal government is clearly not out ahead of the states on the issue of climate change, nor are the states quite as far out

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129. See Kosloff & Trexler, *supra* note 13 (giving such measures as the highest ranking among other state climate change initiatives in terms of reducing emissions from business as usual levels).

130. EPA, U.S. CLIMATE ACTION REPORT 37, Table 3-6 (2002), available at [http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/SHSU5BWHU6/\\$File/uscar.pdf](http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/SHSU5BWHU6/$File/uscar.pdf).

131. *Id.* at 36, Table 3-4.

132. Clean Air Act, § 177, 42 U.S.C. § 7507 (2000).

133. Danny Hakim, *Several States Likely to Follow California on Car Emissions*, N.Y. TIMES, June 11, 2004 (officials in Connecticut, New Jersey, Rhode Island, New York, Massachusetts, Vermont and Maine have stated that the state will follow California's greenhouse gas emission standards for cars; these seven states account for about one-fourth of all cars sold in the United States).

134. See, e.g., Danny Hakim, *Canada Says it may Emulate California on Auto Emissions*, N.Y. TIMES, Mar. 12, 2004.

135. CARB INITIAL STATEMENT, *supra* note 35, at ix.

ahead of the federal government as one might believe as a result of the recent attention garnered by state and local climate change initiatives.<sup>136</sup>

### III. SUBGLOBAL ACTION AS A MEANS TO RATIONAL REGULATION

Given that subglobal governments are not currently reducing greenhouse gas emissions to levels considered rational from a non-cooperative framework, the question arises whether, rather than as an end in and of itself, subglobal regulation could nevertheless function as a means to achieve globally optimal levels of greenhouse gas controls, and if so, how? This Part suggests that it could. By providing a catalyst for regulatory action by higher jurisdictional levels of government encompassing a larger geographic scope, subglobal governments can trigger action by governments with a greater incentive to regulate. Such subglobal action can also trigger a multilateral international agreement in which countries agree to implement cooperative measures. Indeed, many U.S. federal environmental laws and multilateral international environmental agreements came about only after the underlying environmental issue was already being addressed by a subset of lower-level jurisdictions.

We suggest that based upon past history, regulation at a lower jurisdictional level can trigger regulation at a higher level<sup>137</sup> (referred to here as the “domino effect”) as a result of:

- (1) interest group appeals to regulators at higher jurisdictional levels to address environmental externalities, level the competitive playing field, or prevent a welfare-reducing “race-to-the-bottom” due to uncoordinated subglobal regulation;
- (2) the search for larger markets by substitute product producers; or
- (3) a desire to regulate the environmental problem through the use of a market mechanism, such as a tradable permit.<sup>138</sup>

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136. Thus the politics of climate change does not fit neatly into either the traditional predictions of scholars applying public choice theory to environmental legislation, nor to the predictions of revisionists of that scholarship. According to the traditional view, because industry-financed interest groups opposed to environmental protection are deemed to be comparatively stronger than environmental interests on the state and local level than on the national level, federal legislation is thought to be more likely to respond to the broad and diffuse public interest supporting many environmental goals. See Esty, *supra* note 57, at 650-51; Richard B. Stewart, *Pyramids of Sacrifice? Problems of Federalism in Mandating State Implementation of National Environmental Policy*, 86 YALE L.J. 1196, 1213-14 (1977); Joshua D. Sarnoff, *The Continuing Imperative (but Only from a National Perspective) for Federal Environmental Protection*, 7 DUKE ENVTL. L. & POL'Y F. 225, 285-86 (1997). More recently, however, at least one prominent scholar has taken issue with this reading of public choice, contending that there is little theoretical or empirical support for this view, and indeed, that public choice may actually support viewing the states as better protectors of the broad public interest in environmental protection. Revesz, *supra* note 90, at 558 (arguing that public choice theory does not support the usual presumption that the states will be more vulnerable to the influence of industry groups on matters of environmental protection). Given the uneven nature of regulation at the state, local and national level, at least at this point in time, the jury is still out on how public choice applies to climate change regulation in the United States.

137. For purposes of this discussion, a multilateral international agreement is assumed to constitute action at a jurisdictional level “higher” than that of a subglobal government, such as a nation.

The following describes how each of these mechanisms can contribute to the "domino effect" that triggers regulation at higher jurisdictional levels following the initiation of regulations by subglobal governments at lower jurisdictional levels, as well as the contributory role played by existing federal environmental law remedies.

*A. Interest Group Appeals for Preemptive Regulation*

On the domestic level, some of the most prominent examples of the domino effect are those where interest groups have pushed for preemptive federal regulation to eliminate a growing prospect of inconsistent regulation by individual states. For example, the campaign to include tailpipe emission limitations for motor vehicles under the Clean Air Act of 1965 was primarily the result of an industry lobbying campaign for national tailpipe standards that would preempt the tailpipe standards recently enacted by several individual states, including California.<sup>139</sup> The prospect of fifty different state standards for the same product, requiring potentially different manufacturing processes in each state, was sufficient to trigger industry interest in uniform federal regulation.<sup>140</sup> Such a lobbying effort coincided with the interests of environmentalists who saw the prospect of national regulation of automobiles as far more effective in reducing vehicle pollution than a patchwork of state laws.<sup>141</sup> Under the resulting federal law,<sup>142</sup> state vehicle standards were

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138. There is a great degree of overlap between the focus of the present discussion, i.e., whether and when higher jurisdictions can be expected to regulate a given environmental problem when lower jurisdictional authorities are already regulating the problem, with the on-going debate over whether relaxing trade barriers leads to more or less stringent environmental regulations than the jurisdiction would have adopted in the presence of trade barriers. See generally, DAVID VOGEL, TRADING UP: CONSUMER AND ENVIRONMENTAL REGULATION IN A GLOBAL ECONOMY (1995); DANIEL C. ESTY, GREENING THE GATT: TRADE, ENVIRONMENT, AND THE FUTURE (1994); C. FORD RUNGE, FRANCOIS ORTALO-MAGNE & PHILIP VANDE KAMP, FREER TRADE, PROTECTED ENVIRONMENT: BALANCING TRADE LIBERALIZATION AND ENVIRONMENTAL INTERESTS (1994); TRADE AND THE ENVIRONMENT: THE SEARCH FOR BALANCE (James Cameron, et al. eds., 1994). This is because, as will be discussed, the primary means through which the "domino effect" transpires, is interjurisdictional trade. While the discussion below will refer to this debate, the stringency of the standards adopted by the higher level jurisdiction is less its focus than the mechanisms by which regulation at a lower level triggers regulation at a higher level when the higher level lacked any regulatory program in that area. The regulations adopted by the higher jurisdiction may, in fact, be less stringent than those that the jurisdiction would have adopted in the absence of trade; nevertheless, for present purposes the important thing is that it *did* adopt a regulatory program. In the present context, where regulation of greenhouse gas emissions by larger jurisdictional entities is needed to put dent in the rapidly accumulating concentrations of greenhouse gases, the stringency of a given regulatory program is less important than the mere existence of a program.

139. See *Motor Vehicle Mfrs. of the U.S. v. N.Y. State Dept. of Env'tl. Conserv.*, 17 F.3d 521, 524 (2d Cir. 1994); S. REP. NO. 89-192, 5-6 (1965), reprinted in 1965 U.S.C.C.A.N. 3608, 3629-31. The federal law in effect at the time, the Clean Air Act of 1955, did not include vehicle emission standards.

140. *Motor Vehicle Mfrs.*, 17 F.3d at 525.

141. The major interest groups involved in environmental regulation are, not surprisingly, environmental organizations and industry groups. Although much is sometimes made of the relative political power of either group, one commentator claims that the probability that domestic regulation

preempted, with the exception of more stringent standards enacted by California.<sup>143</sup> This same dynamic was repeated in 1990 when the Clean Air Act was significantly amended; again the prospect of fifty different sets of rules for sulfur dioxide emissions drove industry to support uniform federal regulation in the form of a national cap upon emissions implemented through a market-based trading scheme.<sup>144</sup>

The campaign for nationally uniform energy efficiency standards for appliances provides a second domestic law example. During the 1970s, states eager to reduce the energy consumption of appliances in the face of federal inaction on the issue began to enact appliance efficiency standards.<sup>145</sup> In 1978, however, the National Energy Conservation Policy Act preempted such state laws, requiring the Department of Energy (DOE) to establish energy efficiency standards for each of thirteen classes of major energy-consuming appliances.<sup>146</sup> Nevertheless, because DOE granted states waivers from preemption and, at the same time, announced that no federal efficiency standard could be economically justified, state standards remained in effect and continued to grow.<sup>147</sup> Distraught over the prospect of a patchwork of state appliance standards applicable to nationally marketed products, appliance manufacturers entered into negotiations with a major environmental group, the Natural Resources Defense Council, which was equally concerned with the DOE's failure to enact efficiency standards.<sup>148</sup> The result was compromise federal

will move to the international level is highest when the interests of both camps in moving regulation to a higher level, coincide. See ELIZABETH DESOMBRE, DOMESTIC SOURCES OF INTERNATIONAL ENVIRONMENTAL POLICY: INDUSTRY, ENVIRONMENTALISTS AND U.S. POWER 10 (2000). As explained in the text, there is support for this on the domestic level as well. See, e.g., BRUCE ACKERMAN, CLEAN AIR, DIRTY COAL (1981).

142. Air Quality Act of 1967, § 208, Pub. L. No. 90-148, 81 Stat. 485 (1967).

143. See *id.* § 208(b). Congress granted California an exception because of the state's early efforts to control its severe air pollution problems in the Los Angeles air basin. See Christopher T. Giovino, Comment, *California's Global Warming Bill: Will Fuel Economy Preemption Curb California's Pollution Leadership?*, 30 *ECOLOGY L.Q.* 893, 901 (2003). The exception for California has been retained in the Clean Air Act. See Clean Air Act, § 209(e)(2). Under Section 177 of the Act, states are allowed to adopt California's vehicle standards in place of the federal standards. Several northeastern states have chosen to do so in the past. See *supra* note 86. California's decision to regulate carbon dioxide emissions from cars starting in 2009 has evoked controversy over the scope of California's unique regulatory status under the Clean Air Act. See Anne E. Carlson, *Federalism, Preemption and Greenhouse Gas Emissions*, 37 *U.C. DAVIS L. REV.* 281, 300 (2003).

144. See John Carey, *Global Warming*, *BUSINESSWEEK*, Aug. 16, 2004, at 69.

145. See S. REP. NO. 100-6, at 3-4 (1987), reprinted in 1987 U.S.C.C.A.N. 52, 54-55. By 1987, major home appliances were consuming 18 percent of the nation's energy. *Id.*

146. Pub. L. No. 95-619, § 102, 92 Stat. 3206, 3208-09 (1978).

147. S. REP. NO. 100-6, U.S.C.C.A.N. at 54-55.

148. *Id.* at 55

(In an effort to resolve this problem the major appliance manufacturer associations began negotiations with the Natural Resources Defense Council in early 1986. At the end of July an agreement was reached and it was embodied in legislation which was introduced on August 15, 1986, in the House (H.R. 5465) and in the Senate (S. 2781). H.R. 5465 was passed without objection by both Houses of Congress on October 15, 1986 and with only four substantive changes...).

legislation that included the nationally uniform standards sought by industry and default efficiency standards sought by environmental groups.<sup>149</sup>

In a manner similar to that by which state environmental regulation can trigger federal environmental laws on the domestic level, regulation at the national level can provide the momentum needed to solidify a multilateral international environmental agreement. In the international law literature, scholars point to this phenomenon as a beneficial aspect of unilateralism, and examples abound.<sup>150</sup> One is the process leading up to the negotiation, and subsequent enactment, of the Montreal Protocol for control of the production of ozone-depleting substances. In the late 1970s, the United States took several actions to prohibit the circulation of chlorofluorocarbons (CFCs) in interstate commerce. In 1978, U.S. EPA took the further step of prohibiting the use of CFCs in nonessential aerosols. At the same time, the federal Food and Drug Administration prohibited the use of CFCs as propellants in various goods manufactured after 1978. These steps, credited to genuine concern over the consequences of a further deterioration of the ozone layer,<sup>151</sup> were at first vigorously opposed by industry.<sup>152</sup> Soon, however, it became clear that these regulations were only the beginning, and more stringent standards were likely, both on the U.S. domestic level and possibly under a multilateral international agreement.<sup>153</sup> Although the 1985 Vienna Convention did not itself impose production or consumption limits, it demonstrated support for them.<sup>154</sup> At that point, the U.S. CFC industry, originally opposed to domestic regulation, did a

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149. *Id.* Although both of these domestic examples involve product standards, the same dynamic described above has led to the enactment of preemptive federal regulation in the realm of pollution from stationary sources. Here, industry's motivations are slightly different. In the product scenario, a patchwork of state laws confronts manufacturers with a regional or nationwide customer base with increased costs from the necessity of complying with different standards. To the extent stationary sources, such as electric power generating plants, are owned and operated by the same company, this same concern for the additional production costs resulting from nonuniform standards may apply. Nevertheless, for the most part, industry's efforts to obtain uniform environmental standards for stationary sources is motivated by concerns that different state standards create an unlevel playing field, rendering industries in some states "winners" and industries in others, "losers." The uniform national environmental "floors" established in the federal Clean Air and Clean Water Acts are attributed, in large part, to industry's demand for a level playing field. See E. Donald Elliott, Bruce A. Ackerman & John C. Millian, *Toward a Theory of Statutory Evolution: The Federalization of Environmental Law*, 1 J.L. ECON. & ORG. 313 (1985); Sanford E. Gaines, *Rethinking Environmental Protection, Competitiveness, and International Trade*, 1997 U. CHI. LEG. F. 231.

150. See Daniel Bodansky, *What's so Bad about Unilateral Action to Protect the Environment?*, 11 EUROPEAN J. INT'L L. 339, 344 (2000) ("unilateral action, or its threatened use, has often played a critical role in the development of international standards to protect the environment").

151. See RICHARD BENEDICK, *OZONE DIPLOMACY: NEW DIRECTIONS SAFEGUARDING THE PLANET* 27-28 (1991).

152. DuPont, the largest chemical company in the U.S. and also the largest U.S. manufacturer of CFCs, resisted domestic regulation of CFCs, citing uncertainty regarding the extent and causes of ozone depletion. Barbara A. Boczar, *Avenues for Direct Participation of Transnational Corporations in International Environmental Negotiations*, 3 N.Y.U. ENVTL L. J. 1 23-27 (1994).

153. DESOMBRE, *supra* note 141, at 94.

154. *Id.* at 93.

partial about face and publicly endorsed international regulation of ozone-depleting substances.<sup>155</sup> Their logic was that it was better that the entire CFC industry, worldwide, be regulated rather than only those producers located in the United States,<sup>156</sup> and that, if international regulation was going to be a reality, it was better to try to shape those regulations than to be caught unawares. Eventually, countries negotiated the Montreal Protocol to the Vienna Convention, which entered into force in 1989.<sup>157</sup>

In a similar manner, the demand by industry for a level playing field could transform subglobal initiatives on climate change into regulation of greenhouse gases at higher jurisdictional levels. In the United States, for example, utilities subject to restrictions on carbon dioxide emissions in certain states are already arguing that they are disadvantaged in competition with utilities from states that are not regulating such utility emissions.<sup>158</sup> It is thus foreseeable that state and

155. Up until 1986, both American and European producers had steadfastly opposed international regulation of CFCs. Benedict, *supra* note 151, at 31.

156. See Richard Barnett, *Business Forum: Saving the Earth's Ozone Layer; The U.S. Can't Do the Job All Alone*, N.Y. TIMES, Nov. 16, 1986, at 2. Richard Barnett was the Chairman of the Alliance. See also ALLIANCE FOR RESPONSIBLE CFC POLICY, THE MONTREAL PROTOCOL, 1-3; Dupont Position Statement on the Chlorofluorocarbon-Ozone-Greenhouse Issues, 13 ENVTL. CONSERV. 363 (1986).

157. Montreal Protocol on Substances that Deplete the Ozone Layer, Sept. 16, 1987, S. Treaty Doc. No. 100-10, 1522 U.N.T.S. 3. Another example can be found in the evolution of a multilateral agreement to prevent oil pollution through the use of double-hulled tankers. See DAVID HUNTER, JIM SALZMAN, AND DURWOOD ZAEKE, INTERNATIONAL ENVIRONMENTAL LAW AND POLICY, CASE STUDY: THE OIL POLLUTION ACT OF 1990, 731 (2002); Bodansky, *supra* note 150, at 344. In 1990, shortly following the disastrous *Exxon Valdez* oil spill in Prince William Sound, the United States, contending that then-existing international standards for tanker safety were inadequate, enacted legislation prohibiting certain tankers from entering United States waters after 2010 unless they are equipped with double-hulls. Oil Pollution Act of 1990, Pub. L. No. 101-380 (1990) (codified at 33 U.S.C. §§ 2701-2720 (2000)). The double-hull requirement can be found in Section 4115 of the Act. Two years later, presumably responding to calls to level the playing field between tankers servicing U.S. ports and those servicing other international ports, countries amended the multilateral oil pollution agreement for the seas to require that new tankers be equipped with a double-hull, or its equivalent, beginning in 1993. International Convention for the Prevention of Pollution from ships (MARPOL), London, 2 Nov. 1973, reprinted in 12 I.L.M. 1319 (1973); Protocol of Feb. 17, 1978. See Bodansky, *supra* note 150, at 344. Regulation 13F to Annex I of Marpol 73/78. Regulation 13F requires that all new tank vessels built after a certain date be fitted with double hulls, a mid-deck design, or the equivalent.

A more recent example is found in the decision by computer chip manufacturers to throw their support behind a global agreement to reduce perfluorocarbons, a chemical used in chipmaking that is also a potent greenhouse gas. Their motivation was the worry that the European Union would ban the use of perfluorocarbons altogether. See Carey, *supra* note 144. By achieving a worldwide agreement to reduce perfluorocarbons by ten percent by 2010, the manufacturers shortcircuited the EU's more drastic regulatory attempts which may have been copied by other nations. *Id.*

158. See, e.g., Discussion Following the Remarks of Mr. Stephenson and Dr. Page, 28 CANADA-U.S. L. J. 67, 69 (2002) (quoting a U.S. utility corporation official, as stating:

We are part of an organization in Washington of U.S. electrical utilities concerned about the unlevel playing field, if I can use that term, between some of us who are selling power into California from states that are regulating CO<sub>2</sub> competing with companies based in states that are not regulating CO<sub>2</sub>. We believe that is a competitive disadvantage that creates an unlevel playing field. It is a kind of process that, with time, may see increasing lobbying in Washington in the future for federal action here.).

local action in the United States could trigger federal greenhouse gas regulation, and that broader national regulation could result in either a multilateral greenhouse gas agreement or broader participation in the Kyoto agreement.

### B. *The Search for Larger Substitute Product Markets*

The example of international regulation to preserve the ozone layer illustrates a second mechanism for the upward migration of environmental law—the search, by substitute-good manufacturers, for larger markets in which to market their goods. Substitutes for CFCs were developed in the United States by Dupont, the major producer of CFCs, after the United States enacted restrictions upon CFC use.<sup>159</sup> However, this very development of a safe substitute gave the substitute product producers an incentive to create an international market for their product through international regulation.<sup>160</sup> Hence the drive for larger markets for substitute products, often triggered by subglobal regulation, can lead to global regulation.

### C. *Use of Market-Based Regulatory Tools*

A third mechanism that can contribute to the upward migration of subglobal environmental regulation is the subglobal government's use of a market-based regulatory mechanism. An easy to understand example is that of emissions trading. The idea behind emissions trading is to create a market among pollution-emitting facilities in either credits, which represent an amount by which a facility has reduced its emissions, or allowances, which represent permissions to emit a certain amount of pollution. A competitive market in credits or allowances will ensure that their price most nearly reflect the costs of emissions controls.<sup>161</sup> The simplest route to a competitive market is to ensure that the market is sufficiently large so as to have the highest possible number of market participants. Hence, should the architects of a subglobal government desire a workable emissions trading scheme, it is likely that they will gravitate toward the creation of as large a market as is feasible.

### D. *Regulatory Remedies Provided by Federal Environmental Laws*

In the United States, federal environmental laws provide interested persons with legal tools to require the federal government to regulate environmental harms. Two such tools are provisions allowing persons to

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159. DESOMBRE, *supra* note 141, at 27-28.

160. *Id.* at 28.

161. See, e.g., Fredric C. Menz, *Transborder Emissions Trading Between Canada and the United States*, 35 NAT. RES. J. 803, 814 (1995) (suggesting that a bi-national sulfur dioxide emissions trading program encompassing the United States and Canada would be more competitive than a market limited to either country because an expanded market would allow for greater opportunities to trade).

petition the federal government to commence a rulemaking action and provisions allowing "any person" to commence a legal action against the United States for failure to carry out a duty that is nondiscretionary under the law. By far, the most frequent users of the statutory mandamus right of federal environmental laws has been environmental organizations. Nevertheless, states are occasionally plaintiffs, usually when they are seeking to have the federal government adopt regulation of an environmental problem that they have themselves already adopted out of the perception that, in the absence of similar regulations on the federal level, their regulatory program may discourage the location of industry or even cause their existing industries to move to another jurisdiction lacking such regulation.<sup>162</sup>

### E. Conclusions

The discussion above, presenting examples of the domino effect in action, would seem to indicate that greenhouse gas initiatives at the subglobal level could trigger climate change regulation at "higher" jurisdictional levels. Several of the mechanisms described above which have in the past contributed to the domino effect are applicable to the regulatory programs for greenhouse gases, and, indeed, some of them are already underway, posing the possibility that actions at the smaller, subglobal level may result in greenhouse gas regulation by the larger subglobal units of which they are a part.

As in past situations that have resulted in environmental regulation, climate change presents opportunities for coalitions between industry and environmentalists—combinations of so-called "baptists and bootleggers."<sup>163</sup> Industry supporters of greenhouse gas regulation include manufacturers of products that compete with coal and oil, such as natural gas and nuclear power companies and makers of low-emission diesel engines,<sup>164</sup> but also major players in the fossil fuel industry. The Global Climate Coalition, which once attempted to present a united front of oil and gas industries against the Kyoto Protocol, fell apart when major companies, such as Shell Oil, BP and the American Electric Power Company defected based on their calculation that

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162. See, e.g., *Am. Lung Ass'n v. Reilly*, 962 F.2d 258 (2d Cir. 1992) (in underlying action, five northeastern states joined the American Lung Association in filing a citizen suit under the Clean Air Act against the EPA together with the American Lung Association alleging that EPA had breached a nondiscretionary, statutory duty of reviewing (and if necessary revising), at five-year intervals, the National Ambient Air Quality Standards for ozone); *Env'tl. Def. Fund v. Thomas*, 870 F.2d 892 (2d Cir. 1989) (seven states joined environmental groups in filing a citizen suit under the Clean Air Act against the EPA for failure to revise National Ambient Air Quality standards for sulphur oxides); *New York v. Browner*, 50 F. Supp. 2d 141 (N.D.N.Y. 1999) (suit by New York, Connecticut and New Hampshire against EPA claiming EPA failed to comply with its nondiscretionary duty to include in a report on acid deposition standards sufficient to protect sensitive and critically sensitive species).

163. Bruce Yandle & Stuart Buck, *Bootleggers, Baptists and the Global Warming Battle*, 26 HARV. ENVTL. L. REV. 177 (2002).

164. Marianne Lavelle, *A Shift in the Wind on Global Warming*, U.S. NEWS & WORLD REP., Mar. 19, 2001, at 38.

they might reap greater benefits under Kyoto than outside it.<sup>165</sup> In a similar vein, Entergy announced in 2001 that it would become the first U.S. electric company member of the "Partnership for Climate Action", a coalition of international business and environmental leaders that support climate protection policies.<sup>166</sup>

Many members of these industries recognize that not all greenhouse gas regulatory regimes are equal; a regime consisting of different regulatory policies by state, local, and even national governments carries with it increased compliance costs in comparison to uniform national regulation. For example, as a result of electricity deregulation in many states, the reach of electricity grids and markets is now regional, if not national. A patchwork of different state and regional climate regulations could increase costs and to a degree undermine industry competition.<sup>167</sup> Environmental groups, eager to expand the scope of greenhouse gas regulation by instilling it on the national level, have emphasized the vastly different carbon dioxide emissions of power plants located in different states—disparities that would be eradicated by the "level playing field" of national regulation.<sup>168</sup> Interestingly, the American Legislative Exchange Council, a conservative group that lobbies state legislatures, insists that, by raising the specter of a patchwork of inconsistent state laws, the sheer number of recent state and local legislative initiatives on climate change reveals an orchestrated effort to create a mandate for federal legislation.<sup>169</sup>

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165. Steve Liesman, *Inside the Race to Profit from Global Warming: Big Business Produces Some Unexpected Converts*, WALL ST. J., Oct. 19, 1999, at B1. For example, in 1999, Shell Renewables, a subsidiary of Shell Oil Company, established the world's largest solar-panel plant and established Shell Hydrogen to manufacture fuel cells. *Id.*

166. Press Release, Environmental Defense, *Entergy, Environmental Defense Team to Reduce Greenhouse Gases*, May 3, 2001, available at <http://www.environmentaldefense.org/pressrelease.cfm?ContentID=110>.

167. Douglas W. Smith & Kyle W. Danish, *Climate Change: The Heat is On*, PUB. UTIL. FORT. 54 (Jan. 2004).

168. A report from CERES, a national coalition of environmental and investor groups, the Natural Resources Defense Council (NRDC), and Public Service Enterprise Group Inc., entitled *BENCHMARKING AIR EMISSIONS OF THE 100 LARGEST ELECTRIC GENERATION OWNERS IN THE US - 2000*, concludes that fewer than twenty power generation companies in the United States account for fifty percent of carbon dioxide (CO<sub>2</sub>), mercury (Hg), oxides of nitrogen (NO<sub>x</sub>), and sulfur dioxide (SO<sub>2</sub>) emitted into the air by the 100 largest public and private electric power companies in the U.S. and between four and six companies accounted for 25 percent of emissions of each pollutant. Remarkings on the report's findings, a staffmember of the Natural Resources Defense Council said,

[t]he high emission levels of many companies and the vast differences in emission rates among companies demonstrate the need for comprehensive power plant pollution clean up legislation. . . . The Senate Environment and Public Works Committee is currently considering the Clean Power Act, which would deliver the pollution reductions the public has a right to expect, while creating a level playing field for increasingly competitive electricity generators.

Press Release, CERES, *Report Benchmarks Pollution from Top 100 Electric Companies, Shows Disparities Among Competitors* (Mar. 21, 2002), available at [http://www.ceres.org/news/news\\_item.php?nid=82](http://www.ceres.org/news/news_item.php?nid=82).

169. See Alexandra Liddy Bourne, Director, Energy, Environment, Natural Resources and Agriculture Task Force, Am. Legislative Exchange Council, Testimony to the Maine Committee on

Makers of energy products that substitute for fossil fuels, in particular renewable energy, have incentives to support the regulation of greenhouse gases by larger subglobal governments, as this would increase their market-share. An example of this is the push for a national renewable portfolio standard, bringing to the federal level a requirement has already proven popular on the state level. Not surprisingly, legislation to enact a national renewable portfolio standard in Congress<sup>170</sup> is strongly supported by the renewable energy industry<sup>171</sup> and by at least one major electric power company.<sup>172</sup>

Recognition of the greater efficiency of market-based mechanisms as a factor contributing to the expansion of the scope of subglobal regulatory

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Natural Resources: Greenhouse Gas Regulation in the States (Mar. 13, 2003), available at <http://www.alec.org/> (reporting that 66 bills related to regulation of greenhouse gases were introduced in 25 states in the 2001-2002 general assembly session, and 60 bills in 24 states in the 2002-03 session, and stating,

It is unusual to have so many bills with similar language introduced across the country. We can only surmise that there is an orchestrated effort to create a regulatory framework for a federal mandate in the short term and a carbon emissions cap and trade credit system in the long term.).

170. The Renewable Energy and Energy Efficiency Act of 2001 (S. 1333), proposed by Sen. Jeffords (I-VT) and five other Senators, would impose a national minimum renewable energy content for electricity generators that would increase to 20 percent by 2020.

171. See, e.g., Press Release, Geothermal Energy Ass'n, *Geothermal Industry Applauds Senate Energy Bill* (July 31, 2003), available at [http://www.eere.energy.gov/geothermal/pdfs/news7\\_31\\_03.pdf](http://www.eere.energy.gov/geothermal/pdfs/news7_31_03.pdf) (requiring that ten percent of all electricity nationally originate from renewable energy sources by 2020 – double the otherwise expected renewable power percentage – at the same time preserving the state RPS legislation already in effect).

172. See PSEG, *Renewable Power*, at <http://www.pseg.com/environment/climate/new.jsp> (“PSEG supports reasonable Federal Renewable Portfolio Standards such as those recently proposed by Senator Jeff Bingaman (D, N.M.)”). PSEG represents an electric utility that has already committed to support renewable power in its home state of New Jersey and hence a national RPS would ensure that it is not disadvantaged by its state-level commitments. See Business Wire, *Natural Resources Defense Council and New Jersey Electric and Gas Utilities Join to Create New Generation of Renewable Energy & Conservation Programs in New Jersey* (Feb. 10, 2000), available at <http://www.businesswire.com/webbox/bw.020900/200401734.htm> (announcing settlement between Natural Resources Defense Council, PSEG and three other utilities that resulted in the filing, with the New Jersey Board of Public Utilities, of a \$ 423 million plan to support the development of renewable energy technologies in New Jersey, such as photovoltaic solar generators, small wind systems and fuel cells). PSEG’s position on a national RPS reflects its support for mandatory national emissions controls for carbon dioxide. Ken Silverstein, *Tougher CO<sub>2</sub> Controls are Coming*, UTILIPOINT INTERNATIONAL, INC.’S ISSUEALERT (Jan. 15, 2004), available at <http://www.utilipoint.com/issuealert/article.asp?id=1976> (“Newark-based PSEG supports tougher, uniform national carbon dioxide regulations, endorsing a federal measure to make CO<sub>2</sub> reductions mandatory.”). Again, this seems to be motivated by a desire to level the competitive playing field since it is subject to stringent air pollution controls in New Jersey. See Lisa Prevost, *Renewable Energy: Toward a Portfolio Standard?*, PUB. UTIL. FORT. (Aug. 1998) (quoting Tony Borden, PSEG vice president, as supporting uniform EPA regulation of utility carbon dioxide emissions, stating,

New Jersey has had extremely tough air standards, and we've had to make a strong investment here . . . . We don't think it's fair for other utilities to just grind it up a few notches on the output of their plants and send that power here when they don't have to meet the standards we do.).

programs is also at play with respect to direct greenhouse gas regulation.<sup>173</sup> For instance, when New York decided to implement a trading market in carbon dioxide credits, it approached other Northeastern states to develop a regional emissions trading market.<sup>174</sup> While the northeastern states have yet to actually implement a cap and trade system, they are currently engaged in an ambitious project to quantify greenhouse gas from various commercial sectors as a necessary first step toward the development of such a system.<sup>175</sup> In comments revealing their faith in the power of the "domino effect" as it carries national regulation to the international level, opponents of the Kyoto Protocol openly worry that Administration plans for a voluntary program for tradable emissions credits in the United States will "create the institutional framework for a future Kyoto-style emissions cap-and-trade program."<sup>176</sup>

#### CONCLUSION

Our overall goal in this Article has been to explore policy options for addressing a global commons environmental problem in the absence of a comprehensive binding international agreement. More narrowly, using climate change as the quintessential global commons problem, we have (1) questioned the prevailing wisdom that unilateral action by individual countries to restrain despoliation of the global commons is presumptively irrational, and have shown that despite the existence of free-riding by nonregulating commons-users and the "leakage" of benefits, unilateral regulation can still result in a net-benefit to the subglobal regulator; and (2) probed the reasons for the failure of subglobal actors to implement unilateral action more aggressively to at least reduce greenhouse gases to levels considered optimal under noncooperative equilibrium models. We have suggested that unilateral subglobal regulation is a viable, if not optimal, approach to global commons environmental problems.

This Article thus lends support to the growing number of climate protection initiatives by state and local governments in the United States. Many of these actions are not truly regulatory, in the sense that they do not mandate greenhouse gas emissions reductions, but rather lay the foundation for future regulations. Given our conclusion that the United States currently falls short of

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173. See Smith & Danish, *supra* note 167 ("Moreover, inconsistent state and regional policies related to emissions accounting and crediting systems could inhibit the development of cost-saving emissions trading markets . . . [T]he proliferation of inconsistent state and local policies eventually could give rise to calls from regulated entities for national greenhouse gas legislation.").

174. The proposal to develop a regional cap and trade system grew out of recommendations by the New York Greenhouse Gas Task Force. See Ctr. For Clean Air Policy, *April - July 2003 Newsletter*, available at <http://www.ccap.org/pdf/2003-Newsletter--April-July.pdf>.

175. See Northeast States for Coordinated Air use Management, at <http://www.nescaum.org> (describing the Regional Greenhouse Gas Registry (RGGR) at <http://www.rgrr.us>).

176. Am. Legislative Exchange Council, An Open Letter To President Bush About His Plan To Award Regulatory Credits For "Voluntary" Greenhouse Gas Reductions (Oct. 2, 2002), at <http://www.alec.org/> (search for "regulatory credits" using the search box, and select "An Open Letter to President Bush").

the reductions needed to reach noncooperative equilibrium levels, and hence is worse off as a result of its failure to more effectively control greenhouse gas emissions, state and local governments (as well as the federal government) should be encouraged to move ahead and turn these foundational measures into actual regulatory restrictions.

Our purpose here has not been to denigrate the negotiation of cooperative international standards, as such cooperative solutions remain the optimal framework for addressing global commons problems. Rather, the purpose has been to suggest additional policy tools that may be implemented when the international avenue is, for some reason, temporarily or permanently blocked. In such cases, we contend that unilateral action by subglobal actors is better than none; that a glass "half empty" is also a glass "half full." Not only does such activity promise results, especially when engaged in by large emitters, but it may also help in eventually achieving an international solution. By means of a number of "domino effect" mechanisms, environmental regulation at lower subglobal levels is capable of triggering regulation at higher levels. Thus, while not promising pareto-optimality, emissions reductions regulation by subglobal jurisdictions may end up taking us much of the way there.

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