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From Global to Polycentric Climate Governance

Daniel H. Cole
Indiana University Maurer School of Law, dancole@indiana.edu

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From global to polycentric climate governance

Daniel H. Cole*

Abstract. Global governance institutions for climate change, such as those established by the UNFCCC and the Kyoto Protocol, have so far failed to make a significant impact on greenhouse gas emissions. Following the lead of Elinor Ostrom, this paper offers an alternative theoretical framework for reconstructing global climate policy in accordance with the polycentric approach to governance pioneered in the early 1960s by Vincent Ostrom, Charles Tiebout, and Robert Warren. Instead of a thoroughly top-down global regime, in which lower levels of government simply carry out the mandates of international negotiators, a polycentric approach provides for greater experimentation, learning, and cross-influence among different levels and units of government, which are both independent and interdependent. After exploring several of the design flaws of the existing set of global institutions and organizations for greenhouse gas mitigation, the paper explores how those global institutions and organizations might be improved by learning from various innovative policies instituted by local, state, and regional governments. The paper argues that any successful governance system for stabilizing the global climate must function as part of a larger, polycentric set of nested institutions and organizations at various governmental levels.

I. Introduction

Climate change is the greatest collective action problem the international community has ever confronted.[1] Because the problem is global in scope—greenhouse gas emissions from anywhere in the world contribute to rising global mean temperatures and global mean temperature increases entail differential but substantial risks for all countries—it cannot be successfully resolved in the absence of effective global governance. Unfortunately, the global governance institutions

* Indiana University Maurer School of Law, <dancole@indiana.edu>. I am grateful for helpful comments and suggestions on an earlier draft of this paper from Elinor Ostrom, Joanne Scott, Carlton Waterhouse, Alexander Zahar, and participants in the May 2011 Workshop on Comparative Institutional Analysis and Global Governance at the European University Institute, Florence.

[1] See Daniel H. Cole, *Climate Change and Collective Action*, 61 Current Legal Problems 229 (2008); Elinor Ostrom, *Nested Externalities and polycentric institutions: must we wait for global solutions to climate change before taking action at other scales?,* Economic Theory (Online First, 6 August 2010); Jouni Paavola, *Climate Change: The Ultimate 'Tragedy of the Commons'?*, *in* Property in Land and Other Resources (D. Cole and E. Ostrom eds., 2011).

created so far—consisting in the UNFCCC, Kyoto Protocol, and various subsidiary programs, policies, and administrative organizations—have been almost completely ineffectual because of flawed designs and implementation.

The purpose of this paper is not to engage in hand-wringing about the current state of the global governance regime for climate change, or to recommend specific changes. Rather, the goal is to foster an improved understanding how global governance institutions for climate change must function (or fail to function) within a larger, polycentric set of nested institutions and organizations at various governmental levels.[2]

Elinor Ostrom recently observed that "'Global solutions', negotiated at a global level—if not backed up by a variety of efforts at national, regional, and local levels—are not guaranteed to work effectively".[3] To the contrary, they are virtually doomed to fail. No global or international regime (defined as a set of institutions and organizations) can succeed in the absence of support ranging from national implementing legislation to national and sub-national monitoring and enforcement activities. Effective monitoring and enforcement may even require the active participation of non-governmental groups at the local level.[4] So, *effective* global governance institutions inevitably are "polycentric" in nature.[5]

Polycentrism is not, however, just about the participation of multiple levels of government in providing a public good (or mitigating the opposite). A system that is purely hierarchical, with lower levels of government simply carrying out orders from those at higher levels, is not substantially polycentric, as that term is utilized in the literature. Rather, polycentric governance requires a certain level of independence, as well as interdependence, between governance institutions and organizations at various levels. The key issue—applicable to climate policy as much as to other areas of global or international concern—is to determine the appropriate division of responsibility and authority between governance institutions and organizations at global, national, state, and local levels.[6]

To comprehend the polycentric approach, one must first understand the important distinction (as well as the relation) between "government" and "governance". At a basic level, as Jouni

[2] For the sake of clarity, I follow Douglass North's definition of "institutions" as the "rules of the game," including both formal legal rules and informal social norms, that incentivize human behavior. On North's definition, courts, legislative bodies, etc., are not "institutions", but "organizations". See, e.g., Douglass C. North, Institutions, Institutional Change, and Economic Performance 3-4 (1990). North's is not the only definition of "institution", of course. Neil Komesar, for example, defines an "institution" as a decision-making process. The products of such processes (the rules) are not, themselves, the institutions. See Neil K. Komesar, Law's Limits: The Rule of Law and the Supply and Demand of Rights (2001).

[3] Ibid.

[4] As we shall see, this is the case, for example, with respect to forest monitors for carbon offsets under the United Nations Reducing Emissions from Deforestation and Forest Degradation in Developing Countries Program (REDD). See infra notes 73-75 and accompanying text.

[5] The polycentric approach is presented in Section IV.

[6] Another important distinction is between the respective roles of public and private governance institutions, although that distinction is not highlighted in this paper.

Paavola has succinctly expressed it, "governance is what governments do".[7] But governance is not a function limited to the state. Myriad non-governmental organizations, ranging from multi-national corporations to local neighbourhood associations, and even individual property owners, play important roles in governing resources. Thus governance is a "continuum between state-based solutions and solutions which do not involve the state, with hybrid forms in between".[8]

The next section briefly explores the role of global governance in international environmental law generally, and explains why climate change presents an unparalleled challenge for global governance, entailing complications far beyond others the international community has confronted, including depletion of the stratospheric ozone layer. While the "Ozone Accords" (to phase out ozone-depleting substances) are often presented as a model for global environmental agreements, including for climate change,[9] the political and economic dynamics of climate change are far more complex than those involved in the ozone negotiations. Those complications largely explain the design flaws in, and failure (so far) of, the existing global climate-governance regime—recounted in section III, below. The Kyoto Protocol's flaws virtually ensured that it would not reduce global GHG emissions even modestly. Section IV introduces the polycentric governance approach pioneered by social scientists Vincent Ostrom, Charles Tiebout, and Robert Warren in the early 1960s.[10] It provides a basis for rethinking the architecture of climate-stabilization efforts. Section V observes various ways in which institutions at sub-global levels already are making important contributions to climate policy, and considers how greater attention to the appropriate nesting of polycentric climate institutions (which I presume would be based on comparative institutional analysis) could improve the overall quality of climate governance. The paper concludes with additional thoughts on the importance of polycentricity to the evolutionary development of future global climate governance.

II. International Environmental Law as a Realm of Global Governance

It is a truism that environmental problems do not respect legal or political boundaries. Transboundary problems generally require cooperative solutions.[11] In rare but important cases environmental problems impact the "global commons" (global public goods), *seemingly* requir-

[7] Paavola, supra note 1, at 417.

[8] Ibid, at 418.

[9] See infra notes 13-17 and accompanying text.

[10] Vincent Ostrom, Charles Tiebout, and Robert Warren, *The organization of government in metropolitan areas: A theoretical inquiry*, 55 Amer. Pol. Sci. Rev. 831 (1961).

[11] Cooperation is only "generally" required because in some cases unilateral action can resolve social-cost problems. Just as social cost problems between a neighboring crop farmer and cattle rancher, to borrow Ronald Coase's famous example, could be resolved by either party acting alone, so too could at least *some* boundary issues between neighboring states or countries. See Ronald Coase, *The Problem of Social Cost*, 3 J. L. & Econ. 1 (1960). The big question, of course, is whether one party has sufficient incentives to resolve a social cost problem unilaterally. Sometimes they do, as indicated in the discussion below of asteroid strikes. More often, they do not.

ing cooperation at the global level. Examples include the global trade in endangered species, global emissions of substances that deplete the ozone layer, diseases that can cause global pandemics (smallpox, polio, influenza), avoidance of potentially catastrophic asteroid strikes, and of course climate change. It is important to bear in mind, however, that the geographic scale of the threat does not, by itself, determine the scale of the regime needed to avert or minimize the threat. Not every global threat necessitates global governance. Even when global governance is necessary, institutions established at the international or global level are never sufficient, by themselves, for successfully resolving global problems.

Asteroid strikes are an interesting example of a potentially global problem that does not necessarily require a global governance solution. The prevention of large asteroid strikes is, as Scott Barrett describes it, a "single best effort" public good.[12] A single wealthy country, such as the United States, may have the wherewithal, the technology, and even the incentives to alter the path of large asteroids before they can strike the Earth. Some international or global collective action might be desirable for logistical or political reasons, and several wealthy countries would likely be willing to cooperate voluntarily, for instance to minimize the risk of error by a single decision-maker, but no *global* agreement would be needed to resolve the global threat.

Depletion of the stratospheric ozone layer presented the international community with a very different kind of global public-good problem. Simply put, the problem stemmed from anthropogenic emissions of ozone-depleting substances—primarily chemical refrigerants—emitted from millions of discrete sources throughout the world, but primarily from developed countries, where refrigeration and air conditioning are more prevalent. The 1987 Montreal Protocol and other agreements comprising the "Ozone Accords," phased out of production and use the most harmful ODS, several of which are also harmful as greenhouse gases.[13] So successful was the global governance regime for protecting the ozone layer that its framework-convention-and-protocol approach to resolving complex, international environmental issues became the model for all subsequent international environmental regimes, including for climate change.[14] Indeed, efforts to deal with climate change have sometimes, albeit naively, been compared with those

[12] Scott Barrett, Why Cooperate? The Incentive to Supply Global Public Goods Ch. 1 (2007).

[13] It is no exaggeration to say that the Ozone Accords, although not primarily concerned with climate change, have been as or more effective than the Kyoto Protocol in reducing greenhouse gas emissions. See Guus J. M. Velders et al., *The importance of the Montreal Protocol in protecting climate*, 104(12) Proc. Nat'l Acad. Sci. 4814 (2007) ("The climate protection already achieved by the Montreal Protocol alone is far larger than the reduction target of the first commitment period of the Kyoto Protocol").

[14] On the success of the Ozone Accords, see, e.g., Richard Elliot Benedick, Ozone Diplomacy: New Directions in Safeguarding the Planet (1998); John K. Setear, *Ozone, Iteration, and International Law*, 40 Va. J. Int'l L. 193 (1999). On the Ozone Accords as a model for future global environmental regimes, see, e.g., Edward A. Parson, *Protecting the Ozone Layer*, in Institutions for the Earth: Sources of Effective International Environmental protection 27 (P.M. Haas *et al.* eds., 1993); Peter Morrisette, *The Montreal Protocol: Lessons for Formulating Policies for Global Warming*, 19 Pol'y Stud. J. 152 (1991).

to protect the ozone layer.[15] Some common features are evident. Both problems are global in scope and both have been subject to substantial scientific uncertainty and controversy. However, as I have explained elsewhere,[16] climate change presents an almost immeasurably greater collective-action problem.

The ozone negotiations boiled down to a bilateral market conflict between the United States and a few EU member states—the United Kingdom, France, and Germany—which were major producers of chlorofluorocarbons and other ODS. The largest US producer, DuPont, had already developed reliable and affordable ODS substitutes, usable in existing systems. This technological edge effectively determined the US bargaining position in favour of phasing out ODS. The United States led the fight for the Montreal Protocol, burnishing its global environmental reputation while furthering its (and DuPont's) commercial interests. On the other side, the European Union called for more research before regulating ODS—a position that obviously was in the commercial best-interest of its own chemical producers. The United States won the battle after a shift in EU leadership, several members of which did not share the vested interests of the United Kingdom, France, and Germany. Of course, the ozone negotiations also included other countries from around the world, including developing countries, which were mainly concerned with access to an affordable supply of reliable refrigerants. Their acquiescence was purchased, early on, by guarantees of compensation for the marginal-cost increases stemming from ODS phase-out and conversion to new refrigerants.[17]

The fact that relatively few parties had significant commercial interests at stake in the ozone negotiations made it a relatively simple global problem. Climate change, by contrast, presents a far more difficult collective-action problem for several reasons; in brief:[18] (1) the costs and benefits of climate change (or climate change mitigation) are expected to be distributed differentially around the world, creating (comparatively at least) winners and losers;[19] (2) the goal of climate stabilization conflicts with the countervailing need to meet rising global-energy demand, which is a major concern for all developed and developing countries; (3) low-carbon energy technologies that might ameliorate conflicts between the twin goals of reducing carbon emissions and increasing energy supplies are not yet "available" as substitutes for fossil fuels, and will

[15] See, e.g., Richard Elliot Benedick, *The diplomacy of climate change: Lessons from the Montreal Ozone protocol,* 19 Energy Pol'y 94 (1991); Chris Peloso, *Crafting an International Climate Change Protocol: Applying the Lessons Learned from the Success of the Montreal Protocol and the Ozone Depletion Problem*, 25 J. Land Use & Envtl. L. 305 (2010).

[16] Cole, supra note 1.

[17] See Cole, supra note 1, at 237; Benedick, Ozone Diplomacy, supra note 15.

[18] For more detailed explanations of each of these reasons, see Cole, supra note 1; also see Cass R. Sunstein, *Of Montreal and Kyoto: A Tale of Two Protocols*, 31 Harv. Envt'l L. Rev. 1 (2007).

[19] This assumes moderate climate change with global mean temperature increases below 5°C. At higher temperatures, the risk of severe—even catastrophic—climate change increases. If global mean temperatures increase by 7 or 8°C, all countries may suffer heavy losses from climate change. See, e.g., Martin Weitzman, *On modeling and interpreting the economics of catastrophic climate change*, 91 Rev. Econ. & Stat. 1 (2009).

certainly not supplant fossil fuels two decades at least;[20] and (4), in large part because of (3), climate change mitigation lacks the kind of substantial corporate/commercial support that DuPont gave the Ozone Accords. These reasons go a long way towards explaining the various flaws and weaknesses in the Kyoto Protocol and related agreements.

III. Flaws in the Existing Global Climate-Governance Regime

The design flaws of the global climate regime have been so thoroughly described in the literature[21] that not much space needs to be devoted here to rehearsing them. The majority of the problems arise under the Kyoto Protocol rather than the UNFCCC, which, as a framework convention, imposes only minor substantive obligations on the parties. This section focuses on four flaws: (1) the lack of sufficiently stringent emission-reduction targets; (2) the problem of "hot air"—excess emission credits that do not represent actual emission reductions; (3) the reliance on inherently unreliable counterfactual baselines in offset programs; and (4) the high administrative costs of *comprehensive* trading in GHGs from virtually all sources.

The Kyoto Protocol is, at once, exceedingly modest and overly ambitious. Modest are its mitigation targets for developed countries. Ambitious are its elaborate emissions-trading and offset programs, which the parties adopted without due consideration for technical and institutional problems, including high administrative costs (e.g., costs of monitoring and enforcement).

Several Annex I countries, including Iceland, Norway, and Australia, received allocations in excess of 1990 emissions. East European countries in transition accepted targets of no change from 1990 levels. This was, in effect, a generous gift of excess emissions allowances to those countries.[22] Russia received an especially generous portion of "hot air" as a "side payment" for its ratification of the Kyoto Protocol.[23] Its participation and ratification were purchased with the very currency (GHG emissions) the international community was attempting to render scarce for the purpose of creating a viable GHG market. Thanks to the hot-air allowances, the Kyoto Protocol's *statistical* average emissions reduction of 5.2 per cent substantially overstates the actual, aggregate emissions reductions required from Annex I countries.[24] Meanwhile, emissions from developing countries, which are not subject to mandatory reductions under the Kyoto Protocol,

[20] The term "available" appears in scare quotes to denote its use as a quasi term of art. In this context, "available" means the technology exists, is reliable, and is not cost-prohibitive. On those metrics, it is clear that biofuels, solar, wind power, etc., are not "available" substitutes for fossil fuels; at best they are minor supplements. The International Energy Agency's *World Energy Outlook 2010* projects that fossil fuels will remain "the dominant energy sources in 2035" under various demand scenarios. See <http://www.worldenergyoutlook.org/docs/weo2010/WEO2010_ES_English.pdf> at 4.

[21] See, e.g., Cole, supra note 1; David Victor, The Collapse of the Kyoto Protocol and the Struggle to Slow Global Warming (2001).

[22] See, e.g., Daniel H. Cole, Instituting Environmental Protection: From Red to Green in Poland, ch. 7 (1998).

[23] See, e.g., Urs Steiner Brandt and Gert Tinggaard Svendsen, *Surplus emission allowances as side payments: could 'Hot Air' have saved the Kyoto Agreement?*, 4(3) Climate Policy 303 (2005).

[24] See C. Dasgupta, *The Kyoto Protocol After Marrakesh*, 2(1) Int'l J. Reg. & Governance 45 (2005).

have been increasing so rapidly as to more than offset any emissions reductions from developed countries. Even assuming full compliance, the Kyoto Protocol has been entirely consistent with a net increase in global GHG emissions.

Given the Kyoto Protocol's modest targets, one might wonder why the parties focused so much attention on minimizing the costs of achieving them by establishing the flexibility mechanisms—emissions trading, JI, and the CDM.[25] It is unclear to what extent those programs have actually lowered compliance costs for countries with binding emission-reduction targets, but they have undermined the environmental integrity of Kyoto's mitigation regime by providing opportunities for countries to buy their way out of domestic emission reductions with payments for theoretical reductions in other countries. The most problematic trading program has been the CDM. It has been substantially gamed by developing countries, especially China, which has hosted the majority of CDM projects undertaken so far. A sizeable majority of Chinese CDM projects have involved a single gas, HFC-23, a chemical by-product of the manufacture of the refrigerant HCFC-22. Kyoto parties with binding emission-reduction targets have been spending upwards of $800 million per year in China on CDM projects to reduce HFC-23 emissions that could have been incinerated or scrubbed at an estimated cost of just $31 million per year.[26] So profitable have these projects become that HFC-23 has replaced HCFC-22 as the primary product for the Chinese plants.[27]

David Victor has estimated that between one-third and two-thirds of CDM offsets (not just for reductions in emissions of HFC-23) do not reflect actual emission reductions.[28] This may be due partly to implementation problems, but it is also due, at least in part to design flaws, not all of which may be correctable. The EB is currently considering restrictions on CDM projects to reduce HFC-23 emissions from HCFC-22 plants.[29] Even if it were to ban such projects entirely, it would not correct the underlying problem of additionality which depends on counterfactual baselines. The measurement problem inherent in the use of such baselines, and the potential for manipulating them, are endemic to the CDM. In forestry-related offset projects, timber harvesting which is restricted in one area by an offset project may "leak" to another area beyond the boundaries of the CDM project.[30] Under what circumstances could the EB be sure

[25] Since Kyoto, a separate offset program designed especially for forestry-based projects, REDD+, has been integrated into the regime. That program shares many of the same flaws, discussed infra, that plague JI and CDM projects. See infra notes 30-31 and accompanying text.

[26] Keith Bradsher, *Outside Profits, and Questions, in Effort to Cut Warming Gases*, NY Times, 21 December 2006.

[27] This will likely change in 2013, when a new European Commission rule takes effect prohibiting the use of CDM credits from Chinese HFC-23 projects within its own Emissions Trading Scheme. To date, European member states have been the largest funding sources for those CDM projects.

[28] Quoted in John Vidal, *Billions wasted on UN climate programme,* The Guardian, 26 May 2008.

[29] See Executive summary of Methodology Panel Report on HFC-23 Issues (AM0001), EB 58 Report, Annex 11 (undated) <http://cdm.unfccc.int/Reference/Notes/meth_note02.pdf>. As already noted, supra note 26, the EU has already introduced a ban (to take effect in 2013) on member-state participation in HFC-23-related CDM projects.

[30] See infra notes 73–75 and accompanying text on the REDD+ program, which provides for offsets from forest-conservation projects.

that the increased logging in the other area is not a "normal" increase due to market conditions, rather than leakage violating the additionality requirement? Such problems, because they involve counterfactual calculations, seem insuperable.[31]

A more general design flaw in the Kyoto Protocol may be the comprehensive nature of its emission trading regime, which involves GHGs from virtually all sources. The Kyoto parties gave little thought to the problems associated with measuring emissions of various GHGs from different types of sources. Carbon-dioxide emissions from power plants are easily measured, at least in technologically advanced countries—in the United States they have been monitored under the Clean Air Act since 1990. Indeed, CO_2 emissions from combustion do not need to be measured at all, but can be accurately estimated as a coefficient of the carbon content of the fuel and the combustion rate.[32] The measurement problem is not so easily solved for other GHG cases and sources, including carbon emissions from decaying or burning forests, GHG emissions from leaky underground carbon sinks, or methane emissions from rice paddies, the digestive systems of cattle, or melting permafrost.[33] The parties neglected to account for the differential administrative costs, which are likely to be much higher for a comprehensive cap-and-trade regime as opposed to a more limited regime (such as the EU Emissions Trading Scheme or the Regional Greenhouse Gas Initiative of the eastern United States) focused on easily monitored GHGs and sources.[34] Higher administrative costs might offset, or more than offset, the estimated compliance-cost savings of a comprehensive cap-and-trade regime.

Richard Stewart and Jonathan Wiener have argued that a comprehensive cap-and-trade system for GHGs is preferable to one that is limited to easily monitored GHGs because a comprehensive system maximizes compliance-cost savings while minimizing the problem of leakage.[35] By "leakage" here they mean the transfer of GHG-emitting activities from Annex I countries to non-Annex I countries, as well as substitution of unregulated GHGs for regulated GHGs within Annex I countries. The question remains, though, whether the leakage problem is more significant

[31] Jeffrey Frankel, *Formulas for quantitative emission targets*, *in* Architectures for Agreement: Addressing Global Climate Change in a Post-Kyoto World, at 27, 31 (J. E. Aldy and R. N. Stavins, eds., 2007).

[32] See, e.g., <http://www.ecen.com/matriz/eee24/coefycin.htm>. In practice, however, such estimations can be highly complicated. See, e.g., Chris Marnay et al., Estimating Carbon Dioxide Emissions Factors for the California Electric Power Sector, Energy Analysis Department, Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory (Aug. 2002).

[33] See, e.g., Warwick J. McKibbin and Peter J. Wilcoxen, *A credible foundation for long-term international cooperation on climate change*, *in* Architectures for Agreement: Addressing Global Climate Change in the Post-Kyoto World 185, 205 (J. E. Aldy and R. N. Stavins, eds, 2007); Thomas Schelling, *Epilogue: Architectures for agreement*, in Architectures for Agreement: Addressing Global Climate Change in the Post-Kyoto World 343, 344 (J. E. Aldy and R. N. Stavins, eds., 2007) ("Methane, with the possible exception of pipeline leaks, is probably not reliably measurable").

[34] See Daniel H. Cole and Peter Z. Grossman, *Toward a Total-Cost Approach to Environmental Instrument Choice, in* An Introduction to the Law and Economics of Environmental Policy: Issues in Institutional Design, 20 Research in Law and Economics 223, 230, Fig. 1 (T. Swanson, ed., 2002) (showing how the achievement of a quota instrument might be infinitely costly).

[35] Richard B. Stewart and Jonathan B. Wiener, Reconstructing Climate Policy: Beyond Kyoto (2007).

than the monitoring problem associated with a comprehensive cap-and-trade regime. Stewart and Wiener claim that it is, but without any supporting evidence. They dismiss the monitoring problems associated with a comprehensive cap-and-trade system by noting that "Simplified default rules can be adopted to deal with cross-gas comparison indexes and the uncertainties presented in measuring greenhouse gases such as agricultural methane and carbon-dioxide sinks; those rules can be revised as monitoring and measurement techniques improve".[36] But they do not specify what these default rules might look like; nor do they explain how such rules might ensure reliable information about the extent of methane emissions (or reductions in methane emissions) from a rice paddy in Vietnam or carbon-dioxide emission reductions from foregone timber-harvesting in Brazil.

The model for the Kyoto Protocol's emissions trading program was the successful acid rain program from the 1990 Clean Air Act Amendments.[37] But the Kyoto parties failed to learn the appropriate lessons from the acid-rain program, in which the US Congress paid close attention to issues of monitoring, verification, and enforcement. Not only did Congress recognize the importance of adequate monitoring to ensure the integrity of the trading system; it specifically required all regulated facilities to install advanced continuous emission-monitoring systems.[38] By contrast, the parties to the Kyoto Protocol did not include any compliance regime at all, but merely called for future agreement on monitoring and compliance mechanisms. Many countries, and not just the "less developed" ones, lack the institutional or technological capacity for monitoring emissions and enforcing compliance.[39] As David Victor has observed, "Making a trading system work requires... the capacity to monitor the behavior of... enterprises and to enforce compliance. These are not easy tasks. They are akin to what Western governments have had to do when overseeing banking regulation—an area where even highly capable governments have failed, such as the United States did with the savings and loan crisis".[40] (Victor wrote that sentence before the more recent and even more devastating global financial crisis.) According to a qualitative empirical study of the use of "market-based instruments" (MBI), including cap-and-trade, in eleven Latin American and Caribbean countries the increasing use of MBI has "potentially *increased* technical and financial burdens on already fragile institutional structures". The study concludes that "MBIs require strong institutions, adequate legislation, and effective monitoring and enforcement".[41] Of course, all environmental instruments require those attributes to be effective. But institutional and

[36] Ibid. at 60.

[37] On that program, see, e.g., Daniel H. Cole, Pollution and Property: Comparing Ownership Institutions for Environmental Protection 51-9, 79-83 (1992).

[38] See ibid. at 81-2.

[39] See, e.g., Ruth Greenspan Bell and Clifford Russell, *Environmental Policy for Developing Countries*, Issues in Science and Technology (2002), available on-line at <http://www.issues.org/18.3/greenspan.html>.

[40] David Victor, *Fragmented carbon markets and reluctant nations: implications for the design of effective architectures*, in Architectures for Agreement: Addressing Global Climate Change in a Post-Kyoto World 133, 143 (J. E. Aldy and R. N. Stavins, eds., 2007).

[41] See, e.g., Ronaldo Serôa da Motta, Richard M. Huber, and H. Jack Ruitenbeek, *Market based instruments for environmental policymaking in Latin America and the Caribbean: lessons from eleven countries*, 4 Envt. & Dev. Econ. 177, 197 (1999).

technological constraints do not necessarily affect every environmental instrument to the same degree.[42]

If the Kyoto Protocol is a weak treaty and, at best, a tentative half-step in the direction of a functional and effective global climate regime, could the parties have done better? As with many global-governance issues (especially those involving "weakest link" public goods), the climate regime reflects the lowest common denominator of the parties. By mid-2011 we are not close to an agreement adopting a second Kyoto Protocol commitment period to take us beyond 2012. In the face of that looming deadline, the potential benefits of adopting a truly polycentric approach to mitigating GHG emissions deserve more attention.

IV. A Brief Introduction to Polycentric Governance

In a 1961 article on municipal government, Vincent Ostrom, Charles Tiebout, and Robert Warren argued that "The traditional pattern of government in a metropolitan area with its multiplicity of political jurisdictions may more appropriately be conceived as a 'polycentric political system"'.[43] The term "polycentrism", as they define it, connotes many centres of decision-making which are formally independent of each other. Whether they actually function independently, or instead constitute an interdependent system of relations, is an empirical question in particular cases. To the extent that they take each other into account in competitive relationships, enter into various contractual and cooperative undertakings, or have recourse to central mechanisms to resolve conflicts, the various political jurisdictions in a metropolitan area may function in a coherent manner with consistent and predictable patterns of interacting behaviour. To the extent that that is so, they may be said to function as a "system".[44]

While noting that large-scale governance, which Ostrom, Tiebout, and Warren label "Gargantua", may be required to provide many large-scale public services, such as municipal water systems, port facilities, and mass transit, Gargantua may prove insensitive and unresponsive to "the variety of smaller sets of publics that may exist within its boundaries". Many of the interests of smaller publics might be properly negotiated within the confines of a smaller political community without requiring the attention of centralized decision-makers concerned with the big system. This task of recognizing the smaller publics is a problem of "field" or "area" organization. The persistence of bureaucratic unresponsiveness in the big system, however, indicates it is not easily resolved. Large-scale, metropolitan-wide organization is unquestionably appropriate for a number of public services, but it is not the most appropriate scale of organization for the provision of all public services required in a metropolis.[45]

[42] See Daniel H. Cole and Peter Z. Grossman, *When is Command-and-Control Efficient? Technology, Institutions, and the Comparative Efficiency of Alternative Regulatory Regimes for Environmental Protection*, 1999 Wisc. L. Rev. 887.

[43] Ostrom, Tiebout, and Warren, supra note10, at 831.

[44] Ibid.

[45] Ibid. at 837-8.

Polycentricism is not just about the number of governmental levels or units. Rather, as Michael McGinnis has explained, it is characterized by "the concurrence of multiple opportunities by which participants can forge or dissolve links among different collective entities.... [P]articipants must be able to pick and choose those producers and providers [of public goods] that are most appropriate to each specific issue at hand".[46] Instead of a "monocentric hierarchy", where governmental units at higher levels make all the decisions, and units at lower levels simply follow commands from above, a truly polycentric *system* is one in which governmental units both compete and cooperate, interact and learn from one another, and responsibilities at different governmental levels are tailored to match the scale of the public services they provide.[47]

Vincent Ostrom, Tiebout, and Warren, and other early writers on polycentrism, were concerned primarily with issues of local governance, such as law enforcement.[48] For example, one study found that residents of small communities served by a locally organized police force were more satisfied than those in demographically similar neighbourhoods serviced by a larger, more centralized police force.[49] Elinor Ostrom has summarized the basic conclusions from applications of the polycentric approach to metropolitan governance:[50]

1. Public goods and services differ substantially in regard to their production functions and their scale of effects.
2. Policy preferences tend to be more homogeneous within smaller units than across an entire metropolitan area.
3. Citizens who live in areas served by multiple jurisdictions learn more about the performance of any one jurisdiction by seeing or hearing about how problems are handled in other jurisdictions.
4. The presence of large numbers of potential producers of urban goods and services in a metropolitan area allows elected officials more effective choice of producers.
5. Multiple jurisdictions with different scopes and scales of organization allow citizens and officials more choice in selecting modes of providing and producing public goods to try to utilize the best available technology, to achieve economies and avoid diseconomies of scale, and improve performance over time.
6. Producers who must compete for contracts are more likely to search for innovative technologies, to encourage effective team production, as well as citizen co-production, so as to enhance their own performance.

[46] Michael D. McGinnis, *Introduction*, in Polycentricity and Local Public Economies 6 (M.D. McGinnis, ed., 1999).

[47] See Elinor Ostrom, *A Polycentric Approach for Coping with Climate Change*, World Bank Policy Research Working Paper 5095 33 (Oct. 2009).

[48] See, e.g., Elinor Ostrom, Roger B. Parks, and Gordon P. Whitaker, Patterns of metropolitan policing (1978).

[49] Elinor Ostrom, Roger B. Parks, and Gordon P. Whitaker, *Do We Really Want to Consolidate Urban Police Forces? A Reappraisal of Some Old Assertions*, 33 Pub. Admin. Rev. 423 (1973).

[50] Ostrom, supra note 47, at 33-4.

A key factor running through several of the findings seems to be that the polycentric approach provides greater opportunity for experimentation, choice, and learning. Such considerations are important at virtually all levels of social organization.

Because the polycentric approach was developed, and has been applied, predominantly in the context of metropolitan governance, it is not so well known or appreciated by scholars focused on international or global issues. However, the model easily scales up for application to all governance levels, including global governance. Vincent Ostrom has observed, for example, that polycentric governance is closely related to political theories of federalism and dual sovereignty underlying the US Constitution's allocation of powers between the federal government and the states.[51] More recently, Elinor Ostrom has introduced polycentricity into the climate-policy literature,[52] using a somewhat broader definition: "A polycentric system exists when multiple public and private organizations at multiple scales jointly affect collective benefits and costs".[53]

Applying the polycentric approach to climate change does not imply that global governance is either unnecessary or irrelevant. Rather, the idea is to improve global climate governance by, first, differentiating issues that must be decided at the global level from those that might more effectively be dealt with at other levels of government; and, second, putting global climate institutions and organizations in a position to *learn* from, and be influenced by, the experiences and insights derived from institutions and organizations at other levels of government (which, in turn, learn from their own experiences as well as those of other governance units at various levels). The next section describes how a polycentric approach might improve climate governance.

V. Improving Climate Governance by a Polycentric Approach

As noted in the introduction, climate policy is at least *weakly* polycentric in that various programs have been established at different levels of government to mitigate GHG emissions. The European Union has established its own, internal, emissions-trading scheme. In the United States, the EPA is in the process of establishing GHG regulations under the Clean Air Act, despite the fact that

[51] See Vincent Ostrom, *Polycentricity (Part 1)*, in M.D. McGinnis (ed.), Polycentricity and Local Public Economies 52 (1999). Recently, scholars have argued that traditional conceptions of federalism no longer accurately describe the allocation of governmental authority in the United States. Instead, they offer new conceptions of "dynamic", "adaptive", or "interactive" federalism, which, they argue, better capture the concurrent, changeable, and cross-influential nature of relations between various levels of government. See, e.g., Kirsten H. Engel, *Harnessing the Benefits of Dynamic Federalism in Environmental Law*, 56 Emory L. J. 159 (2006); David E. Adelman and Kristen H. Engel, *Adaptive Federalism: The Case Against Reallocating Environmental Regulatory Authority*, 92 Minn. L. Rev. 1796 (2008); Robert A. Schapiro, *Toward a Theory of Interactive Federalism*, 91 Iowa L. Rev. 243 (2005). If anything, these new approaches to federalism are even more consistent with the polycentric approach than traditional notions of federalism and dual sovereignty.

[52] Ostrom, supra note 1 and supra note 47.

[53] Ostrom, supra note 1.

the US Senate has not ratified the Kyoto Protocol.[54] And China, which has no binding emission-reduction obligations under the Kyoto Protocol, has promised to reduce the carbon intensity of its economic production to an extent that will lead to substantial deviation from a business-as-usual trend.[55]

At sub-national governmental levels, California is in the process of implementing a serious mitigation program of its own, which includes emissions trading.[56] California belongs to the Western Climate Initiative, a consortium of US states and Canadian provinces working to establish a regional emissions-trading program for GHGs beginning in 2012 (which might or might not get off the ground). Already up and running is an emissions-trading program established by a consortium of states in the northeastern United States—the Regional Greenhouse Gas Initiative (RGGI).[57] Meanwhile, more than half of American states have adopted Renewable Energy Portfolios, which are intended (at least, that is the claim) to reduce GHG emissions.[58]

Several US local governments have undertaken useful actions to curb GHG emissions. As early as 1993, Portland, Oregon, for example, established a plan to reduce GHG emissions by 20 per cent below 1990 levels by 2010. It did not meet the goal; in fact, nominal emissions rose by 0.7 per cent between 1993 and 2005, mainly because of a rapidly rising local population. Nevertheless, per-capita emissions fell by 12.5 per cent during that period,[59] which is no mean achievement (especially compared to the rest of the United States, where per-capita emissions rose during that same period). More recently, the City of Berkeley, California, has launched a successful program to reduce GHG emissions by financing the installation of solar-heating systems in residences. Solar technology is expensive to install, but provides energy savings that, over time, more than compensate for the costs of installation and maintenance. Berkeley's FIRST program provides homeowners with loans for solar installations, thereby reducing the high upfront costs. The homeowners then pay back the loans at a low rate of interest in regular instalments along

[54] See <http://www.epa.gov/climatechange/initiatives/index.html>.

[55] See, e.g., David Cohen-Tanugi, Putting it into Perspective: China's Carbon Intensity Target, NRCD White Paper (Oct. 2010).

[56] See <http://www.arb.ca.gov/cc/cc.htm>; and <http://www.pewclimate.org/what_s_being_done/in_the_states/ab32>.

[57] See <http://www.westernclimateinitiative.org/>. The RGGI actually functions more like a carbon tax than a cap-and-trade program. This is due primarily to two factors: (1) the caps have been soft and (2) 100% of allowances are auctioned (with a price floor that has kept the value of allowances from falling to zero during the recent recession). The allowance auctions provide revenues to participating states, which are required by the terms of the RGGI Memorandum of Understanding to reinvest a substantial percentage of those revenues in climate change-related projects, such as energy-efficiency improvements for low-income citizens and public buildings. Nearly all of the environmental benefits claimed under the RGGI relate to such investments. The volume and value of trading have been extraordinary low—symptomatic of a soft cap.

[58] See <http://apps1.eere.energy.gov/states/maps/renewable_portfolio_states.cfm>; and <http://www.pewclimate.org/what_s_being_done/in_the_states/rps.cfm>. Many of these programs seem to be much more about providing farm subsidies than reducing GHG emissions. Especially in Midwestern states that support ethanol production from corn, the climate benefits of renewable portfolio standards are dubious.

[59] See Hari Osofsky and Janet Koven Levit, *The Scale of Networks? Local Climate Change Coalitions*, 8 Chi. J. Int'l. L. 409 (2008).

with their property taxes.[60] The savings on energy costs from the solar installations make those payments affordable.[61]

Even private organizations have engaged in voluntary, collective action to reduce GHG emissions. Jouni Paavola has written about the Cement Sustainability Initiative (CSI), created in 2002 by ten large cement manufacturers, under auspices of the World Business Council for Sustainable Development.[62] The CSI developed a CO_2 protocol for member companies to use in setting voluntary emission-reduction targets. By 2009, the CSI membership had grown to cover two-thirds of all cement manufacturing outside of China. Between 1990 and 2006, firms participating in the CSI reduced CO_2 emissions per ton of cement nodule (clinker) production by six percent, and improved thermal energy efficiency by fourteen percent. It is difficult to determine, however, to what extent the CSI was responsible for these changes, as compared with market factors that drive firms to improve productive efficiency. Moreover, emissions from CSI participants increased by 35 per cent during that same period because their output grew by 50 per cent.

A very different approach to private, voluntary collective action to reduce GHG emissions was taken by the Chicago Climate Exchange (CCX), a private emissions-trading market, established in 2003. At its height, the CCX had more than one hundred corporate members from all US states, eight Canadian provinces, and sixteen other countries. Participants made legally binding commitments to meet annual reduction targets (as against baselines set in accordance with historical emissions). They could meet those targets through internal reductions in emissions or by purchasing emission allowances through the CCX from other firms that reduced emissions below targeted levels. An explicit goal of the CCX was to position itself as the primary national exchange, once the US Congress got around to enacting a federal cap-and-trade scheme. As the years passed without any federal action to create such a scheme, many CCX participants began to lose interest. In 2010, the CCX was acquired by Intercontinental Exchange, which closed it down at the end of that year,[63] after the US Senate, once again, failed to pass a cap-and-trade bill. The story of the CCX and its demise is a sad one, but it highlights the important institutional connections required, across various levels of governance, to make a climate regime work.

Many of the programs discussed above have little to do with compliance with the Kyoto Protocol. In theory, the RGGI, California's Global Warming Solutions Act, the City of Berkeley's FIRST program, and even the CCX, could constitute mechanisms for US compliance with the Kyoto Protocol. But the US government has not expressed any intention of abiding by its Kyoto

[60] See Ostrom, supra note 1.

[61] Local governments have also banded together, both national and internationally, to reduce carbon emissions. See Paavola, supra note 1 (discussing the Cities for Climate Protection Programme).

[62] Ibid.

[63] See Christopher Porto, *Chicago Climate Exchange Set to Close: What Went Wrong?*, Carbon Capitalist, 14 November 2010.

targets since President Bush denounced the Protocol in 2001.[64] Consequently, regional, state, and local GHG-reduction programs in the United States are probably better viewed as independent programs, which in some cases deviate substantially from the Kyoto Protocol's regulatory architecture. For example, because the RGGI focuses on a single gas (CO_2) from one major source (power plants), it constitutes a far more limited trading program than those established in the Protocol.

Even programs that clearly are part of national Protocol-compliance strategies, such as the EU-ETS, deviate substantially in structure from the Protocol's flexibility mechanisms. The EU-ETS, like RGGI, focuses only on carbon-dioxide emissions, albeit from a larger set of sources. It remains far more limited in scope than the comprehensive trading of GHGs from virtually all sources authorized in the Kyoto Protocol. Under the "Linking Directive", which ties the EU-ETS to the Protocol's offset programs, ETS participants originally were allowed to use CDM or JI offsets to meet at most six per cent of their compliance obligations.[65] In amendments to the ETS in 2009,[66] the European Union raised the ceiling to 50 per cent for 2008-2020, although it established fairly stringent conditions for offset use and authorized the European Commission to limit or prohibit certain kinds of offset projects. (The Commission recently used that authority to ban the use of CERs from HFC-23 projects in China, although the ban takes effect only in 2013, after the first compliance period ends.[67])

More generally, in designing the ETS, the European Commission paid much closer attention to the lessons of earlier emissions-trading programs (including the US acid-rain program), especially with respect to monitoring and other administrative costs. Indeed, it was precisely this concern over administrative costs that led the Commission to limit the ETS, at least initially, to carbon-dioxide emissions from a relative few, large-emitting sectors of the economy. From a polycentric perspective, the EU-ETS is not simply a Kyoto compliance mechanism for the European Union but a possibly preferable institutional *alternative* to Kyoto's trading mechanisms, from which the UNFCCC parties might learn valuable lessons for a post-Kyoto treaty. The ETS is far from ideal. It has suffered from serious design flaws and implementation problems relating, for example, to the stringency of member-state-imposed caps, the lack

[64] In Copenhagen in 2009, President Obama made a (non-credible) commitment to reduce US emissions, but not with reference to the Kyoto target. See, e.g., David Biello, *U.S. Commits to Greenhouse Gas Cuts under Copenhagen Climate Accord*, Scientific American, 29 January 2010, <http://www.scientificamerican.com/article.cfm?id=us-commits-to-greenhouse-gas-cuts-under-copenhagen-accord>.

[65] It may seem odd that the EC proposed to link the ETS with Kyoto offset programs at all, given its evident concern with administrative costs in designing the ETS. No doubt, the EC understood many of the flaws of those offset programs, when it proposed the Linking Directive. However, as a matter of practical politics, the "Linking Directive" was vitally important for securing Russian ratification of the ETS, which, as noted earlier, was strictly necessary for the Kyoto Protocol to enter into legal effect. The legislative history makes clear that this was well understood within the European Union at the time the Linking Directive was proposed and adopted.

[66] Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community, L140/63, 5 June 2009 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0063:0087:EN:PDF.

[67] See <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/11/56>.

of a price floor for allowances (a problem exposed during the global economic recession), the security of emission and trading logs, and even the outright theft of allowances and tax scams.[68] Despite these flaws, the European Commission was far more careful and deliberate in designing the ETS than the Kyoto parties were in determining the structure of Kyoto trading programs.

The legislative history of the ETS indeed suggests that the Commission specifically intended to amend and improve the Kyoto regime by establishing the world's first large-scale carbon-trading system. In an August 2000 "Green paper on greenhouse gas trading within the European Union," the Commission called for implementation of a EU-wide GHG trading program prior to the start of the Kyoto Protocol compliance period in 2008, in order to "provide valuable insights that can be fed into the United Nations negotiating process".[69] The Commission apparently perceived that, by being a first-mover in creating a large, regional trading system, it could influence (for the better) the future development of global climate policy. Subsequent events (Copenhagen, Cancun, the failure of the US Congress to follow the European Union's lead in structuring its own trading program[70]) have clearly disappointed EU hopes of influencing post-Kyoto negotiations by forging ahead in the development of international carbon markets.

Meanwhile, the European Union has amended the EU-ETS to ameliorate certain flaws in the system. In 2009, for example, the ETS Directive was amended to shift authority for setting national caps for each compliance period from the member states to the European Commission beginning in 2013.[71] As noted, the Commission has banned the use of offset credits from HFC-23 projects starting in 2013. The relative ease of amending institutions within existing federal, national, state, or local government structures, as lessons are learned over time, is a significant advantage over the unwieldy process of international negotiation. Thus, despite its many flaws, the EU-ETS has always been a far more serious, deliberative, and potentially effective endeavour than the Kyoto Protocol's flexibility mechanisms for mitigating GHG emissions.

[68] See, e.g., Environmental Audit Committee – Fourth Report: The role of carbon markets in preventing dangerous climate change, House of Commons, Session 2009-10 <http://www.publications.parliament.uk/pa/cm200910/cmselect/cmenvaud/290/29002.htm> (finding national GHG emission caps to be too loose); Juliette Jowit, *Turner adds voice to calls for a 'floor price' on carbon permits*, The Guardian, 4 March 2009, <http://www.guardian.co.uk/environment/2009/mar/04/emissions-trading-carbon-price>; Joshua Chaffin, *Cyber-theft hals EU emissions trading,* Financial Times, 19 January 2011 <http://www.ft.com/intl/cms/s/0/27ee8cb0-2401-11e0-bef0-00144feab49a.html#axzz1MZP2yxV0>; Ashley Seager, *Copenhagen summit: Denmark rushes in laws to stop carbon trading scam*, The Guardian, 3 December 2009 <http://www.guardian.co.uk/environment/2009/dec/03/copenhagen-summit-carbon-trading-scam>.

[69] Commission of the European Communities, Green Paper of 3 August 2000 on greenhouse gas emissions trading within the European Union COM (2000) 87 final, p. 7.

[70] Virtually all proposals to establish GHG emissions-trading programs considered by Congress in recent years have been comprehensive, *a la* the Kyoto Protocol, rather than limited, *a la* the EU ETS (and the RGGI). Ironically, Congress has paid less attention than has the EC to the lessons of its own acid rain program, which was very much concerned with costs of monitoring and enforcement. See supra note 62 and accompanying text.

[71] See supra note 67.

Had other major-emitting countries—especially the United States—followed the European Union's lead, and established similar programs capable of linking up with the EU-ETS, the result would have been a de facto global trading system that, while enabled by the Kyoto targets, deviated substantially (in a positive direction) from Kyoto's "rules of the game" for trading. Instead of a top-down imposition of international legal rules resulting from global negotiations, a global carbon market might have emerged in a more bottom-up fashion (if that phrase sensibly applies to inter-linked *national* actions[72]). Linking up separately created trading schemes created nationally, regionally, or even at the state level (as in the case of California) probably remains the best hope for improving the Kyoto Protocol's environmentally dubious set of flexibility mechanisms.

Another example of the value of a polycentric approach to climate governance comes from the REDD program.[73] REDD was negotiated separately from the Kyoto Protocol, which generally avoided practices related to land use, land-use change, and forestry for mitigating GHG emissions. REDD would create an offset program that operates much like the CDM, and replicates many of its flaws, especially with respect to problems of leakage and additionality.[74] In one very important respect, however, REDD differs from the CDM and other Kyoto flexibility mechanisms: it explicitly recognizes the role of *local,* indigenous forest communities in monitoring and enforcing forest-conservation projects. While remote sensing (e.g., by satellite) can provide some sense of the level of deforestation, it is not very useful for assessing changes in the carbon content of forests, which requires (among other things) the ability to actually measure the circumference of trees. In other words, adequate forest monitoring requires feet on the ground, and those feet have to be attached to people who have the right incentives to monitor the forests and enforce compliance with the terms of REDD projects.[75]

Incentives are, of course, directly affected by institutional structures, including those established at the global level. However, it would be absurd to suggest that an institutional framework adopted by the international community could, by itself, either mandate or guarantee the right incentives for effective forest monitoring by local stakeholders. REDD, far more than the Kyoto Protocol, recognizes the importance of nested institutions at all levels of government, responsive to differential national circumstances, levels of development (e.g. per-capita GDP), local communities (including indigenous peoples), and other stakeholders. Of course, that recognition alone will not ensure that REDD projects achieve their GHG mitigation goals. It is up to national and sub-national governments to ensure that the proper institutions are put in place to create the incentives for local forest users.

[72] If nations in international negotiations are viewed like individuals in ordinary contracting situations, then it makes sense to think of inter-linked national actions as a bottom-up approach to international institution building, in contrast to the top-down imposition of regimes established in global negotiations.

[73] <http://www.un-redd.org/AboutREDD/tabid/582/Default.aspx>.

[74] Another inherent problem is permanence. For how long must a REDD+ project conserve a forest or forest-area against harvesting to warrant issuance of offset credits?

[75] See, e.g., Elinor Ostrom and Harini Nagrendra, *Insights on linking forests, trees, and people from the air, on the ground, and in the laboratory*, 103 Proc. Nat'l Acad. Sci. 19224 (2006).

VI. Conclusion

In recent years, scholars from various disciplines have questioned the wisdom of comprehensive, top-down climate governance. Robert Keohane and David Victor have argued that "a climate change regime complex, if it meets specified criteria, has advantages over any politically feasible comprehensive regime, particularly with respect to adaptability and flexibility".[76] Their definition of "regime complex", as a middle ground between "fully integrated institutions that impose regulation through comprehensive, hierarchical rules" and "highly fragmented collections of institutions with no identifiable core and weak or nonexistent linkages between regime elements",[77] is consistent with theories of polycentric governance, as defined in the social science literature and employed in this paper.[78] In a similar vein, the international consulting firm Booz and Company recently published a paper arguing that nationally based climate mitigation and adaptation strategies, tailored to each country's specific needs and assets, constitute a more "realistic and viable approach to combating the effects of climate change" than a "top-down, internationally-directed approach".[79] Moreover, national and sub-national policies, if adopted by key actors, could have a substantial positive impact on international climate regimes. A very interesting recent working paper by Geoffrey Heal and Howard Kunreuther employs Thomas Schelling's tipping model[80] to show that a small set of countries, by adopting climate-control measures, could "make it in the interests of all others to do likewise".[81] For example, Heal and Kunreuther find that "China and the EU between them have been instrumental in making carbon-free energy considerably less expensive, suggesting that they could be part of a tipping set, or even form one".[82] In a similar vein, as argued in this paper, if the United States adopted a cap-and-trade regime similar in structure, scale, and scope to the EU-ETS, the resulting market would predominate and possibly displace the Kyoto mechanisms. Such a development would constitute a significant improvement to the global climate regime (or "regime complex"), given the flaws of the Kyoto structures.

Unfortunately, international negotiators do not appear to be discussing, let alone conducting comparative cost-benefit analyses (an operationalized form of comparative institutional analysis) to determine, the proper scale and scope of emissions trading (in comparison with other mitigation instruments such as taxes or non-tradable quotas). More than anything, the lack of due attention

[76] Robert O. Keohane and David G. Victor, The Regime Complex for Climate Change, The Harvard Project on International Climate Agreements, Discussion Paper 10-33 1 (2010).

[77] Ibid. at 3-4.

[78] Kenneth W. Abbott, The Transnational Regime Complex for Climate Change (2011). Available at <http://ssrn.com/abstract=1813198>.

[79] Nick Pennell et al., Bottom Up and Country Led: A New Framework for Climate Change Action. Booz & Co. (2010), available at <http://www.booz.com/global/home/what_we_think/reports_and_white_papers/ic-display/48841378>.

[80] See Thomas C. Schelling, *Dynamic Models of Segregation*, 1 J. Math. Socio. 141 (1971); and Thomas C. Schelling, Micromotives and Macrobehavior (1978).

[81] Geoffrey Heal and Howard Kunreuther, Tipping Climate Negotiations, NBER Working Paper Series, Working Paper 16954 (April 2011) <http://www.nber.org/papers/w16954>.

[82] Ibid. at 14.

to, first, the flaws in the existing international legal order and, second, the existence of better institutional mechanisms at lower levels of government may simply indicate that we have not yet reached the kind of tipping point Heal and Kunreuther's model suggests exists. From a polycentric perspective, the outcome of international negotiations over the next two years may have less long-term importance for the shape of global climate policy than what happens in the European Union, United States, China, and other key countries—both domestically and through smaller-scale international arrangements—over the next five to ten years.