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ARTICLES

CLIMATE CHANGE ADAPTATION AND THE STRUCTURAL TRANSFORMATION OF ENVIRONMENTAL LAW

BY
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The path of environmental law has come to a cliff called climate change, and there is no turning around. As climate change policy dialogue emerged in the 1990s, however, the perceived urgency of attention to mitigation strategies designed to regulate sources of greenhouse gas emissions quickly snuffed out meaningful progress on the formulation of adaptation strategies designed to respond to the effects of climate change on humans and the environment. Only recently has this "adaptation deficit" become a concern now actively included in climate change policy debate. Previously treating talk of adaptation as taboo, the climate change policy world has begrudgingly accepted it into the fold as the reality of failed efforts to achieve global

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mitigation policy has combined with the scientific evidence that committed warming will continue the trend of climate change well into the future regardless of mitigation policy success.

But do not expect adaptation policy to play out for environmental law the way mitigation policy has and is likely to continue. Mitigation policy has been framed as an initiative primarily within the domain of environmental law—a form of pollution control on steroids—and thus it will be environmental law that makes the first move and other policy realms that apply support or pushback. By contrast, environmental law does not “own” adaptation policy; rather, numerous policy fronts will compete simultaneously for primacy and priority as people demand protection from harms and enjoyment of benefits that play out as climate change moves relentlessly forward. This makes it all the more pressing for environmental law, early in the nation’s formulation of adaptation policy, to find its voice and establish its place in the effort to close the adaptation deficit.

Toward that purpose, this Article examines the context and policy dynamics of climate change adaptation and identifies ten trends that will have profound normative and structural impacts on how environmental law fits in: 1) shift in emphasis from preservationism to transitionalism in natural resources conservation policy, 2) rapid evolution of property rights and liability rules associated with natural capital adaptation resources, 3) accelerated merger of water law, land-use law, and environmental law, 4) incorporation of a human rights dimension in climate change adaptation policy, 5) catastrophe and crisis avoidance and response as an overarching adaptation policy priority, 6) frequent reconfigurations of transpolicy linkages and trade-offs at all scales and across scales, 7) shift from “front end” decision methods relying on robust predictive capacity to “back end” decision methods relying on active adaptive management, 8) greater variety and flexibility in regulatory instruments, 9) increased reliance on multiscale governance networks, and 10) conciliation.

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I. INTRODUCTION

The path of environmental law has come to a cliff called climate change, and there is no turning around. Someday, maybe soon, the federal government will take the big leap and enact new legislation designed to curb our nation’s greenhouse gas emissions. Whether it is through a carbon tax, a cap-and-trade program, or some new regulatory innovation, the measure will be hailed by many and derided by many others. The supporters will throw a big party, and the opponents will hold a wake. When the hangovers wear off the next day, however, one thing will still be soberingly true no matter how aggressive the newly-minted legislation: Humans and our fellow species are looking into a future of climate change that will last a century or more, and we’ve done very little in the United States to prepare ourselves for it.

Indeed, the policy world’s fixation on achieving, or blocking, federal greenhouse gas emission legislation as part of our national strategy for

climate change mitigation¹ has contributed to our neglect of national policy for climate change adaptation.² This wrong turn happened early in the development of domestic climate change policy. As Professor Dan Tarlock observed in 1992, at the time there was “a growing split between environmentalists who advocate mitigation, and ‘rational’ resource policy analysts who have strongly endorsed adaptation.”³ Adaptation was winning the day, on the premise that “we should adopt the easy, low cost mitigation strategies to reduce energy use and then concentrate on selecting the most efficient adaptation strategies.”⁴ Tarlock insightfully suggested three reasons for exercising caution in pursuing that approach:

First, adaptation is based on the ideology of scientific progress, a faith that is open to question. The principle message of environmentalism is that the tenets of Enlightenment thinking must be re-evaluated since science and technology may not always prevent serious harm or make things better. Second, the degree of friction in the proposed institutional responses is often underestimated so institutions may not perform as expected. Adaptation clearly exposes winners and losers in a reallocation. It is not reasonable to expect losers to accept all

¹ Climate change mitigation “refers to options for limiting climate change by, for example, reducing heat-trapping emissions such as carbon dioxide, methane, nitrous oxide, and halocarbons, or removing some of the heat-trapping gases from the atmosphere.” U.S. GLOBAL CHANGE RESEARCH PROGRAM, GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES 10–11 (2009), available at <http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf>; see also INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2001: MITIGATION app. at 716 (Bert Metz et al. eds., 2001), available at http://www.grida.no/climate/ipcc_tar/wg3/pdf/app.pdf (mitigation strategies involve “an anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases”).

² Climate change adaptation “refers to changes made to better respond to present or future climatic and other environmental conditions, thereby reducing harm or taking advantage of opportunity. Effective mitigation measures reduce the need for adaptation.” U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 1, at 11; see also INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: IMPACTS, ADAPTATION AND VULNERABILITY app. at 869 (M.L. Perry et al. eds., 2007) (“Adjustment in natural or *human systems* in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.”), available at <http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-app.pdf>. Climate change adaptation is also known as “climate proofing,” see Paul Stanton Kibel, *Climate Adaptation Policy at the Continental Level: Natural Resources in North America and Europe*, 27 PACE ENVTL. L. REV. (forthcoming 2010) (manuscript at 1, on file with author), and as “coping,” see U.S. Env’tl. Prot. Agency, Adaptation, <http://www.epa.gov/climatechange/effects/adaptation.html> (last visited Apr. 18, 2010).

³ A. Dan Tarlock, *Now, Think Again About Adaptation*, 9 ARIZ. J. INT’L & COMP. L. 169, 170 (1992).

⁴ *Id.* A representative example of this line of thinking prevailing at the time is found in RICHARD N. COOPER, ENVIRONMENT AND RESOURCE POLICIES FOR THE WORLD ECONOMY 41–50 (1994). The 1992 United Nations Framework Convention on Climate Change mentioned adaptation but was not regarded at the time as placing any significant emphasis on adaptation strategies as a policy objective, focusing instead on mitigation goals. See E. Lisa F. Schipper, *Conceptual History of Adaptation in the UNFCCC Process*, in THE EARTHSCAN READER ON ADAPTATION TO CLIMATE CHANGE 19, 19 (E. Lisa F. Schipper & Ian Burton eds., 2009) [hereinafter ADAPTATION TO CLIMATE CHANGE]. See generally Daniel Bodansky, *The United National Framework Convention on Climate Change: A Commentary*, 18 YALE J. INT’L L. 451 (1993) (recounting the decisions made at the convention and its focus on efforts to reduce greenhouse gas emissions).

losses. More generally, institutional inflexibility is increasingly being adopted as a means to protect legitimate interests excluded from dominant resource allocation regimes. . . . Third, many institutions have no fair and adequate mechanism to deal with global warming. In these cases, adaptation is the adoption of a no action strategy, which may often be the most costly one.⁵

As news about climate change grew steadily worse in the years after Tarlock's assessment,⁶ the domestic policy pendulum quickly swung sharply in mitigation's direction. Indeed, the challenge of climate change was portrayed as so exceptional, and the need for a new mitigation policy of sweeping dimensions thus so pressing, that talk of adaptation became taboo for fear it might knock the mitigation train off its tracks and lead to complacency.⁷ In their impressive book on the topic, *The Earthscan Reader*

⁵ Tarlock, *supra* note 3, at 170–71. Tarlock was responding to views about adaptation policy expressed in Paul E. Waggoner, *Now, Think of Adaptation*, 9 ARIZ. J. INT'L & COMP. L. 137 (1992). Tarlock, *supra* note 3, at 170 n.7.

⁶ A premise of this Article is that the climate system is changing at anomalously rapid rates compared to historical trends, and that anthropogenic (human-induced) sources of greenhouse gases (primarily carbon dioxide) are a significant causal factor. I do not endeavor here to convince anyone of this, nor do I go into more detail about the science behind how greenhouse gas emissions and other climate-forcing phenomena contribute to global climate change. The Intergovernmental Panel on Climate Change (IPCC), an international scientific project representing hundreds of scientists, has produced a series of reports, including a comprehensive set in 2007, synthesizing scientific information on climate change and its effects on human and ecological conditions. *See, e.g.*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: SYNTHESIS REPORT (2007), available at http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf. A more recent synthesis of the science and observed trends of climate change is found at UNITED NATIONS ENV'T PROGRAMME, CLIMATE CHANGE SCIENCE COMPENDIUM 2009 (Catherine P. McMullen & Jason Jabbour eds., 2009), available at http://www.unep.org/pdf/ccScienceCompendium2009/cc_ScienceCompendium2009_full_en.pdf. Two highly accessible reports for those less scientifically inclined are available from the National Academy of Sciences. *See* NAT'L ACADEMY OF SCIS., ECOLOGICAL IMPACTS OF CLIMATE CHANGE (2009), available at http://dels.nas.edu/dels/rpt_briefs/ecological_impacts.pdf; NAT'L ACADEMY OF SCIS., UNDERSTANDING AND RESPONDING TO CLIMATE CHANGE (2008), available at http://dels.nas.edu/dels/rpt_briefs/climate_change_2008_final.pdf. I recognize that there remains tremendous uncertainty about how climate systems will in fact change under different emissions scenarios and about the efficacy of different mitigation strategies. It is already evident, for example, that the 2007 IPCC findings overestimated some climate change effects and underestimated others. *See* Pallava Bagla, *No Sign Yet of Himalayan Meltdown*, *Indian Report Finds*, 326 SCI. 924 (2009) (while some glaciers appear to be melting faster than IPCC predictions, glaciers in India may be melting slower); Richard A. Kerr, *Amid Worrisome Signs of Warming, 'Climate Fatigue' Sets In*, 326 SCI. 926 (2009) (discussing examples). The IPCC studies have also been dragged into the "Climategate" public relations fiasco, in which the content of e-mails and other materials hacked from the accounts of several IPCC scientists at Climatic Research Unit of the University of East Anglia in Norwich, England, has led to questions about the scientists' personal motives and scientific practices. *See* Climate Research Unit E-mail Hacking Incident, <http://en.wikipedia.org/wiki/Climategate> (last visited Apr. 18, 2010) (providing a thorough, up to date, and even-handed account). Nevertheless, I believe the vast weight of evidence points in the direction of anthropogenically caused climate change. My focus is not on causal factors, however, but rather on the ways in which it is likely humans will need or desire to adapt to the harmful and beneficial impacts of climate change at local and regional scales.

⁷ For a discussion of the portrayal of climate change mitigation in policy literature as "exceptional" in policy scope and thus demanding measures outside the bounds of

on *Adaptation to Climate Change*,⁸ E. Lisa F. Schipper and Ian Burton sum up the tension that existed through the 1990s and well into the following decade:

[I]nterest in adaptation was overwhelmed by concern about the need to reduce greenhouse gas emissions and stabilize atmospheric greenhouse gas concentrations. Proponents of adaptation faced two obstacles that were attributed to adaptation: reducing the apparent need for mitigation; and playing down the urgency for action. For one, 'adaptationists' were distrusted because their proposals seemed to undermine the need for mitigation. Critics felt that belief in the potential value of adaptation would soften the resolve of governments to grasp the nettle of mitigation and thus play into the hands of the fossil fuels interests and the climate change [skeptics]. In addition, because climate change was popularly perceived as a gradual process, adaptation was not considered urgent as there would be time to adapt when climate change and its impacts became manifest. These views dominated in the mid and late 1990s.⁹

The problem is that mitigation policy soon ran into the same three problems Tarlock suggested would plague adaptation policy: Institutions lack the political will to impose tough lifestyle sacrifices on people in general; those who expect to be losers, were a mitigation regime to gear up, have squawked loudly in objection to the anticipated regulatory measures; and no fair and adequate mechanism has been devised to deal with the

conventional air pollution regulation models, see John Copeland Nagle, *Climate Exceptionalism*, 40 ENVTL. L. 53 (2010).

⁸ ADAPTATION TO CLIMATE CHANGE, *supra* note 4.

⁹ E. Lisa F. Schipper & Ian Burton, *Understanding Adaptation: Origins, Concepts, Practice and Policy*, in ADAPTATION TO CLIMATE CHANGE, *supra* note 4, at 1, 7; see also Waggoner, *supra* note 5, at 146 (1992) ("The first obstacle to adaptation is reluctance to contemplate it."). The concern over adaptation crowding out mitigation in political spheres is not unfounded. Mitigation expenditures, for example, impose significant costs in the present, but cannot be expected to deliver results potentially for decades. Investments in mitigation, moreover, have significant positive externalities, as any improvement in climate conditions is shared globally, whereas the benefits of adaptation investments will usually accrue primarily to the community making the expenditures. These features of mitigation compared to adaptation often are argued as leading to an inherent political bias in favor of adaptation investments. See generally Thomas C. Heller, *Environmental Realpolitik: Joint Implementation and Climate Change*, 3 IND. J. GLOBAL LEGAL STUD. 295, 309 (1995) ("[T]he usual collective action problems associated with public goods demand that strategies aimed at mitigation create institutions able to coordinate and monitor a cooperative regime. Adaptation, by contrast, is local in character and requires no commitment to common solutions."). Another source of this bias is what Professor Eric Biber refers to as

the concept of "backlash"—the possibility that there will be a significant push to repeal or roll back regulatory standards in the context of delayed harm problems. Backlash might occur in the context of delayed harms because of the inevitable gap between the initiation of regulatory controls and the beginning of any actual declines in the levels of environmental harm. The risk of backlash is accentuated because of the fragile political support for most regulatory systems that address delayed harms, and because the changes in the environment that delayed harms cause may undermine the political support for continued environmental regulation.

Eric Biber, *Climate Change and Backlash*, 17 N.Y.U. ENVTL. L.J. 1295, 1299 (2009).

distributional effects of a comprehensive regulatory regime even if the political will were there to put one in place.¹⁰ So, as with adaptation, mitigation is often portrayed as a scientific and technological challenge that eases us out of the climate change problem without sacrifices or losers—pump greenhouse gases into the ground; invent a cheap solar panel; launch mirrors into space; seed the oceans with iron.¹¹

Today it is abundantly clear that these drags on the formulation of our domestic climate change policy are persistent and debilitating. A comprehensive national strategy that successfully reduces greenhouse gas emissions to levels thought to be adequate to arrest climate change, a feat which the United States obviously could not accomplish alone even if it were known what those levels should be, quite clearly is not around the political corner.¹² And it is just as clear that the miracle technological

¹⁰ As Harvard University oceanographer and IPCC member James J. McCarthy concisely sums up the situation: “What is lacking is resolve.” Earl Lane & Becky Ham, *As Climate Change Intensifies, McCarthy Urges Adaptation Focus*, 326 SCI. 680, 680 (2009), available at <http://www.sciencemag.org/cgi/reprint/326/5953/680.pdf> (quoting James J. McCarthy); see also Robert W. Hahn, *Climate Policy: Separating Fact from Fantasy*, 33 HARV. ENVTL. L. REV. 557, 560 (2009) (“[N]ational leaders appear to lack the political will to achieve global emission reductions in a timely manner.”). Not that we weren’t warned of this way back at the beginning of it all. As Robert M. White, then-president of the National Academy of Engineering, said before the 1990 annual meeting of the American Society of International Law,

It is likely that no matter what policy actions we take, fully arresting the climate warming is just not in the cards. Bringing about international agreement on procedures for mitigating climate warming will be difficult and lengthy. The law of the sea negotiations are a good analogue. They took fifteen years, and the United States has yet to sign the Law of the Sea Treaty. Reasons for the reluctance of the United States relate to the demands of the developing nations for significant technology transfer and economic assistance. These issues, which have so far stymied U.S. adherence to the Law of the Sea Treaty, will be even more complicated and more pervasive in any treaty of the atmosphere that is negotiated.

And so the likelihood is that humanity will have to adapt to some climate changes.

Robert M. White, *The Great Climate Debate*, 84 AM. SOC’Y INT’L L. PROC. 346, 355 (1990).

¹¹ The efficacy and risks associated with these and other climate engineering fixes are hotly debated in the science and engineering communities. See Gabriele C. Hegerl & Susan Solomon, *Risks of Climate Engineering*, 325 SCI. 955, 955 (2009); H. Jesse Smith et al., *Clearing the Air*, 325 SCI. 1641 (2009) (discussing the possibility of successfully implementing carbon capture and sequestration). For discussions of some of the technological proposals and their legal implications, see generally William Daniel Davis, *What Does “Green” Mean?: Anthropogenic Climate Change, Geoengineering, and International Environmental Law*, 43 GA. L. REV. 901, 904–05 (2009); Alexandra Klass, *Climate Change and Carbon Sequestration: Assessing a Liability Regime for Long-Term Storage of Carbon Dioxide*, 58 EMORY L.J. 103, 108 (2008); Jay Michaelson, *Geoengineering: A Climate Change Manhattan Project*, 17 STAN. ENVTL. L.J. 73, 77–78 (1998); James Edward Peterson, *Can Algae Save Civilization? A Look at Technology, Law, and Policy Regarding Iron Fertilization of the Ocean to Counteract the Greenhouse Effect*, 6 COLO. J. INT’L ENVTL. L. & POL’Y 61 (1995).

¹² I have no expertise and offer no opinion about what levels of reductions in greenhouse gas emissions are necessary globally to arrest climate change, and what share of those reductions the United States ought to bear. Whatever the answer is to both those questions, we are nowhere near to being close to those reductions in either respect; thus, formulation of an adaptation strategy is a necessity.

breakthrough is not past the research stage. Add to that the unavoidable reality of so-called committed warming—the climate change already built into the climate system as a result of past greenhouse gas emissions—which will play out for many decades even if one of these breakthroughs happened yesterday,¹³ and the cold war between mitigation and adaptation is finally thawing. Climate change is already happening, and more is yet to come no matter what, thus a consensus is building that mitigation needs adaptation, and vice versa, even if they fundamentally are different and sometimes competing policy thrusts.¹⁴

It is not, in other words, an either-or choice between mitigation and adaptation.¹⁵ The time when such a choice could have been made—when

¹³ “[N]o matter how aggressively heat-trapping emissions are reduced, some amount of climate change and resulting impacts will continue due to the effects of gases that have already been released.” U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 1, at 11; *see also* Richard A. Kerr, *How Urgent Is Climate Change?*, 318 SCI. 1230, 1230 (2007) (“The system has built in time lags. Ice sheets take centuries to melt after a warming. The atmosphere takes decades to be warmed by today’s greenhouse gas emissions.”); V. Ramanathan & Y. Feng, *On Avoiding Dangerous Anthropogenic Interference with the Climate System: Formidable Challenges Ahead*, 105 PROC. NAT’L ACAD. SCI. 14,245, 14,245–46 (2008) (estimating committed warming of 2.4°C even if greenhouse gas concentrations are held to 2005 levels); Susan Solomon et al., *Irreversible Climate Change Due to Carbon Dioxide Emissions*, 106 PROC. NAT’L ACAD. SCI. 1704, 1704 (2009) (estimating a 1000-year committed warming effect).

¹⁴ The Government Accountability Office recently identified this thawing effect:

Thus far, federal government attention and resources have been focused on emissions reduction options, climate science research, and technology investment. In recent years, however, climate change adaptation—adjustments to natural or human systems in response to actual or expected climate change—has begun to receive more attention because the greenhouse gases already in the atmosphere are expected to continue altering the climate system into the future, regardless of efforts to control emissions.

GOV’T ACCOUNTABILITY OFFICE, CLIMATE CHANGE ADAPTATION: STRATEGIC FEDERAL PLANNING COULD HELP GOVERNMENT OFFICIALS MAKE MORE INFORMED DECISIONS 2 (2009), *available at* <http://www.gao.gov/new.items/d101113.pdf>. Thus, in contrast to the 1992 Convention, *see supra* note 4, the so-called Copenhagen Accord of 2009 recognizes that “[e]nhanced action and international cooperation on adaptation is urgently required.” Conference of the Parties to the Framework Convention on Climate Change, Copenhagen, Den., Dec. 7–19, 2009, *Report of the Conference of the Parties at Its Fifteenth Session*, at 6, U.N. Doc. FCCC/CP/2009/11/Add.1 (Mar. 30, 2010) (advance unedited version of Copenhagen Accord, Dec. 2/CP.15) *available at* <http://unfccc.int/resource/docs/2009/cop15/eng/11a01.pdf#page=4>. An alternative way of conceptualizing the thawing of climate change mitigation and adaptation is as components of an overall pollution policy, in this case a global pollution problem. Professor John Nagle has outlined four general responses to pollution: prevention, control, avoidance, and tolerance. *See Nagle, supra* note 7, at 67–68. Climate change mitigation fits the prevention and control categories of Nagle’s typology, and adaptation encompasses avoidance, in that it reduces harms but not emissions, and tolerance, in that it covers coping with the harms that cannot be avoided. Nagle points out that pollution policy in general has increasingly accommodated avoidance and tolerance strategies, such as measures to impose institutional controls on contaminated sites rather than provide full remediation, and noise abatement ordinances that do not prevent all noisy inconveniences. *See id.* at 67–68, 86, 88. Climate change adaptation, in this framework, thus seems like pollution policy as usual, albeit on a much more complex scale. *Id.* at 82–88.

¹⁵ *See* John Smithers & Barry Smit, *Human Adaptation to Climatic Variability and Change*, in ADAPTATION TO CLIMATE CHANGE, *supra* note 4, at 15, 18 (“It is increasingly accepted that the

starting to install a meaningful mitigation regime could have obviated the need to ever have to think about adaptation—is long since past by many decades. There is no choice any longer: “Mitigation and adaptation are both essential parts of a comprehensive climate change response strategy.”¹⁶ There certainly is room for argument over the relative mix of the two strategies and how much to spend respectively on them, questions I do *not* address here.¹⁷ But almost all recent legal scholarship and policy dialogue now recognizes that formulating and implementing adaptation strategies must in any case be a significant component of our domestic climate change law and policy.¹⁸

basic decision facing governments and society is not whether to pursue limitation or adaptation strategies, but rather how to combine these approaches”).

¹⁶ U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 1, at 11.

¹⁷ It is not possible at this time to assemble reliable data and projections required to engage in such an analysis at a level of detail necessary to make meaningful decisions. The obvious tension between mitigation and adaptation is that spending more on one, if the measures are effective, reduces the need for the other, but there is no *a priori* basis for determining which strategy deserves greater investment globally, regionally, nationally, or locally. See Christopher D. Stone, *Beyond Rio: “Insuring” Against Global Warming*, 86 AM. J. INT’L L. 445, 474–75 (1992). For some general expositions on these questions reaching a variety of conclusions, see JOSEPH E. ALDY & WILLIAM A. PIZER, ISSUES IN DESIGNING U.S. CLIMATE CHANGE POLICY (Res. for the Future, Discussion Paper No. 08-20-REV, 2008), available at <http://www.rff.org/RFF/Documents/rff-dp-08-20%5B1%5D.pdf>; Hahn, *supra* note 10; Jason Scott Johnston, *A Looming Policy Disaster*, REG., Fall 2008, at 38; Jody Freeman & Andrew T. Guzman, *Sea Walls Are Not Enough: Climate Change and U.S. Interests* (Univ. of Cal. Berkeley Pub. Law & Legal Theory Working Paper Group, Paper No. 1357690, 2009), available at <http://ssrn.com/abstract=1357690> (follow “One-Click Download” hyperlink).

¹⁸ See, e.g., Katherine M. Baldwin, *NEPA and CEQA: Effective Legal Frameworks for Compelling Consideration of Adaptation to Climate Change*, 82 S. CAL. L. REV. 769, 775 (2009), available at <http://weblaw.usc.edu/why/students/orgs/lawreview/documents/BaldwinforWebsite.pdf> (“[A]daptation measures must still be employed to combat the impacts of climate change that will inevitably occur, despite the institution of heroic mitigation efforts.”); Alejandro E. Camacho, *Adapting Governance to Climate Change: Managing Uncertainty Through a Learning Infrastructure*, 59 EMORY L.J. 1, 17 (2009) available at <http://www.law.emory.edu/fileadmin/journals/elj/59/59.1/Camacho.pdf> (“Unfortunately, legislators and regulators in the United States and elsewhere have only begun to consider the role of adaptation in combating climate change.”); Robin Kundis Craig, *“Stationarity Is Dead”—Long Live Transformation: Five Principles for Climate Change Adaptation Law*, 34 HARV. ENVTL. L. REV. 9, 14 (2010) (“American environmental law and policy are not keeping up with climate change impacts and the need for adaptation.”); Daniel A. Farber, *Adapting to Climate Change: Who Should Pay?*, 23 J. LAND USE & ENVTL. L. 1, 2 (2007) (“Adaptation has been a neglected topic In my view, this is a mistake.”); Peter Hayes, *Resilience as Emergent Behavior*, 15 HASTINGS W.-NW. J. ENVTL. L. & POL’Y 175, 175 (2009) (“[T]he main game is now adaptation which renders mitigation no less urgent, but shifts the political equation in dramatic ways that cannot be ignored any longer.”); Thomas Lovejoy, *Mitigation and Adaptation for Ecosystem Protection*, 39 ENVTL. L. REP. (Envtl. Law Inst.) 10,072, 10,073 (2009) (“The adaptation part of the climate change agenda is only just beginning to get attention, and needs much more right away.”); Ileana M. Porras, *The City and International Law: In Pursuit of Sustainable Development*, 36 FORDHAM URB. L.J. 537, 593 (2009) (“Most climate change experts and policy-makers recognize that adaptation and mitigation are not mutually exclusive strategies but must, on the contrary be employed in tandem.”). One contemporary anti-adaptationist holdout in the post-thaw literature is found in Matthew D. Zinn, *Adapting to Climate Change: Environmental Law in a Warmer World*, 34 ECOLOGY L.Q. 61 (2007). Zinn claims that “climate change presents a choice for public policy: mitigate our contribution

The period during which adaptation policy was in the doghouse, however, stunted progress on forging its theory, design, and implementation. The accruing “adaptation deficit”¹⁹ has grown large, putting us far behind the European Union, Australia, and many other nations in this respect.²⁰ In short, “the United States . . . lacks sufficient investment in the sciences required for moving beyond climate science to define impacts and vulnerabilities.”²¹ Domestic law and policy are in no better shape. To be sure, legal scholarship on climate change policy is sharply on the rise.²² Most of it, however, focuses on the configuration of instruments and institutions to accomplish mitigation, as in the debates over the efficacy of carbon taxes versus cap-and-trade²³ and the advantages of federal top-down versus local bottom-

to it or attempt to adapt to a changing world.” *Id.* at 61. Having adopted that questionable either-or choice as the policy premise, perhaps as a straw man, in an effort to support the “mitigation-preferring policy” choice, *id.* at 66, Zinn then goes on to explore “how unchecked climate change, in a world of adaptation rather than mitigation, might alter environmental law,” *id.* at 65. His apocalyptic vision of such a world is, indeed, more than scary, but there are no serious proposals to be found in the prevailing legal or policy literature advocating we adopt what Zinn calls an “adaptation-preferring climate policy—one that wholly or mostly rejects mitigation.” *Id.* at 63. Any assessment of the evolution of environmental law in such a scenario, or of any field of law for that matter, thus is likely unrepresentative of what can be expected in a dual mitigation-adaptation strategy. That said, Zinn’s work is useful as a strong reminder that mitigation policy must, sooner or later, be effective to avoid having climate change overwhelm our adaptive capacity.

¹⁹ For discussion of the term “adaptation deficit,” see Ian Burton, *Climate Change and the Adaptation Deficit*, in ADAPTATION TO CLIMATE CHANGE, *supra* note 4, at 89, 90, 91–92.

²⁰ The European Union (EU) maintains an active website on climate change adaptation policy with links to adaptation policy white papers and the national adaptation strategies of EU nations. See European Commission, Living with Climate Change in Europe, http://ec.europa.eu/environment/climat/adaptation/index_en.htm (last visited Apr. 18, 2010). For a recent detailed comparison of the different national strategies, see ROB SWART ET AL., PARTNERSHIP FOR EUROPEAN ENVIRONMENTAL RESEARCH, EUROPE ADAPTS TO CLIMATE CHANGE: COMPARING NATIONAL ADAPTATION STRATEGIES (2009), available at http://www.peer.eu/fileadmin/user_upload/publications/PEER_Report1.pdf, and for a general overview of the thrust of EU adaptation policy, see DARRYN MCEVOY ET AL., ADAPTATION AND MAINSTREAMING OF EU CLIMATE CHANGE POLICY: AN ACTOR-BASED PERSPECTIVE (Ctr. for European Policy Studies, CEPS Policy Brief No. 149, 2008), available at <http://www.ceps.eu/ceps/download/1424>.

²¹ Eric J. Barron, *Beyond Climate Science*, 326 *Sci.* 643, 643 (2009) (noting the author is the director of the National Center for Atmospheric Research).

²² In a search conducted April 17, 2010, 1181 files in Westlaw’s Journals and Law Reviews (JLR) database used the terms “climate change” and “mitigat!” (which includes variations such as mitigate, mitigates, mitigation, and mitigative) at least once in the same sentence, with 778 (66%) of those published in 2007 or later. Similarly, 1015 files used the terms “climate change” and “adapt!” at least once in the same sentence, with 655 (65%) published in 2007 or later. In both cases, but particularly with the adaptation references, the coverage in many of the publications is fleeting or even amounts to no more than a citation to a document that contains the search words in its title.

²³ Compare Robert N. Stavins, *A Meaningful U.S. Cap-and-Trade System to Address Climate Change*, 32 *HARV. ENVTL. L. REV.* 293 (2008) (advocating a cap-and-trade system), and Jonathan B. Wiener, *Property and Prices to Protect the Planet*, 19 *DUKE J. COMP. & INT’L L.* 515 (2009) (same), with Reuven S. Avi-Yonah & David M. Uhlmann, *Combating Global Climate Change: Why a Carbon Tax Is a Better Response to Global Warming than Cap and Trade*, 28 *STAN. ENVTL. L.J.* 3 (2009) (advocating a carbon tax system), Roberta F. Mann, *The Case for the Carbon Tax: How to Overcome Politics and Find Our Green Destiny*, 39 *Envtl. L. Rep.* (Envtl. Law Inst.)

up initiatives.²⁴ Although discussion of climate change adaptation, especially more recently, is often included in those scholarly contributions,²⁵ it is seldom included as a significant focus and almost never with concrete domestic policy proposals offered.²⁶ Indeed, the vast majority of legal

10,118 (2009) (same), Michael Waggoner, *The House Erred: A Carbon Tax Is Better than Cap and Trade*, TAX NOTES, Sept. 21, 2009, at 1257 (same), and Michael J. Zimmer, *Carbon Tax: Ready for Prime Time?*, 8 SUSTAINABLE DEV. L. & POL'Y 67 (2008) (same).

²⁴ Professor Daniel Farber observes there is a "vigorous debate about the appropriate roles of the state and federal governments in reducing greenhouse gases and mitigating climate change." Daniel A. Farber, *Climate Adaptation and Federalism: Mapping the Issues* 1 (Univ. of Cal. Berkeley Pub. Law & Legal Theory Working Paper Group, Paper No. 1468621, 2009), available at <http://ssrn.com/abstract=1468621> (follow "One-Click Download" hyperlink). Virtually every possible configuration of governance has been advocated. Compare Randall S. Abate, *Kyoto or Not, Here We Come: The Promise and Perils of the Piecemeal Approach to Climate Change Regulation in the United States*, 15 CORNELL J.L. & PUB. POL'Y, 369, 401 (2006) ("State, regional, and local climate change initiatives may be subject to criticism, but in light of the current federal regime, such criticism may be unduly harsh."), Kirsten H. Engel, *Mitigating Global Climate Change in the United States: A Regional Approach*, 14 N.Y.U. ENVTL. L.J. 54, 58 (2005) (outlining means of implementing a "regional interstate cooperative approach"), Alexandra B. Klass, *State Innovation and Preemption: Lessons from State Climate Change Efforts*, 41 LOY. L.A. L. REV. 1653 (2008) (arguing for a more restrictive approach to federal preemption jurisprudence), and Hari M. Osofsky & Janet Koven Levit, *The Scale of Networks?: Local Climate Change Coalitions*, 8 CHI. J. INT'L L. 409 (2008) (arguing the advantages of a local jurisdiction "bottom-up networking" approach), with Thomas D. Peterson et al., *Developing a Comprehensive Approach to Climate Change Policy in the United States that Fully Integrates Levels of Government and Economic Sectors*, 26 VA. ENVTL. L.J. 227 (2008) (arguing for policy formulation at all levels), and Jonathan B. Wiener, *Think Globally, Act Globally: The Limits of Local Climate Policies*, 155 U. PA. L. REV. 1961, 1962 (2007) ("[S]ubnational state-level action is not the best way to combat global climate change."). See generally Symposium, *Federalism and Climate Change: The Role of the States in a Future Federal Regime*, 50 ARIZ. L. REV. 673 (2008). Two points on which there appear to be universal agreement are 1) thus far, climate change mitigation policy has been shaped largely by the states, see Patrick Parenteau, *Lead Follow or Get Out of the Way: The States Tackle Climate Change with Little Help from Washington*, 40 CONN. L. REV. 1453 (2008); and 2) federal attention to formulation of a national mitigation policy has intensified in the past year, see Geoffrey Clemm & Mark Griffin Smith, *Emerging U.S. Climate Policy: Where We Are and How We Got Here* (Colo. College Working Paper Group, Paper No. 2009-04, 2009), available at <http://ssrn.com/abstract=1440339> (follow "One-Click Download" hyperlink).

²⁵ As evidence of the recent merging of the two themes, 465 articles identified in my literature search, *supra* note 22, mention both mitigation and adaptation in the same paragraph, with 309 (66%) of those published in 2007 or later.

²⁶ A significant exception comes from the work of water law scholars, who have been examining the implications of climate change adaptation on water law since the early 1990s. Their work is discussed *infra* Part III.C. Notable examples of more comprehensive contributions to the legal scholarship on climate change adaptation outside of water law include Baldwin, *supra* note 18 (proposing ways environmental assessment statutes, such as The National Environmental Policy Act of 1969, 42 U.S.C. §§ 4321-4347 (2006), can be used to help formulate adaptation strategies); Camacho, *supra* note 18 (providing a sweeping overview of the need for adaptation and proposing an "adaptive governance" model for natural resources management agencies); Craig, *supra* note 18 (outlining general guidelines for formulating adaptation strategies); Farber, *supra* note 18 (examining allocation of responsibility for effects of climate change and costs of adaptation); Ira Feldman & Joshua H. Kahan, *Preparing for the Day After Tomorrow*, 8 SUSTAINABLE DEV. L. & POL'Y 61 (2007) (providing a broad survey of federal and state adaptation policies); Robert L. Glicksman, *Ecosystem Resilience to Disruptions Linked to Global Climate Change: An Adaptive Approach to Federal Land*

scholarship touching on climate change adaptation explores not domestic preparedness, but rather the scope of responsibility developed nations have to assist the adaptation efforts of the least developed nations most vulnerable to the effects of climate change.²⁷ The latter is an important policy concern, but the former deserves urgent and focused attention as well.

Likewise, the actual on-the-ground law of climate change, albeit still limited in scope, is overwhelmingly about mitigation.²⁸ Most of the litigation aimed at shaping climate change policy is about either forcing the government to regulate or prohibit new sources of greenhouse gas emissions or stopping the government from doing so.²⁹ Likewise, virtually all federal, state, and local climate change law on the books or proposed for adoption addresses mitigation.³⁰ Only a few adaptation planning efforts, and even fewer concrete policies, have been adopted, so far mostly (as with mitigation policies) by state and local governments.³¹ Overall, very little litigation,

Management, 87 NEB. L. REV. 833 (2009) (offering principles of adaptive management for public land agencies); and J.B. Ruhl, *Climate Change and the Endangered Species Act: Building Bridges to the No-Analog Future*, 88 B.U. L. REV. 1 (2008) (exploring adaptation strategies that can be taken on behalf of endangered species). Interest in the topic among legal scholars is growing fast, however, as evidenced by the University of North Carolina Law School's recent creation of the Center for Law, Environment, Adaptation, and Resources, the inaugural event of which in 2008 was a conference on climate change adaptation. See Univ. of N. Carolina Sch. of Law, *Adapting Legal Regimes in the Face of Climate Change*, <http://www.law.unc.edu/centers/clear/workshops/climatechange/default.aspx> (last visited Apr. 18, 2010).

²⁷ For examples, see *infra* Part III.D.

²⁸ See Craig, *supra* note 18, at 18 ("In the United States, much of the legal attention to climate change, whether expressed through litigation, legislation, or scholarship, has focused on *mitigation* . . .").

²⁹ See generally Robert A. Wyman et al., *Significant Climate Issues Likely to Be Raised in the Federal Courts*, 39 *Env'tl. L. Rep. (Env'tl. Law Inst.)* 10,925, 10,925–43 (2009) (surveying the potential scope of climate litigation but focusing overwhelmingly on issues related to mitigation). A useful depiction of the breadth and depth of climate change litigation can be found at a case-tracking chart that lawyers at the law firm of Arnold & Porter maintain. See MICHAEL B. GERRARD & J. CULLEN HOWE, *CLIMATE CHANGE LITIGATION IN THE U.S.*, available at <http://www.climatecasechart.com>. The chart divides climate change into three primary categories: statutory claims, common law claims, and public international claims. *Id.* at 1. Within the statutory claims category are claims to force the government to act, claims to stop government action, and claims to regulate private conduct. *Id.* My colleague David Markell and I are preparing a more detailed empirical analysis of the cases included in the chart, very few of which, based on our initial review, involve claims that could be described as focused on adaptation strategies.

³⁰ Ruhl, *supra* note 26, at 13 n.42.

³¹ In their thorough 2007 survey of international and domestic adaptation initiatives, Feldman and Kahan conclude that "states have led the way in climate change adaptation considerations," while "[f]ederal-level discussions and considerations are preliminary." Feldman & Kahan, *supra* note 26, at 66; see also Camacho, *supra* note 18, at 46–60 (examining the fledgling federal agency initiatives). Confirming this assessment, the Government Accountability Office recently concluded a comprehensive review of federal adaptation policy with the finding that "[w]hile federal agencies are beginning to recognize the need to adapt to climate change, there is a general lack of strategic coordination across agencies, and most efforts to adapt to potential climate change impacts are preliminary." GOV'T ACCOUNTABILITY OFFICE, *supra* note 14, at 5. A significant step forward came in President Obama's October 2009 Executive Order 13,514, which among other things endorsed an interagency Climate Change Adaptation Task Force "already engaged in developing the domestic and international

legislation, policy, or regulation in the United States has to do with how to manage the effects of climate change on people or the environment.

This Article is intended to further catalyze and, I hope, help organize a dialogue in legal scholarship and among policy makers with the principal focus of developing the environmental law and policy dimension of climate change adaptation. It adopts several premises about which little further discussion is provided: 1) work on mitigation law and policy will continue globally at multiple governance scales for several decades before significant legal regimes are in place; and 2) regardless of how aggressively that work progresses, climate warming committed to date will be exacerbated by additional net increases in greenhouse gas emissions for the foreseeable future until the mitigation measures take hold; meaning that 3) there will necessarily be an extended period of measurably significant climate change; but 4) at some point, probably many decades into the future, the mitigation measures will gain traction on greenhouse gas emissions and will arrest further climate change to lead us into a new stabilized climate regime.

The first three premises, already mentioned above, seem so beyond serious contestation that only a Pollyanna would argue to the contrary, and thus point inexorably to the need to define an adaptation component of climate change law. The fourth premise—that there is actually an “end” to climate change if we start working hard and soon on a mitigation strategy—is the hopeful one about which we cannot be certain. It raises the normative

dimensions of a U.S. strategy for adaptation to climate change.” See Exec. Order No. 13,514, 74 Fed. Reg. 52,117, 52,124 (Oct. 8, 2009). To follow the work of the Task Force, see Council on Env'tl. Quality, Climate Change Adaptation Task Force, <http://www.whitehouse.gov/administration/eop/ceq/initiatives/adaptation> (last visited Apr. 18, 2010). The Department of the Interior has taken the lead among federal agencies in developing adaptation policy. See generally U.S. Dep't of the Interior Sec'y Order No. 3,289 (Sept. 14, 2009), available at <http://www.interior.gov/climatechange/SecOrder3289.pdf> (addressing the impacts of climate change on America's natural and cultural resources); U.S. FISH & WILDLIFE SERV., U.S. DEP'T OF THE INTERIOR, RISING TO THE CHALLENGE: STRATEGIC PLAN FOR RESPONDING TO ACCELERATING CLIMATE CHANGE 1–2, 10, 12 (2009) (public comment draft), available at http://www.fws.gov/home/climatechange/strategic_plan.html. The Environmental Protection Agency also has a fact sheet posted on its website providing links to several reports the agency's Global Change Research Program has produced on climate change impacts and adaptation. See U.S. Env'tl. Prot. Agency, *supra* note 2. Up-to-date information about state mitigation and adaptation strategies can be found through the Seventh Generation Advisors, State Climate Policy Track, http://seventhgenerationadvisors.org/index.php?option=com_content&view=article&id=79%3Astate-climate-policy-tracker&catid=4&Itemid=19 (last visited Apr. 18, 2010), and through an interactive map tool maintained by the Center for Climate Strategies, U.S. Climate Policy Action, <http://www.climatestrategies.us> (last visited Apr. 18, 2010). California has established the most detailed state adaptation strategy. See CAL. NATURAL RES. AGENCY, CALIFORNIA CLIMATE ADAPTATION STRATEGY (2009), available at <http://www.energy.ca.gov/2009publications/CNRA-1000-2009-027/CNRA-1000-2009-027-F.PDF>. Maryland's Commission on Climate Change also has begun substantial policy analysis and development focused on infrastructure and health issues. See Md. Comm'n on Climate Change, Adaptation and Response Working Groups, <http://www.mdclimatechange.us/twg.cfm> (last visited Apr. 18, 2010). At the local level, New York City offers an example of a local jurisdiction taking proactive steps toward developing a climate change adaptation policy. See Edna Sussman et al., *Climate Change Adaptation: Fostering Progress Through Law and Regulation*, 18 N.Y.U. ENVTL. L.J. 55 (2010) (discussing various city initiatives).

question that adaptation policy ultimately must answer: when we get to the “other side” of climate change, what do we hope to have accomplished with adaptation law and policy? We have no analog for what the world will look like then.³² Unlike mitigation policy, for which the goal is clear, adaptation policy thus has no well-defined target.³³ My final premise, therefore, is that the adaptation component of climate change law has two overarching dynamic goals. First, it is to effectively and equitably manage the harms and benefits of climate change while mitigation policy does its work.³⁴ Second, it is to supply interim strategies to put us in a position to resume long-term planning for sustainable development when climate change is “over.”³⁵ Adaptation law, in other words, is about building a bridge to get us across the chasm of climate change intact.

To be sure, adopting both of those goals will trigger intense normative debates about what are “harms” and “benefits” of climate change, how do we

³² Many ecologists believe we face a “no-analog” future—one for which we have no experience on which to base projections of ecosystem change and for which models designed to allow active management decisions as climate change takes effect are presently rudimentary and imprecise. See Peter Cox & David Stephenson, *A Changing Climate for Prediction*, 317 SCI. 207, 207–08 (2007); Matthew C. Fitzpatrick & William W. Hargrove, *The Projection of Species Distribution Models and the Problem of Non-Analog Climate*, 18 BIODIVERSITY & CONSERVATION 2255, 2255–57 (2009); Douglas Fox, *Back to the No-Analog Future?*, 316 SCI. 823, 823, 825 (2007); Douglas Fox, *When Worlds Collide*, CONSERVATION, Jan.–Mar. 2007, at 28, 32–33.

³³ See Burton, *supra* note 19, at 93 (“What is meant by mitigation is clearly understood. By contrast adaptation means too many unclear things.”).

³⁴ As discussed at several points later in this Article, climate change is not all about harms—there will be benefits in many forms for many regions of human populations and for many species. Agriculture in the United States, for example, may find benefits to warming temperatures, increased precipitation, and higher carbon dioxide levels. See Olivier Deschênes & Michael Greenstone, *The Economic Impacts of Climate Change: Evidence from Agricultural Output and Random Fluctuations in Weather*, 97 AM. ECON. REV. 354, 355–57 (2007). Of particular relief to many is that “the production of high-quality wine grapes is expected to benefit from a warmer climate because of a longer growing season and more favorable growing conditions in the short-term.” CAL. NATURAL RES. AGENCY, *supra* note 31, at 94.

³⁵ In 1987, the Brundtland Commission, formed by the United Nations General Assembly, endorsed “sustainable development” as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” WORLD COMM’N ON ENV’T & DEV., OUR COMMON FUTURE 43 (1987). Although since then more meat has been added to exactly what that means, this definition remains at the core of sustainable development theory. See John C. Dernbach, *Sustainable Development: Now More Than Ever*, in STUMBLING TOWARD SUSTAINABILITY 45, 45 (John C. Dernbach ed., 2002). Within this framework, climate change adaptation can be thought of as an interim strategy for sustainable development during the era of climate change. As I describe climate change adaptation *infra*, therefore, it is a necessary but short-term predicate for returning to a position of long-term sustainable development planning, in that climate change will be too complex for us to know at any point what is sustainable development within the meaning of the definition. See Robert W. Kates, et al., *Sustainability Science*, 292 SCI. 641, 641–42 (2001). Indeed, adaptive measures taken to avoid potentially disastrous effects of climate change, such as massive water transfers to sustain urban populations or erecting vast sea wall complexes to protect coastal populations, may not be compatible with current (or future) conceptions of sustainable development policies and practices. For an insightful discussion of sustainable development in the context of climate change, see David L. Markell, *Greening the Economy Sustainably*, 1 WASH. & LEE J. ENERGY, CLIMATE, & ENV’T (forthcoming 2010), available at <http://ssrn.com/abstract=1376380> (follow “One-Click Download” hyperlink).

“manage” them, and what set of conditions will position us to resume “sustainable development.” I do *not* attempt to resolve those questions here. Rather, this Article is intended to describe the policy space within which those questions will be debated in the field of environmental law. Climate change will impose unyielding physical, biological, and social constraints on what is possible to achieve through environmental law, but it will also exert tremendous structural pressures on the very design and implementation of the law itself. Environmental law, in other words, will undergo its own structural transformation regardless of the normative adaptation goals we set for it, which in turn will limit the normative goals we can hope to achieve with it. This Article, therefore, is aimed primarily at describing how environmental law is likely structurally to be shaped, constrained, and even liberated by the realities and demands of climate change adaptation, so that we can better understand how to apply it and what to expect to accomplish with it.

Part II briefly describes the context within which climate change adaptation and adaptation law will evolve. It starts with a survey and synthesis of some of the prevailing theories of climate change adaptation, then outlines the features of climate change adaptation in its three modes: 1) *resisting* the effects of climate change to maintain the status quo *in situ*; 2) *transforming in situ* to new physical, economic, and social arrangements to adapt to climate change; and 3) *moving* in search of better conditions for adaptation. Climate change impacts prompting one or more of these adaptive responses will come in three simultaneous waves putting relentless pressure on environmental law. First will be the direct alterations to regional and local environments caused by the macro effects of climate change, such as inundation of wetlands caused by sea level rise and vegetation transition caused by reduced rainfall. Central goals of environmental law, such as ecological conservation, will be severely challenged in these contexts. Second will be the direct environmental impacts of human adaptation responses, such as coastal armoring to withstand sea level rise and increased water diversion and usage to offset lower rainfall. Environmental law has always attempted to manage human behavior toward the environment, and that job will be more complex than ever when aimed at climate change adaptation behavior. Finally, environmental law must interact with other fields of law and policy and manage the indirect environmental spillover effects of adaptive responses that have little or nothing to do directly with the environment, such as in national security, immigration, public health, human rights, finance, housing, and trade policies. Environmental law has long recognized the need to address policy spillover effects, but they will be intensified in the climate change adaptation context.

Part III of the Article then describes the ten structural trends I predict environmental law will experience over the next few decades as it is shaped by the adaptation modes and pressures outlined in Part II. Although I confess to relying on a strong dose of my own experience and perspective in formulating the trends, I have endeavored in earnest to make them more than just the world according to J.B. Ruhl. First, I conducted a literature survey by culling through the legal scholarship covering climate change adaptation in some substantial

way and accounting for dominant themes and perspectives.³⁶ Based on that assessment, I articulated and organized a set of trends, which I then briefly described in several postings on the environmental law professors listserv, *envlawprofs*, for reactions from anyone willing to comment. I received many insightful comments, based on which I refined my list to these ten trends:

1. Shift in emphasis from preservationism to transitionalism in natural resources conservation policy
2. Rapid evolution of property rights and liability rules associated with natural capital adaptation resources
3. Accelerated merger of water law, land-use law, and environmental law
4. Incorporation of a human rights dimension in climate change adaptation policy
5. Catastrophe and crisis avoidance and response as an overarching adaptation policy priority
6. Frequent reconfigurations of transpolicy linkages and trade-offs at all scales and across scales
7. Shift from “front end” decision methods relying on robust predictive capacity to “back end” decision methods relying on active adaptive management
8. Greater variety and flexibility in regulatory instruments
9. Increased reliance on multiscalar governance networks
10. Conciliation

The first six of the trends reflect forces that will transform the boundaries and capacity of environmental law. The next three trends anticipate shifts in the policy instruments, decision methods, and institutional restructuring that will follow inevitably from the first six trends. The final trend captures some holistic observations about the posture of environmental law in the period of climate change adaptation.

Notwithstanding the rather sprawling scope encompassed in the ten trends, an overarching theme emanates from their collective impact: Do not expect adaptation policy to play out for environmental law the way mitigation policy has and is likely to continue. Mitigation policy has been framed as an initiative primarily within the domain of environmental law, a

³⁶ As previously mentioned, *supra* note 22, as of April 17, 2010, 1015 files in Westlaw's Journals and Law Reviews (JLR) database used the terms “climate change” and “adapt!” at least once in the same sentence. I reviewed all of them to identify those treating the topic of climate change adaptation in law (not limited to environmental law) in some substantial manner. I also culled through entries on the Social Science Research Network and legal blogs in search of similar publications. I reviewed each of the final set of articles to identify the author's assessment of the development of the law in response to the modes and pressures of climate change adaptation discussed in Part II of this Article.

form of pollution control on steroids, and thus it will be environmental law that makes the first move and other policy realms that apply support or pushback. By contrast, environmental law does not “own” adaptation policy; rather, numerous policy fronts will compete simultaneously for primacy and priority as people demand protection from harms and enjoyment of benefits. This makes it all the more pressing for environmental law, early in the nation’s formulation of adaptation policy, to find its voice and establish its place in efforts to close the adaptation deficit.

II. WHAT IS CLIMATE CHANGE ADAPTATION?

I ask readers to take as a given that climate change impacts under any realistic mitigation scenario are going to be complex and unpredictable over the next century.³⁷ The major categories of probable impacts for humans and the environment in the United States include the following:

- Climate change will stress water resources. . . .
- . . . Crop and livestock production will be increasingly challenged. . . .
- . . . Coastal areas are at increasing risk from sea level rise and storm surge. . . .
- . . . Risks to human health will increase. . . .
- . . . Climate change will interact with many social and environmental stresses. . . .
- . . . Thresholds will be crossed, leading to large changes in climate and ecosystems.³⁸

I provide details in Part III where needed to advance the discussion, but for now it suffices to acknowledge that climate change will play out over the globe in a multitude of dynamic, feedback-plagued, nonlinear physical and biological trends that will be uneven spatially and temporally across the planet and will pose numerous policy trade-offs.³⁹ Sea level will rise here and

³⁷ For evidence, see INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 6, *passim*; UNITED NATIONS ENV’T PROGRAMME, *supra* note 6, *passim*; U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 1, *passim*. I offer no specific predictions about the intensity, distribution, or longevity of impacts in any local or regional setting. Indeed, I argue later in this Article that such predictions are beyond current modeling capacity and thus policy decisions should not be made based on the assumption of robust predictive capacity. See *infra* Part III.G.

³⁸ See U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 1, at 12. For a comprehensive assessment of global impacts and impacts in other countries, see INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 2, *passim*.

³⁹ The scientific literature exploring these complex dynamics and exposing our lack of understanding about what lies ahead as temperature rises is legion. See, e.g., DANIEL B. FAGRE ET AL., U.S. CLIMATE CHANGE SCI. PROGRAM: THRESHOLDS OF CHANGE IN ECOSYSTEMS 5–13 (2008) (public review draft) (U.S. Geological Survey, Synthesis and Assessment Product 4.2, 2009), available at <http://downloads.climate-science.gov/sap/sap4-2/sap4-2-final-report-all.pdf> (examining numerous positive feedback properties leading to nonlinear thresholds in climate change dynamics); Almut Arneth et al., *Clean the Air, Heat the Planet?*, 326 SCI. 672, 672–73 (2009) (examining the feedback effects between conventional air pollution control and climate change mitigation, concluding that complex positive and negative feedback links exist, and that, on balance, the evidence and models suggest that “air pollution control will accelerate warming in

fall there;⁴⁰ there will be more rain here and less there;⁴¹ some species will die, some will move, and some will stay;⁴² some crops will fail where they once thrived and some will thrive where they once had no hope;⁴³ some humans will get poorer, some richer, some will move around, and some will die. The picture of how these and other impacts will play out will change over time, and it will all be happening under a new set of rules about which

the coming decades"); Gordon B. Bonan, *Forests and Climate Change: Forcings, Feedbacks, and the Climate Benefits of Forests*, 320 SCI. 1444, 1444–49 (2008) (explaining the complex and nonlinear forest-climate interactions); I. Eisenman & J.S. Wettlaufer, *Nonlinear Threshold Behavior During the Loss of Arctic Sea Ice*, 106 PROC. NAT'L ACAD. SCI. 28, 28–31 (2009) (describing the nonlinear "tipping points" in the ice-albedo feedback effect); Jerome Gaillardet & Albert Galy, *Himalaya—Carbon Sink or Source?*, 320 SCI. 1727, 1727–28 (2008) (explaining the uncertainties of the sinks and sources of the carbon geological cycle); Steven W. Running, *Ecosystem Disturbance, Carbon, and Climate*, 321 SCI. 652 (2008) (explaining the uncertainties of ecological sinks and sources such as fires and insect epidemics). Dust, pollutant haze, and other aerosols in the atmosphere, for example, deflect incoming solar radiation and thus have a cooling effect. See Richard A. Kerr, *Another Global Warming Icon Comes Under Attack*, 317 SCI. 28, 28 (2007) (explaining that because "[a]erosols cool the planet by reflecting away sunlight and increasing the reflectivity of the clouds," climate change models can vary widely depending on assumptions about aerosol levels). Other research focuses on the nonlinear effects these feedback loops have on the pace of change, such as acceleration of ice sheet melting. See Richard A. Kerr, *Both of the World's Ice Sheets May Be Shrinking Faster and Faster*, 326 SCI. 217 (2009). As temperatures rise on average, moreover, other positive and negative feedback effects are triggered that could amplify or impede further warming. Melting tundra, for example, releases more greenhouse gases, and researchers have found this effect is far exceeding expected levels because of its feedback properties. See K.M. Walter et al., *Methane Bubbling from Siberian Thaw Lakes as a Positive Feedback to Climate Warming*, 443 NATURE 71 (2006). The effect leads to a positive feedback loop in the following manner: As the greenhouse gases are released, they contribute to warming that melts the tundra faster, which releases more greenhouse gases more rapidly, and so on. See Katey M. Walter et al., *Methane Bubbling from Northern Lakes: Present and Future Contributions to the Global Methane Budget*, 365 PHIL. TRANSACTIONS ROYAL SOC'Y A 1657, 1671 (2007). This effect is believed to have played a significant role in the last deglaciation. See K.M. Walter et al., *Thermokarst Lakes as a Source of Atmospheric CH₄ During the Last Deglaciation*, 318 SCI. 633, 633 (2007). Ecologists believe these and other transformations in the tundra "could be a one-way ticket," meaning they are irreversible. See John Bohannon, *The Big Thaw Reaches Mongolia's Pristine North*, 319 SCI. 567, 568 (2008). Researchers believe there is a strong potential for similar nonlinear change effects throughout the world's peatlands. See Nancy B. Dise, *Peatland Response to Global Change*, 326 SCI. 810 (2009). For other examples of ecological thresholds of irreversibility that climate change is likely to cross, see ADVISORY COMM. FOR ENVTL. RESEARCH & EDUC., NAT'L SCI. FOUND., *TRANSITIONS AND TIPPING POINTS IN COMPLEX ENVIRONMENTAL SYSTEMS 28–31* (2009), available at http://www.nsf.gov/geo/ere/ereweb/ac-ere/nsf6895_ere_report_090809.pdf.

⁴⁰ J.X. Mitrovika et al., *The Sea-Level Fingerprint of West Antarctic Collapse*, 323 SCI. 753, 753 (2009) (suggesting that although generally global sea levels will rise as a result of a collapse of the West Atlantic Ice Sheet, gravitational changes associated with loss of the ice sheet could actually lead to a net sea-level fall in some places).

⁴¹ INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 6, at 8 (explaining likely precipitation increases and decreases in various regions of the world).

⁴² Eric Post et al., *Ecological Dynamics Across the Arctic Associated with Recent Climate Change*, 325 SCI. 1355 (2009).

⁴³ See, e.g., GERALD C. NELSON ET AL., INT'L FOOD POLICY RESEARCH INST., *CLIMATE CHANGE: IMPACT ON AGRICULTURE AND COSTS OF ADAPTATION 4* (2009), available at <http://www.ifpri.org/sites/default/files/publications/pr21.pdf>.

over time, and it will all be happening under a new set of rules about which we know very little at the moment.⁴⁴ How bad it will be for any particular local or regional community is unclear; indeed, it won't be so bad for some people or other species in some places—it might even be smashing good.⁴⁵

The bottom line for policy, therefore, is that planning for the future based on the climate of the past will lead to folly.⁴⁶ Climate change will require people to develop new strategies for avoiding and recovering from its harms and capturing and harnessing its benefits. This will become a costly global undertaking⁴⁷ with potentially significant environmental impacts of its own.⁴⁸ Environmental law thus necessarily will be part of the policy formulation mix, and to play that role, environmental law will need a theory of adaptation to better understand the modes in which people will

⁴⁴ See U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 1, at 11 (“[S]ociety won't be adapting to a new steady state but rather to a rapidly moving target. Climate will be continually changing, moving at a relatively rapid rate, outside the range to which society has adapted in the past.”).

⁴⁵ Although the science and economics of climate change acknowledge this uneven distribution of effects and corresponding costs and benefits, most legal scholarship on climate change emphasizes only the bad effects. For a discussion of the policy complexities raised by the distribution of human costs and benefits associated with climate change, arguing that prevailing domestic mitigation policy proposals do not adequately take the benefits into account, see Johnston, *supra* note 17, at 38–41. It is probable that some other species will also enjoy benefits from climate change. See, e.g., Post et al., *supra* note 42, at 1355 (discussing the potential benefits of a warming climate for reindeer). As discussed *infra* Part III.G, I believe it would be folly to attempt to design mitigation or adaptation policy around any sort of cost-benefit analysis of the relative harms and benefits of climate change. Nevertheless, where benefits do accrue to humans or other species, I see no point in ignoring them when designing adaptation strategies.

⁴⁶ See Rosina M. Bierbaum & Robert B. Zoellick, *Development and Climate Change*, 326 SCI. 771, 771 (2009) (arguing that “[p]lanning for the future based on the climate of the past will erode development gains, deepen vulnerabilities, and increase inequities” and noting the authors are Dean of the School of Natural Resources and Environment at the University of Michigan and President of the World Bank, respectively).

⁴⁷ The International Institute for Environment and Development recently released a review and assessment of global climate change adaptation cost estimates, which not surprisingly are expected to differ from sector to sector and from region to region and to vary widely based on assumptions about timing, intensity, and technique of mitigation and adaptation strategies. See MARTIN PARRY ET AL., ASSESSING THE COSTS OF ADAPTATION TO CLIMATE CHANGE: A REVIEW OF THE UNFCCC AND OTHER RECENT ESTIMATES (2009), available at <http://www.iied.org/pubs/pdfs/11501IIED.pdf>. The report concludes that prior estimates of \$49–\$171 billion global investment per year through 2030 for necessary adaptation initiatives underestimates likely funding needs by a factor of two to three. See *id.* at 8–14. In another recent study, the World Bank estimates that developing nations face an adaptation price tag of \$75–\$100 billion annually through 2050. See WORLD BANK, THE COSTS TO DEVELOPING COUNTRIES OF ADAPTING TO CLIMATE CHANGE: NEW METHODS AND ESTIMATES: EXECUTIVE SUMMARY: CONSULTATIVE DRAFT (2009), available at <http://siteresources.worldbank.org/INTCC/Resources/Executivesummary.pdf>. The European Environment Agency has also provided a useful report on the complexity of estimating adaptation costs. See EUROPEAN ENV'T AGENCY, CLIMATE CHANGE: THE COST OF INACTION AND THE COST OF ADAPTATION § 3, at 22–35 (2007) (reviewing the main methodological issues).

⁴⁸ I discuss in Parts II and III several contexts in which adaptation will take the form of physical alteration of land and other resources, thus raising the potential for direct and indirect environmental impacts. Zinn's evaluation of the extreme “no mitigation” policy scenario dwells significantly on this effect. See Zinn, *supra* note 18.

adapt and the pressures doing so will place on the environment and environmental law.

A. Adaptation Policy Parameters

Unlike the story in legal scholarship, the body of literature on climate change adaptation from the physical, social, and policy sciences is already massive and growing at a stunning rate. It is also difficult to make sense of the emerging theory in terms relevant to legal discourse, as the literature proposes all variety of models for understanding what climate change adaptation is about but offers very little in the way of concrete frameworks for building hard law to apply at national, state, and local governance scales. I cannot hope here to comprehensively review the full scope of the theoretical foundations being advanced; rather, I have extracted and synthesized from the various leading sources seven parameters that authors present as the predominant drivers of adaptation policy design, each of which defines a range of policy perspectives or options summarized in Table 1 at the conclusion of this section.

1. Actor

Although formulation of climate change policy is more often associated with the *public* sector leading the way with *planned* initiatives, climate change adaptation policy will be profoundly influenced by strategies and initiatives from the *private* sector taking *autonomous* initiatives.⁴⁹ Private markets and institutions will adapt to climate change with individualized and industry-wide strategies and initiatives that may go a long way toward facilitating the reduction of harms and the harnessing of benefits of climate change. Moreover, within the two categories, public and private, a broad array of actors is defined, including various scales of government and types of private actors, including individuals, corporations, and nongovernmental organizations, all with keen interest in adaptation policy.⁵⁰ In addition to basic questions of which governance scale is appropriate for public planning, therefore, the public sector also will need to consider the role and regulation of private autonomous adaptation efforts.

⁴⁹ U.S. Envtl. Prot. Agency, Glossary of Climate Change Terms, <http://www.epa.gov/climatechange/glossary.html> (last visited Apr. 18, 2010) ("Various types of adaptation can be distinguished, including . . . private and public adaptation, and autonomous and planned adaptation."). Public adaptation is generally associated with planned adaptation, and private adaptation with autonomous adaptation. See JOHN M. ANTLE, RES. FOR THE FUTURE, AGRICULTURE AND THE FOOD SYSTEM: ADAPTATION TO CLIMATE CHANGE 4 (2009), available at <http://www.rff.org/rff/documents/RFF-Rpt-Adaptation-Antle.pdf> ("Many . . . adaptations at the farm level and in the broader food system and economy are made without government involvement and are referred to as *autonomous adaptation* Other adaptations that involve government intervention are referred to as *planned adaptations*").

⁵⁰ See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 2, at 720.

2. Response Orientation

Many adaptation policy theorists distinguish between *proactive* adaptation strategies (also known as preventative, or anticipatory) and *reactive* strategies.⁵¹ Proactive strategies anticipate climate change impacts to design measures that will reduce harm or harness benefits in the future, such as crop and livelihood diversification, seasonal climate forecasting, community-based disaster risk reduction, famine early warning systems, insurance, water storage, supplementary irrigation, and so on.⁵² By contrast, reactive strategies design responses based on observed climate change impacts as they occur through measures such as emergency response, disaster recovery, and migration.⁵³ Many climate change impacts could be addressed through either orientation. The United States Fish and Wildlife Service explains the distinction:

Reacting to climate change . . . is reactive adaptation. Combating rising sea levels by pumping sand ashore to replenish beaches and maintain existing habitat for nesting sea turtles and shorebirds is an example of reactive adaptation. A second approach to responding to climate change is to manage toward future, and often less certain, landscape conditions by predicting and working with the effects of climate change. . . . An example of anticipatory adaptation is planning for sea level rise by modeling future shoreline conditions; developing shoreline "retreat" plans (including relocation of infrastructure) that allow rising sea levels to erode existing beaches and establish new shorelines landward for nesting sea turtles and shorebirds; and monitoring the results.⁵⁴

In general, the perception is that "a 'wait and see' or reactive approach is often inefficient and could be particularly unsuccessful in addressing irreversible damages, such as species extinction or unrecoverable ecosystem damages, that may result from climate change," though in some cases there may be no choice but to wait and see.⁵⁵

3. Adaptation Goals

It is stating the obvious that the goal of most climate change adaptation policy development is to minimize and recover from the *harms* of climate change. But that cannot be the exclusive focus. Although it is not often acknowledged in the climate change mitigation dialogue, which is mostly about preventing climate change because of its perceived distributional harm to some populations and net aggregate harm to humans and the environment, climate change will produce *benefits* for many human

⁵¹ See *id.*; Camacho, *supra* note 18, at 15; Feldman & Kahan, *supra* note 26, at 67; U.S. Envtl. Prot. Agency, *supra* note 49 ("Various types of adaptation can be distinguished, including anticipatory and reactive adaptation . . .").

⁵² See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 2, at 721.

⁵³ *Id.*

⁵⁴ U.S. FISH & WILDLIFE SERV., *supra* note 31, at 11 (emphasis omitted).

⁵⁵ INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 2, at 721; see also Camacho, *supra* note 18, at 16.

communities and other species, in some cases substantial benefits.⁵⁶ Temperature and rainfall changes, for example, will open up new agricultural or recreational possibilities for areas previously limited in these respects.⁵⁷ Hence, the goal of regional and local climate change adaptation policy frequently will be about taking advantage of change and making life better, not worse, for people and other species. This will no doubt be politically sensitive, as many communities will be struggling predominantly to reduce harm, but securing benefits when and where they are available will nonetheless be an inevitable goal of adaptation policy in general and often times a primary goal locally.

4. Management Target

In broad terms climate change will initiate environmental impacts in two different dimensions. One will be *changes in variability* of natural events for which we already have developed adaptive strategies, such as floods, hurricanes, and fire.⁵⁸ Also known as Type I adaptation, the challenge here will be whether the existing adaptive strategies are sufficiently robust to manage the effects of increased or decreased frequency of these natural events.⁵⁹ The other dimension of effects involves the *absolute changes* to the environment that will result from climate change, such as sea level changes, reduced glacial coverage, and higher mean surface temperatures.⁶⁰ We have not developed tested adaptation strategies for these changes, also known as Type II adaptation, simply because we have not experienced them in the past several centuries over any significant period of time.⁶¹ There will also be synergistic effects between these two types of change, as for example when increased hurricane frequency combines with higher sea levels to exacerbate coastline and inland vulnerability in some areas.⁶²

5. Policy Foundation

Climate change adaptation will involve a mix of *substantive* and *procedural* strategies and innovations. Professor Alex Camacho describes government substantive adaptation in three categories: 1) altering the environment to minimize the effects of climate change, 2) regulations and other measures to alter the way private actors interact with the environment, and 3) agency management planning designed around adaptation.⁶³ By contrast, procedural adaptation involves "strategies that manage the regulatory programs and processes that develop more direct

⁵⁶ See Deschênes & Greenstone, *supra* note 34, at 354.

⁵⁷ *Id.*

⁵⁸ See Burton, *supra* note 19, at 90.

⁵⁹ *See id.*

⁶⁰ *See id.*

⁶¹ *See id.*

⁶² *See id.*

⁶³ Camacho, *supra* note 18, at 21-22.

strategies.⁶⁴ These could include new decision making processes, such as the use of adaptive management in natural resources management, and far broader changes to institutional and governance systems.⁶⁵ The same two-pronged approach could be used in private sector climate change adaptation as well.

6. Capital Employed

Climate change adaptation will be a capital-intensive undertaking, but we will not be limited to using only *technological* capital. We will also be deploying *financial* capital to invest in new technologies and institutions, *human* capital in the form of adaptation knowledge and skills, *social* capital in groups and institutions with new norms and practices, and *natural* capital such as wetlands and coastal dunes to provide adaptive capacity.⁶⁶ Responding to increased storm surge frequency and intensity along coasts, for example, could rely on technological capital in the form of seawalls, financial capital in the form of modified insurance and financing policies, human capital in the form of improved building techniques, social capital in the form of emergency response and retreat practices, and natural capital in the form of enhanced coastal wetlands and dune systems.⁶⁷ It will only infrequently be obvious which form of capital investment will prove most effective at avoiding harm or harnessing benefits, and often there will be trade-offs inherent in selecting one mix of capital versus an alternative.

7. Strategy

Adaptation to climate change impacts will leverage two different but closely related strategies focused on deflecting and recovering from the blows of climate change.⁶⁸ One is to *reduce vulnerability* by improving the reliability of infrastructure and other mechanisms designed to shield human communities and ecosystems from the harmful effects of climate change, such as by constructing seawalls to protect coastal areas or limiting new development permits on coasts likely to experience sea level rise.⁶⁹ If the

⁶⁴ *Id.* at 23.

⁶⁵ See *id.* at 23–24. Camacho's focus is on procedural adaptation strategies, particularly adaptive management, which are taken up *infra* Part III.H.

⁶⁶ See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 2, at 727–28.

⁶⁷ See U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 1, at 152.

⁶⁸ See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 2, at 720 (“Adaptation to climate change takes place through adjustments to reduce vulnerability or enhance resilience in response to observed or expected changes in climate and associated extreme weather events.”); John Handmer & Stephen Dovers, *A Typology of Resilience: Rethinking Institutions for Sustainable Development*, in ADAPTATION TO CLIMATE CHANGE, *supra* note 4, at 187, 196; Nathan E. Hultman, *Worth More Than Good Advice: Lessons of Hurricane Katrina for Development in a Changing Climate*, 11 GEO. PUB. POL’Y REV. 47, 49–50 (2006).

⁶⁹ See JONATHAN ENSORE & RACHEL BERGER, UNDERSTANDING CLIMATE CHANGE ADAPTATION: LESSONS FROM COMMUNITY-BASED APPROACHES 13–16 (2009) (describing types of climate change hazards and impacts, and how vulnerabilities can inform adaptation strategies); P. Mick Kelly &

risks associated with vulnerability can be reduced through such methods, less harm will be sustained and less capital will need to be deployed to recover from the effects of climate change. Yet, not all the risks of climate change can be reduced in this manner, as costs, technological constraints, lack of knowledge, and mistaken assumptions will limit the capacity to improve reliability. The other strategy thus focuses recovering from the blow of climate change by *enhancing resilience* to impacts, such as through improved emergency response techniques and habitat restoration methods.⁷⁰ Many human communities and ecological landscapes will require a mix of these strategies to make effective use of available technological, financial, human, social, and natural capital.⁷¹

Table 1. Climate Change Adaptation Design Parameters

Parameter	Design Options
Actor	Public-Planned ↔ Private-Autonomous
Orientation	Proactive (a/k/a Preventative, Anticipatory) ↔ Reactive
Goals	Avoid and Repair Harm ↔ Capture and Harness Benefits
Management Target	Change in Variability ↔ Absolute Change
Policy Foundation	Substantive ↔ Procedural
Capital Employed	Technological ↔ Financial ↔ Human ↔ Social ↔ Natural
Strategy	Reduce Vulnerability ↔ Enhance Resilience

B. Modes of Adaptation

As the previous Subpart illustrates, climate change adaptation measures will come in many combinations of policy parameters and the mix of federal, state, local, and private responses is likely to be exceedingly complex. But no matter what the mix and what form any particular adaptation policy assumes, every adaptation measure is designed to facilitate one or more of three possible modes of adaptation for local and regional human populations and for other species and their ecosystems: 1) *resist* the effects of climate change to maintain the status quo in situ; 2) *transform* physical, social, environmental, or economic conditions in situ to minimize harm or maximize benefits associated with climate change impacts; or 3) *move* humans or other species to locate better adaptive capacities.

W. Neil Adger, *Theory and Practice in Assessing Vulnerability to Climate Change and Facilitating Adaptation*, in ADAPTATION TO CLIMATE CHANGE, *supra* note 4, at 161, 167–74.

⁷⁰ See ENSORE & BERGER, *supra* note 69, at 17–25; Handmer & Dovers, *supra* note 68, at 187, 190–204.

⁷¹ Blending the two strategies together is often described under the label of “adaptive capacity.” See, e.g., INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 2, at 729; Brian H. Hurd, *Challenges of Adapting to a Changing Climate*, 26 UCLA J. ENVTL. L. & POL’Y 77 (2008).

Take as examples the city of Miami, Florida, and the nearby Biscayne Bay Aquatic Preserve, which the state of Florida established in 1974 to be “preserved in an essentially natural condition so that its biological and aesthetic values may endure for the enjoyment of future generations.”⁷² These human and natural environments face substantial threats from climate change impacts such as sea level rise, introduction and loss of species, loss of coastal resources, and more frequent and intensive storm events, to name but a few.⁷³ Miami’s city managers and the Preserve’s resource managers could adopt either of the three adaptation policy goals, but with vastly different policy implications.

1. Resist

Some people like the status quo. Miami, for example, might want to stay as close as possible to the way Miami is today, notwithstanding climate change. The city might invest in this resist mode of adaptation by building seawalls, using pesticides to control invasive disease-bearing insects and parasites, importing more sand, energy, and water to support its beach tourism industry, and establishing health management systems to deal with increased disease. The Preserve managers might work tirelessly to import water, soils, and other resources to prop up wetlands and corals diminished from climate change, and they may intervene to prevent species from moving into or out of Biscayne Bay in response to climate change.⁷⁴

Obviously, this kind of resistance to climate change can only go so far on a local basis. The capital costs needed to resist all the effects of climate change would be daunting in many locations. Even where sufficient financial capital is available to make that kind of investment, fierce competition among localities for access to water, energy, and other resources necessary for sustained resistance is likely to be the norm. Indeed, on a macroregional or national scale the resist strategy cannot be uniformly maintained—to the extent managing numerous areas such as Miami and the Preserve for the status quo depends on importing water, energy, or other resources from somewhere else, then obviously not every human and natural environment can be managed for the status quo. Nevertheless, it is likely many areas of the nation will take measures to retain at least some aspects of the status quo through adoption of the resist mode of climate change adaptation strategies.

⁷² FLA. STAT. ANN. § 258.397(1) (West 2009).

⁷³ For an overview of the variety of climate change impacts Florida’s coastal areas are likely to face, see NATURAL RES. DEF. COUNCIL, *FEELING THE HEAT IN FLORIDA: GLOBAL WARMING ON THE LOCAL LEVEL* (2001), available at <http://www.nrdc.org/globalwarming/florida/florida.pdf>. The legal implications of this extensive array of problems are explored in Kelley M. Jancaitis, *Florida on the Coast of Climate Change: Responding to Rising Seas*, 31 ENVIRONS ENVTL. L. & POL’Y J. 157 (2008).

⁷⁴ The resist mode of adaptation has also been referred to as “hard resilience.” See Marcus Moench, *Adapting to Climate Change and the Risks Associated with Other Natural Hazards: Methods for Moving from Concepts to Action*, in ADAPTATION TO CLIMATE CHANGE, *supra* note 4, at 249, 256–72.

2. Transform

The transformative effects climate change will have on conceptions of variability and change in human and natural environments will undermine the very premise of many resistance strategies. The resist mode of adaptation is likely to be swamped by climate change in many contexts, shifting the focus of performance from maintaining the status quo to measuring how far off the status quo conditions have moved. Given this reality, some communities and resource managers are likely simply to adopt a transform mode of adaptation from the start. Transform modes of adaptation assume that maintaining the status quo is either not feasible or is not a desirable policy goal because of costs or other trade-offs, and thus adopt transition and change as integral parts of adaptation policy.⁷⁵ Miami's city managers, for example, may hope to replace beach tourism with some other form of tourism. And rather than try to hold on to existing coastal structures and infrastructure supporting them, Miami might decide to impose significant beachfront setbacks and stop providing new public infrastructure to continue supporting new private development along the existing coast.⁷⁶ Similarly, the Preserve's managers may decide to replace species-specific goals with broader goals such as conserving an overall mix of biodiversity without regard to species assemblage or the health of a particular species. What passes as "Miami" or the "Preserve," in other words, would no longer be referenced from the status quo of the past but rather from the anticipated future.

3. Move

The stark reality of climate change is that conditions could exhibit extreme swings for the better or worse in some areas. In those circumstances, it is possible neither the resist mode nor the transform mode of adaptation will be viable. Conditions may become too stressed in some areas to tolerate, or too good in other areas to forego. If people decide to leave Miami for other areas, or if the Preserve's resource managers decide to engage in assisted migration of species to other aquatic settings, that reflects a decision that maintaining the status quo *in situ* is not feasible or practicable *and* that transformation with change *in situ* is not viable either.⁷⁷

⁷⁵ In its most basic form, the transform mode of adaptation can be thought of as little more than a coping strategy, an approach many people in least developed nations will have no choice but to adopt. See Susanna Davies, *Are Coping Strategies a Cop-Out?*, in ADAPTATION TO CLIMATE CHANGE, *supra* note 4, at 99. As described in the text, however, the transform mode of adaptation could involve concerted measures to adapt to climate change while pursuing economic and social improvement. *Id.* at 110–11.

⁷⁶ These are among the risk minimization measures being recommended to South Carolina. See S.C. DEP'T OF HEALTH & ENVTL. CONTROL, ADAPTING TO SHORELINE CHANGE: A FOUNDATION FOR IMPROVED MANAGEMENT AND PLANNING IN SOUTH CAROLINA 20–52 (draft 2009).

⁷⁷ See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 2, at 736–37.

The move strategy is already evident in the shifting ranges of some species.⁷⁸ Of even greater concern to climate adaptation policy is the likelihood that people numbering in the hundreds of millions may be displaced from climate change “hot spots” and seek refuge elsewhere.⁷⁹ Human migration in response to environmental change has been experienced before mostly in connection with local disasters, whereas climate change may trigger broader, longer, and more persistent migratory responses.⁸⁰ But who will welcome climate refugees, and who is prepared for them whether welcome or not?

C. Environmental Policy Pressures

Climate change adaptation carried out through the three modes, using various combinations of the adaptation policy parameters, will present three sources of pressure on the environment that will require formulation of environmental policy decisions: 1) direct environmental effects, 2) the environmental effects of human adaptation, and 3) policy spillover effects.

1. Direct Environmental Effects

One set of environmental policy decisions for climate change adaptation will involve measures to respond on behalf of the environment to the direct effects of climate change, such as sea level rise, species migrations, and shifting hydrology, that mitigation policy has yet to arrest and which have not been the target of broader adaptation policy initiatives. Environmental law has always had the dual functions of controlling sources of harm (e.g., pollution control) and responding to the effects that have not been or cannot be avoided (e.g., site remediation).⁸¹ Climate change adaptation will require us to think more innovatively, however, as we design policy measures in the resist, transform, and move modes to assist species and ecosystems in avoiding harm and harnessing benefits of climate change.

For example, Section 4(a) of the Endangered Species Act (ESA)⁸² provides for designation of “critical habitat” of endangered species that includes “specific areas outside the geographical area occupied by the

⁷⁸ See Post et al., *supra* note 42, at 1355–56 (discussing Arctic species).

⁷⁹ Summarizing studies by various international aid organizations, the Asian Development Bank estimates 50 million environmentally displaced people by 2010 and over 200 million by 2050. See ASIAN DEV. BANK, CLIMATE CHANGE AND MIGRATION IN ASIA AND THE PACIFIC: EXECUTIVE SUMMARY 2 (draft 2009).

⁸⁰ See Elizabeth Burleson, *Climate Change Displacement to Refuge*, 25 J. ENVTL. L. & LITIG. (forthcoming 2010) (manuscript at 1–2), available at <http://ssrn.com/abstract=1470486> (follow “One-Click Download” hyperlink); Jane McAdam, *Environmental Migration Governance* 1 (Univ. of New S. Wales Faculty of Law Research Series, Working Paper No. 1, 2009), available at <http://ssrn.com/abstract=1412002> (follow “One-Click Download” hyperlink).

⁸¹ See generally 1 FRANK P. GRAD, TREATISE ON ENVIRONMENTAL LAW § 1.02, at 1-8 to -13 (2009) (describing pollution control and conservation of natural resources as two of the major branches of environmental law).

⁸² Endangered Species Act of 1973, 16 U.S.C. §§ 1531–1544 (2006).

species . . . upon a determination . . . that such areas are essential for the conservation of the species."⁸³ This authority could provide a viable way to respond to ecological reshuffling of species. To the extent climate models can predict with reasonable certainty where a species might successfully migrate to adapt to changes brought about by climate change, a credible interpretation of the critical habitat provisions would allow the agency to "reserve" those areas through critical habitat designations,⁸⁴ thus helping to secure migratory corridors and the species' transitional and final ecological homes.

This approach to facilitate species as they adapt through a move mode would also provide an effective tool to guide human adaptation measures to minimize effects in designated areas, thus securing a greater chance for the species to withstand climate change transitions and establish a viable population in its new ecological home. Of course, that is part of the problem—measures designed to assist species and ecosystems in adapting to climate change could constrain human adaptation measures, and vice versa, which leads to the next type of policy pressure.

2. *Environmental Effects of Human Adaptation*

Just as the primary threats to species and ecosystems before climate change centered around human-induced ecological change, it is likely that the resist, transform, and move modes of human adaptation to climate change will play a leading role in threatening environmental resources. For example, climate change is likely to lead human populations to increase rainwater harvesting and water storage, adjust the timing and location of crop plantings, relocate seawalls and other storm barriers, move urban infrastructure to account for changing water supply opportunities, and shift recreational facilities such as ski slopes to higher altitudes, to name just a few probable responses.⁸⁵

Several forms of human adaptation impacts will present the most pernicious of such threats. First, many human communities are likely to find it necessary and possible to migrate to avoid rising sea levels along coastal areas, to relocate agricultural land uses, and to obtain secure water supplies from ever distant locations.⁸⁶ These migrations and transfers of resources will necessarily involve some conversion of land uses in areas that presently provide suitable ecological conditions for particular species, in some cases at scales sufficient to pose a threat to the species.⁸⁷ Relocated human communities will likely also introduce ecological degradations from new or amplified pollution, noise, water diversions, and other stresses.⁸⁸ Many

⁸³ *Id.* § 1532(5)(A).

⁸⁴ See Ruhl, *supra* note 26, at 35–37.

⁸⁵ See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 6, at 57.

⁸⁶ See Norman Meyers, *Environmental Refuges in a Globally Warmed World*, 43 *BIOSCIENCE* 752, 752–58 (1993).

⁸⁷ See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, IPCC TECHNICAL PAPER V: CLIMATE CHANGE AND BIODIVERSITY 3–4 (2002), available at <http://www.ipcc.ch/pdf/technical-papers/climate-changes-biodiversity-en.pdf>.

⁸⁸ See *id.* at 42–43.

human communities, relocated or not, also will implement climate change mitigation and adaptation measures designed primarily to protect human health and welfare, such as coastal flood barriers, which in some cases could threaten ecological conditions for other species.⁸⁹ Even planting of forests to sequester carbon could degrade conditions for some species.⁹⁰ Lastly, human adaptation to climate change involving population relocations and increased flow of goods and resources to new settlement areas is likely to introduce nonnative species to local ecosystems, some of which will establish successfully.⁹¹

3. Policy Spillover Effects

Climate change adaptation will engage a far broader policy realm than just environmental policy, and the focus of other policy fronts such as national security, immigration, public health, and food supply is likely not to place environmental impacts at the forefront of decision-making processes.⁹² Environmental law thus will be faced with managing the spillover environmental effects of these other policy decisions, and often will do so not as an “insider” in the decision process. This will not be a new role for environmental law by any means, but climate change could present such pressing and immediate policy response needs in these other contexts that environmental law sees itself pushed even harder to the margins.

III. TEN STRUCTURAL TRENDS IN ENVIRONMENTAL LAW

The previous Part outlines the policy context of climate change adaptation. There will be widespread need at national, state, and local governance scales to design and implement strategies that facilitate how humans, other species, and ecosystems resist, transform, and move in response to climate change.⁹³ Every such adaptation initiative can choose from a complex mix of policy parameters, and every such adaptation initiative could present environmental impacts of its own. Particularly over the next two decades, as adaptation policy initially ramps up, environmental lawyers can expect a highly dynamic period of change.

⁸⁹ See *id.* at 43.

⁹⁰ See *id.* at 36.

⁹¹ The Environmental Protection Agency has suggested that “important progress has been made in identifying climate change effects on invasive species, but . . . our understanding of effects on specific species and interactions of other stressors needs to be improved.” Effects of Climate Change on Aquatic Invasive Species and Implications for Management and Research, 72 Fed. Reg. 45,046, 45,047 (Aug 10, 2007). Most invasive species introductions are human induced. Peter M. Vitousek et al., *Biological Invasions as Global Environmental Change*, 84 AM. SCIENTIST 468, 468 (1996).

⁹² See discussion *infra* Part III.F.

⁹³ See generally INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 6, at 56 (“[A]dditional adaptation measures will be required at regional and local levels to reduce the adverse impacts of projected climate change and variability, regardless of the scale of mitigation undertaken over the next two to three decades.”).

To be sure, no one could reasonably accuse environmental law of being static; indeed, the forty-year story of modern statutory environmental law is one largely of change. But it has been a story primarily of goal-oriented change motivated from within environmental law to address discrete pollution media and conservation objectives.⁹⁴ Those days are over. Environmental law does not “own” climate change adaptation policy. Rather, it may be just the reverse, as national, state, and local adaptation priorities place tremendous pressure on environmental law to partner with other fields of law in facilitation of adaptation. I am not sure where this leads, but I have some ideas about how climate change adaptation policy will most profoundly transform environmental law—ten of them to be exact.

A. Trend One: Shift in Emphasis from Preservationism to Transitionalism in Natural Resources Conservation Policy

The development of environmental law has taken many of its cues from environmental and ecological sciences, which themselves have evolved over time.⁹⁵ With ecology in particular, the trend over the past half-century has been increasingly to focus on the complex flux qualities of ecosystems and to place less emphasis on conceptions of stasis and natural stability.⁹⁶ Nevertheless, the “dynamic equilibrium” model that is now firmly in place in ecology is based on the assumption of “stationarity,” which as Milly et al. explains is “the idea that natural systems fluctuate within an unchanging envelope of variability.”⁹⁷ Although ecologists understand that the envelope can be stretched by natural and anthropogenic events, those are considered manageable disturbances. In the context of water resources, for example, Milly et al. argue that

[t]he stationarity assumption has long been compromised by human disturbances in river basins. Flood risk, water supply, and water quality are affected by water infrastructure, channel modifications, drainage works, and land-cover and land-use change. Two other (sometimes indistinguishable) challenges to stationarity have been externally forced, natural climate changes and low-frequency, internal variability (e.g., the Atlantic multidecadal oscillation) enhanced by the slow dynamics of the oceans and ice sheets. Planners have tools

⁹⁴ See generally A. Dan Tarlock, *The Nonequilibrium Paradigm in Ecology and the Partial Unraveling of Environmental Law*, 27 *LOY. L.A. L. REV.* 1121 (1994) (discussing the broad objectives of pollution risk remediation and biodiversity protection and the overall paradigm shift in the scientific justification for environmental law).

⁹⁵ See Fred P. Bosselman & A. Dan Tarlock, *The Influence of Ecological Science on American Law: An Introduction*, 69 *CHI.-KENT L. REV.* 847 (1994).

⁹⁶ See Reed F. Noss, *Some Principles of Conservation Biology, as They Apply to Environmental Law*, 69 *CHI.-KENT L. REV.* 893, 893 (1994) (“Among the new paradigms in ecology, none is more revolutionary than the idea that nature is not delicately balanced in equilibrium, but rather is dynamic, often unpredictable, and perhaps even chaotic.”); see also Bryan Norton, *Change, Constancy, and Creativity: The New Ecology and Some Old Problems*, 7 *DUKE ENVTL. L. & POL’Y F.* 49 (1996); Jonathan Baert Wiener, *Law and the New Ecology: Evolution, Categories, and Consequences*, 22 *ECOLOGY L.Q.* 325 (1995).

⁹⁷ P.C.D. Milly et al., *Stationarity Is Dead: Whither Water Management*, 319 *SCI.* 573, 573 (2008).

to adjust their analyses for known human disturbances within river basins, and justifiably or not, they generally have considered natural change and variability to be sufficiently small to allow stationarity-based design.⁹⁸

Legal scholars who have traced the influence of this scientific paradigm shift on environmental law find, as is often the case, law lagging behind.⁹⁹ Legal regimes that formed before the dynamic equilibrium model was well developed, particularly conservation programs such as the ESA, the Wilderness Act,¹⁰⁰ and the National Wildlife Refuge System,¹⁰¹ to this day depend heavily on the natural stability model of ecosystems and the strategy of setting aside habitat reserves to implement it.¹⁰² Only recently has the discipline of ecosystem management emerged with any concrete policy force to prompt movement toward the dynamic equilibrium model.¹⁰³ This newer, more flexible conservation orientation, however, still depends strongly on the stationarity premise and its appeal to “natural” and “native” models of ecosystem dynamics.¹⁰⁴ For example, the disciplines of habitat restoration and enhancement, which rest at the foundation of newer approaches to conservation policy such as wetlands and habitat mitigation banking, assume that we know the bounds of the stationarity envelope for the given ecosystem and can work to preserve them in perpetuity.¹⁰⁵

⁹⁸ *Id.* (citations omitted).

⁹⁹ See Bosselman & Tarlock, *supra* note 95; Holly Doremus, *The Endangered Species Act: Static Law Meets Dynamic World*, WASH. U. J.L. & POL'Y (forthcoming 2010), available at <http://ssrn.com/abstract=1444164> (follow “One-Click Download” hyperlink); J.B. Ruhl, *Thinking of Environmental Law as a Complex Adaptive System: How to Clean Up the Environment by Making a Mess of Environmental Law*, 34 HOUS. L. REV. 933 (1997); Tarlock, *supra* note 94; Jonathan Baert Wiener, *Beyond the Balance of Nature*, 7 DUKE ENVTL. L. & POL'Y F. 1 (1996).

¹⁰⁰ 16 U.S.C. §§ 1131–1136 (2006).

¹⁰¹ National Wildlife Refuge System Administration Act of 1966, 16 U.S.C. §§ 668dd–668ee (2006).

¹⁰² See Craig, *supra* note 18, at 32–40 (examining “environmental and natural resources law’s most basic paradigms of regulation and management: preservation and restoration”); Doremus, *supra* note 99 (manuscript at 25–30) (describing conservation policy as relying on “[t]he triumvirate of harvest regulation, restrictions on commerce, and reserve creation”); Annecoos Wiersema, *A Train Without Tracks: Rethinking the Place of Law and Goals in Environmental and Natural Resources Law*, 38 ENVTL. L. 1239, 1249 (2008) (“The traditional belief by lawyers in the balance of nature has led to laws that focused on individual species and setting aside sites of habitat without more.”).

¹⁰³ See generally Bosselman & Tarlock, *supra* note 95 (discussing the evolution of various ecological science paradigms during the last century).

¹⁰⁴ See R. Edward Grumbine, *What Is Ecosystem Management?*, 8 CONSERVATION BIOLOGY 27 (1994) (advocating management of ecosystems for their “native” properties); Bruce Pardy, *Ecosystem Management in Question: A Reply to Ruhl*, 23 PACE ENVTL. L. REV. 209, 213–14 (2005) (proposing management of ecosystems for “natural” conditions). For arguments against retaining these conceptions of “nature” as the policy driver in environmental law, see J.B. Ruhl, *The Myth of What Is Inevitable Under Ecosystem Management: A Response to Pardy*, 21 PACE ENVTL. L. REV. 315 (2005); J.B. Ruhl, *The Pardy-Ruhl Dialogue on Ecosystem Management, Part IV: Narrowing and Sharpening the Questions*, 24 PACE ENVTL. L. REV. 25 (2007); Wiener, *supra* note 99.

¹⁰⁵ See J.B. Ruhl, *Compensatory Mitigation in the Climate Change Era—Business as Usual or Time for a Change?*, NAT'L WETLANDS NEWSL., July–Aug. 2009, at 28, 28 (discussing the premises of habitat mitigation programs and their poor fit with climate change).

The stationarity premise and all on which it based, however, are going to fall to pieces in the era of climate change. In its stead ecologists now warn of the no-analog future—ecological variability unprecedented in the history of ecology, riddled with nonlinear feedback and feedforward loops, previously unknown emergent properties, and new thresholds of irreversible change.¹⁰⁶ The “envelope” of variability will grow to dimensions not previously experienced, and ecologists, including paleoecologists who have studied past climate change eras, have no analog for predicting where it is headed.¹⁰⁷ Clearly, therefore, the stationarity premise, which threw the natural stability premise out the window, is about to be thrown out the window itself.

Resource managers have begun to come to grips with this reality. Climate change, in the words of the U.S. Fish and Wildlife Service, “is the trans-formational conservation challenge of our time, not only because of its direct effects, but also because of its influence on the other stressors that have been and will continue to be, major conservation priorities.”¹⁰⁸ Similarly, in the water resources context Milly et al. suggest that

[i]n view of the magnitude and ubiquity of the hydroclimatic change apparently now under way, however, we assert that stationarity is dead and should no longer serve as a central, default assumption in water-resource risk assessment and planning. Finding a suitable successor is crucial for human adaptation to changing climate.¹⁰⁹

So, what is the successor for conservation policy? Clearly, the preservationist foundations of the habitat reserve strategy, whether applied in the form of a wildlife refuge, a habitat mitigation set aside for an endangered species, a wilderness area, or a wetlands mitigation bank, are on shaky ground.¹¹⁰ What is it that the reserve is preserving if “natural” and “native” no longer have the same meaning as they do under the stationarity premise? Is a species migrating from a now inhospitable climate-altered ecosystem “invasive” in its new ecosystem, or is it to be commended and protected for its “natural” adaptation? Is a wildlife refuge established for waterfowl a failure if it dries up, and if so should we import water to keep it “natural” so the “native” species can remain there?¹¹¹ We could debate these questions, of course, but my point is that the prevailing model of

¹⁰⁶ See *supra* note 32 and accompanying text.

¹⁰⁷ See U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 1, at 11 (“Climate will be continually changing, moving at a relatively rapid rate, outside the range to which society has adapted in the past. The precise amounts and timing of these changes will not be known with certainty.”).

¹⁰⁸ U.S. FISH & WILDLIFE SERV., *supra* note 31, at 7.

¹⁰⁹ Milly et al., *supra* note 97, at 573.

¹¹⁰ See Noss, *supra* note 96, at 893 (“[C]lassical preservationist approaches to conservation, to the extent they attempt to hold nature static, do not reflect realities of nature.”).

¹¹¹ The U.S. Fish and Wildlife Service warns that “the original purposes for which some of our National Wildlife Refuges have been established may change or become obsolete.” U.S. FISH & WILDLIFE SERV., *supra* note 31, at 9.

conservation has no answers. These questions only exist because we are entering a whole different ballgame.

In short, if stationarity is dead in conservation science, preservationism is dead in conservation policy. This is a constraint climate change will impose on environmental law regardless of our needs and desires. Preservation of natural ecological conditions, which would require going all in with our conservation chips in the resist mode of climate change adaptation, is going to be either impossible in many circumstances or more expensive than could possibly be justified in others.¹¹²

Over time, our ability to “manage for resilience” of current systems in the face of climate change will be limited as temperature thresholds are exceeded, climate impacts become severe and irreversible, and socioeconomic costs of maintaining existing ecosystem structures, functions, and services become excessive. At this point, it will be necessary to “manage for change,” with a re-examination of priorities and a shift to adaptation options that incorporate information on projected ecosystem changes.¹¹³

Hence the successor, managing for change, must embrace the transform and move modes, looking toward a transition to the future for its reference points rather than to the past as preservationism does. The transition, to put it bluntly, is from the nature we once knew to the nature that we expect to find around us on the other side of climate change. Only when we get there, however, can we begin to talk again about what belongs where under the new set of natural conditions.

What does this mean for conservation policy during the century of climate change adaptation? One option is simply to let ecosystems ride out climate change and see what we get, but most ecologists believe active management of some kind is needed to better serve the twin goals of adaptation—to minimize harm along the way and to position us to resume sustainability planning in the future.¹¹⁴ Two overarching principles seem to rise in answer to those goals. First, although techniques of restoration and enhancement will still be used in practice, they must be directed toward new transitional strategies.¹¹⁵ For example, whereas the critical habitat program

¹¹² This is a major premise of Robin Craig’s development of principles for implementing adaptation policies. See Craig, *supra* note 18, at 32–40.

¹¹³ U.S. CLIMATE CHANGE SCI. PROGRAM & THE SUBCOMM. ON GLOBAL CHANGE RESEARCH, PRELIMINARY REVIEW OF ADAPTATION OPTIONS FOR CLIMATE-SENSITIVE ECOSYSTEMS AND RESOURCES 1–6 (2008), available at http://oaspub.epa.gov/eims/eimscomm.getfile?p_download_id=474224.

¹¹⁴ See Kathy J. Willis & Shonil A. Bhagwat, *Biodiversity and Climate Change*, 326 SCI. 806, 807 (2009) (discussing the challenges of resources management as we “see species turnover, migrations, and novel communities”).

¹¹⁵ As Professor Debra Donahue suggested in comments on an early version of the Article, restoration techniques developed under the stationarity premise of natural states will remain useful as a means of reducing nonclimate stresses within ecological contexts. The U.S. Fish & Wildlife Service has made this a priority of its climate change adaptation strategy. See U.S. FISH & WILDLIFE SERV., *supra* note 31, at 22. Similarly, grazing law expert Joe Feller suggests that drier conditions in the West will make it necessary to reduce livestock grazing on federal public

under the ESA has been fixated on identifying and preserving existing essential habitat for species, it will probably do many climate-threatened species more good to roll in conservation strategies across the landscape over time to track where species are migrating or likely will migrate.¹¹⁶ The critical habitat for a climate-threatened species, in other words, might be not only where the species is found today, but also where it will try to go in the future.¹¹⁷

Second, the central objective of conservation policy for climate change adaptation should be focused broadly on biodiversity conservation rather than on conservation of particular species, particular refuge purposes, or particular wilderness conditions.¹¹⁸ Rather, ecosystem resilience is what will best position us for resuming sustainability planning in the next century, and ecosystem resilience resides in biodiversity.¹¹⁹ In short, environmental law is going to have to give up on the preservation strategy, which will be

lands in order to put them in a position to be useful for other adaptation uses. See Joseph Feller, *Climate Change and Livestock Grazing on Western Rangelands*, in CLIMATE CHANGE: A READER (William Rodgers et al. eds.) (forthcoming 2010) (manuscript at 14–17, on file with author).

¹¹⁶ See Ruhl, *supra* note 26, at 35–37 (discussing this use of the critical habitat program of the ESA).

¹¹⁷ Even further, serious consideration will need to be given to more active measures to help species adapt, such as through “assisted migration,” which involves the intentional relocation of organisms to an area in which their species has never existed. See Alejandro E. Camacho, *Assisted Migration: Redefining Nature and Natural Resources Law Under Climate Change*, 27 YALE J. ON REG. (forthcoming 2010), available at <http://ssrn.com/abstract=1495370> (follow “One-Click Download” hyperlink), (arguing that “contemporary natural resource law’s fidelity to historic baselines, protecting preexisting biota, and shielding nature from human activity is increasingly untenable in light of climate change”).

¹¹⁸ See ELISA BARBOUR & LARA KUEPPERS, PUB. POLICY INST. OF CAL., CONSERVATION AND MANAGEMENT OF ECOLOGICAL SYSTEMS IN A CHANGING CALIFORNIA 16 (2008), available at http://www.ppic.org/content/pubs/report/R_1108EBR.pdf (“[M]aintaining an ecosystem that is resistant or resilient to fire and invasive species might supplant a goal of maintaining a particular species list in a given site.”). For legal commentary on this topic, see Craig, *supra* note 18, at 46–48 (recognizing the need for resilience-based management); Doremus, *supra* note 99 (manuscript at 48) (arguing that effective ecosystem resilience management cannot be based on biodiversity metrics); Glicksman, *supra* note 26, at 881–84 (emphasizing the need for ecosystem level management for resilience); James L. Olmsted, *Climate Surfing: A Conceptual Guide to Drafting Conservation Agreements in the Age of Global Warming*, 23 ST. JOHN’S J. LEGAL COMMENT. 765 *passim* (2008) (emphasizing biodiversity management); and Noss, *supra* note 96, at 904 (“Maintaining viable ecosystems is usually more efficient, economical, and effective than a species-by-species approach.” (emphasis omitted)). European scholars have suggested the same for European Union policy. See An Cliquet et al., *Adaptation to Climate Change: Legal Challenges for Protected Areas*, 5 UTRÉCHT L. REV. 158, 174–75 (2009), available at <http://ssrn.com/abstract=1440152> (follow “One-Click Download” hyperlink).

¹¹⁹ See Ahmed Djoghlaif, *Climate Change and Biodiversity in Polar Regions*, 8 SUSTAINABLE DEV. L. & POL’Y 14, 16 (2008) (“[C]onservation and sustainable use of biodiversity is an essential element of any strategy to adapt to climate change.”); see also Jeffrey D. Sachs et al., *Biodiversity Conservation and the Millennium Development Goals*, 325 SCI. 1502 (2009) (discussing the importance of biodiversity management to human well-being); W.J. Sutherland et al., *One Hundred Questions of Importance to the Conservation of Global Biological Diversity*, 23 CONSERVATION BIOLOGY 557, 561 (2009) (discussing the important research questions for managing on a biodiversity basis in the climate change era); Matt Walpole et al., *Tracking Progress Toward the 2010 Biodiversity Target and Beyond*, 325 SCI. 1503 (2009) (discussing biodiversity management indicators).

immensely difficult given how deeply ingrained it is in environmentalism's psyche. The job of its successor, transitionalism, will be to shape conservation policy toward the transform and move modes of climate change adaptation.

*B. Trend Two: Rapid Evolution of Property Rights and Liability Rules
Associated with Natural Capital Adaptation Resources*

A fairly reliable rule of thumb is that if the insurance industry is convinced something is going to be a problem, it is going to be problem. And the insurance industry is convinced climate change is going to be a problem.¹²⁰ What this means is that insurers are anticipating that climate change will lead to costly property losses, business damages, and personal injuries to insured and insurable interests, and that adaptation to avoid or repair those damages will also be costly.¹²¹ This, of course, raises both

¹²⁰ See ASS'N OF BRITISH INSURERS, ASSESSING THE RISKS OF CLIMATE CHANGE: FINANCIAL IMPLICATIONS 3, 5 (2009), available at <http://www.abi.org.uk/Media/Releases/2009/11/45222.pdf> [hereinafter ABI, FINANCIAL IMPLICATIONS] (examining the flow-through impact on insurance prices and the impact on insurance capital requirements); ASS'N OF BRITISH INSURERS, THE FINANCIAL RISKS OF CLIMATE CHANGE 5-8 (2009), available at <http://www.metoffice.gov.uk/insurance/abi-report.html> [hereinafter ABI, FINANCIAL RISKS] (estimating necessary insurance premium increases and insurance losses due to increased flood and wind damage); THE GENEVA ASS'N, THE INSURANCE INDUSTRY AND CLIMATE CHANGE - CONTRIBUTION TO THE GLOBAL DEBATE 56-57 (2009), available at http://www.genevaassociation.org/PDF/Geneva_Reports/Geneva_report%5B2%5D.pdf (identifying as key adaptations for the insurance industry storms and flooding, agricultural issues, water availability, heat issues, and health issues); TIM LENTON ET AL., MAJOR TIPPING POINTS IN THE EARTH'S CLIMATE SYSTEM AND CONSEQUENCES FOR THE INSURANCE SECTOR 4 (2009) (providing a report commissioned by Allianz, a global financial company); CAROLYN KOUSKY & ROGER M. COOKE, CLIMATE CHANGE AND RISK MANAGEMENT: CHALLENGES FOR INSURANCE, ADAPTATION, AND LOSS ESTIMATION 6 (Res. for the Future, Discussion Paper No. 09-03-REV, 2009), available at <http://www.rff.org/RFF/Documents/RFF-DP-09-03.pdf>. Legal commentators have begun to explore the complex issues climate change will present for the insurance and financial industries. See Richenda Connell et al., *Evaluating the Private Sector Perspective on the Financial Risks of Climate Change*, 15 HASTINGS W.-N.W. J. ENVTL. L. & POL'Y 133 (2009); J. Wylie Donald & Craig W. Davis, *Carbon Dioxide: Harmless, Ubiquitous and Certainly Not a "Pollutant" Under a Liability Policy's Absolute Pollution Exclusion*, 39 SETON HALL L. REV. 107 (2009); Michael G. Faure, Commentary, *Insurability of Damage Caused by Climate Change*, 155 U. PA. L. REV. 1875 (2007); Sean B. Hecht, *Climate Change and the Transformation of Risk: Insurance Matters*, 55 UCLA L. REV. 1559 (2008); Howard C. Kunreuther & Erwann O. Michel-Kerjan, *Climate Change, Insurability of Large-Scale Disasters, and the Emerging Liability Challenge*, 155 U. PA. L. REV. 1795 (2007); Evan Mills, *The Role of U.S. Insurance Regulators in Responding to Climate Change*, 26 UCLA J. ENVTL. L. & POL'Y 129 (2008); Alberto Monti, *Climate Change and Weather-Related Disasters: What Role for Insurance, Reinsurance and Financial Sectors?*, 15 HASTINGS W.-N.W. J. ENVTL. L. & POL'Y 151 (2009); Christina Ross et al., *Limiting Liability in the Greenhouse: Insurance Risk-Management Strategies in the Context of Global Climate Change*, 43 STAN. J. INT'L L. 251 (2007).

¹²¹ See, e.g., ABI, FINANCIAL IMPLICATIONS, *supra* note 120, at 3, 5 (examining the flow-through impact on insurance prices and the impact on insurance capital requirements); ABI, FINANCIAL RISKS, *supra* note 120, at 5-8 (estimating necessary insurance premium increases and insurance losses due to increased flood and wind damage); THE GENEVA ASS'N, *supra* note 120, at 56-57 (identifying as key adaptations for the insurance industry storms and flooding, agricultural issues, water availability, heat issues, and health issues).

opportunities and risks for insurers, but that is, after all, the nature of insurance. My point in bringing up the insurance industry, though, is that insurers tend to be astute at detecting significant shifts in relationships and expectations looming on the horizon and try to anticipate how new forms of injury will work their way through the insurance coverage and liability system.¹²² Thus it is no surprise that the industry has moved quickly to begin to assess the impacts of climate change.

What has piqued the insurance industry's interest in climate change is also sure to grab the attention of legal systems. Much of the focus in that respect has been in establishing the public law of mitigation and adaptation strategies through legislative and regulatory initiatives.¹²³ We should not forget, however, about the common law. In particular, the same unsettling of relationships and expectations that is on the mind of insurers is bound to creep into the common law through pressure on existing property rights and liability rules. Climate change adaptation will inextricably and fundamentally link people in ways they have not experienced before, and new controversies are bound to surface in connection with their property and their safety. Put simply, some people are going to take actions with their property and personal behaviors, or fail to take actions, that put the property and safety of other people at significant risk of injury. It is inevitable that those injured will pursue remedies, and the courts will have to determine who should pay.¹²⁴

Take for example the owner of coastal property with an intact dune system. As sea level rises and hurricane activity intensifies, that property will become increasingly important as a buffer from storm surge for inland properties.¹²⁵ Should that change the way we view the property rights associated with the property? To be sure, an extensive public law regime exists to limit the use of coastal and other natural resources in the interest of public goals such as conservation, but it has not been directed primarily at formulating the relationship between private parties with stakes in the protective functions of natural resources.¹²⁶ With rising sea levels, loss of coastal dunes will increase risks to inland property, businesses, and people.¹²⁷ Similar scenarios could be played out for coastal wetlands, aquifer

¹²² Suraje Dessai et al., *Defining and Experiencing Dangerous Climate Change*, 64 CLIMATE CHANGE 11, 14–15 (2004); Ross et al., *supra* note 120.

¹²³ See Feldman & Kahan, *supra* note 26 (providing a broad survey of federal and state adaptation policies); Alice Kaswan, *The Domestic Response to Global Climate Change: What Role for Federal, State, and Litigation Initiatives?*, 42 U.S.F. L. REV. 39 (2007) (summarizing existing and developing statutory and regulatory responses to climate change).

¹²⁴ For the related question of who should bear the costs of implementing adaptation measures, see Farber, *supra* note 18; Daniel A. Farber, *Apportioning Climate Change Costs*, 26 UCLA J. ENVT. L. & POL'Y 21 (2008).

¹²⁵ See generally Antonio Mascarenhas, *Oceanographic Validity of Buffer Zones for the East Coast of India: A Hydrometeorological Perspective*, 86 CURRENT SCI. 399, 399, 404 (2004) (discussing "the protective value of coastal landforms" and acknowledging the need for "mandatory buffer zones").

¹²⁶ See, e.g., *Lucas v. S.C. Coastal Council*, 505 U.S. 1003, 1007–08 (1992) (examining public regulation of coastal property development).

¹²⁷ Mascarenhas, *supra* note 125, at 404.

recharge resources, inland wetlands providing groundwater recharge and thermal regulation, and a host of other settings. To the extent the common law is settled on the scope of relative property rights in these contexts—for example, that there is no restraint as a matter of the common law of nuisance on the destruction of coastal dunes—that was all settled before climate change came into the law's consciousness.

And we know the common law evolves to take into account new developments in the law's consciousness. Indeed, Justice Scalia has reminded us of this in a context directly on point in his majority opinion in *Lucas v. South Carolina Coastal Council*, where he established the "relevant background principles" of state property law as the reference point for testing whether public regulation or private property—in that case, development of coastal dunes—goes so far as to constitute a categorical taking of property.¹²⁸ He also confirmed, however, that those background principles evolve with "changed circumstances or new knowledge," such that, over time, what was once allowed under common law no longer is.¹²⁹ No doubt this is not what he intended, but those few lines have opened up a cottage industry of lawyers searching for new knowledge and changed circumstances to move the background principles one way or the other.¹³⁰

Over the past decade, for example, the discipline of ecological economics has produced a burgeoning body of research illuminating the significant economic value that functioning ecosystems, acting as natural capital, supply humans in the form of direct and indirect ecosystem services, such as the capacity of coastal wetlands to mitigate storm surges.¹³¹ Even without having to take into account climate change impacts, this body of new knowledge is already surfacing in commentary and the courts to put pressure on common law property doctrine, particularly the law of public and private nuisance and of the public trust doctrine, to reconfigure relative property rights accordingly.¹³² And well it should, as it simply

¹²⁸ *Lucas*, 505 U.S. at 1030.

¹²⁹ *Id.* at 1031.

¹³⁰ See, e.g., Michael C. Blumm & Lucas Ritchie, *Lucas's Unlikely Legacy: The Rise of Background Principles as Categorical Takings Defenses*, 29 HARV. ENVTL. L. REV. 321 (2005) (surveying different bases for moving the common law under this principle); J.B. Ruhl, *The "Background Principles" of Natural Capital and Ecosystem Services—Did Lucas Open Pandora's Box?*, 22 J. LAND USE & ENVTL. L. 525 (2007) (exploring the new knowledge of ecosystem services as a basis for influencing common law doctrine).

¹³¹ See Gretchen C. Daily, *Introduction: What Are Ecosystem Services?*, in NATURE'S SERVICES: SOCIETAL DEPENDENCE ON NATURAL ECOSYSTEMS 1, 7–8 (Gretchen C. Daily ed., 1997). Most recently, the United Nations's Millennium Ecosystem Assessment published a global survey of the production and delivery of ecosystem services. See WALTER V. REID ET AL., MILLENNIUM ECOSYSTEM ASSESSMENT, ECOSYSTEMS AND HUMAN WELL-BEING: SYNTHESIS (2005), available at <http://www.millenniumassessment.org/documents/document.356.aspx.pdf>. For a more detailed history, including coverage of the emergence of the ecosystem services concept in legal literature, see James Salzman, *A Field of Green? The Past and Future of Ecosystem Services*, 21 J. LAND USE & ENVTL. L. 133 (2006).

¹³² See J.B. Ruhl, *Making Nuisance Ecological*, 58 CASE W. RES. L. REV. 753 (2008); J.B. Ruhl & James Salzman, *Ecosystem Services and the Public Trust Doctrine: Working Change from Within*, 15 S.E. ENVTL. L.J. 223, 230–37 (2007).

requires that property owners use property efficiently and pay for their negative externalities.

Climate change will only accelerate this evolutionary process.¹³³ Already, for example, renewable energy markets emerging in response to climate change mitigation policies are causing property law scholars to reexamine old topics such as access to solar energy¹³⁴ as well as to explore uncharted territory such as access to wind energy¹³⁵ and who owns the underground space that might be devoted to carbon sequestration.¹³⁶ Climate change adaptation strategies are even more likely to trigger property rights disputes in need of new judicial examination given mounting knowledge about ecosystem services.¹³⁷ As natural capital resources that provide ecosystem services such as storm surge mitigation factor increasingly into climate change adaptation policy—which will happen precisely because of the ecosystem services provided—it is likely that the common law will grab hold of this new knowledge even more aggressively. Indeed, whereas the public nuisance and other common law claims that states and other interests have lodged against large sources of greenhouse gas emissions as part of a mitigation litigation strategy are high profile media stories notwithstanding

¹³³ Other commentators have identified the potential for the needs of climate change adaptation to profoundly influence the development of common law property rights. See, e.g., Robin Kundis Craig, *Adapting to Climate Change: The Potential Role of State Common Law Public Trust Doctrines*, 34 VT. L. REV. (forthcoming 2010), available at <http://ssrn.com/abstract=1431663> (follow “One-Click Download” hyperlink) [hereinafter Craig, *Adapting to Climate Change*]; Craig, *supra* note 18, at 61–63; Michael Hiatt, *Come Hell or High Water: Reexamining the Takings Clause in a Climate Changed Future*, 18 DUKE ENVTL. L. & POL’Y F. 371 (2008); Carol M. Rose, *Big Roads, Big Rights: Varieties of Public Infrastructure and Their Impact on Environmental Resources*, 50 ARIZ. L. REV. 409 (2008); Ruhl, *supra* note 132, at 776 n.83; Ruhl & Salzman, *supra* note 132, at 230–31; Gregory Sergienko, *Property Law and Climate Change*, NAT. RESOURCES & ENV’T, Winter 2008, at 25. For a similar theme involving water rights, see *infra* Part III.C.

¹³⁴ See Sara C. Bronin, *Modern Lights*, 80 U. COLO. L. REV. 881, 884–85 (2009) (proposing a solar energy rights regime similar to water law); Sara C. Bronin, *Solar Rights*, 89 B.U. L. REV. 1217 (2009) (exploring likely rights conflicts under existing solar energy access rights).

¹³⁵ See Troy Rule, *A Downwind View of the Cathedral: Using Rule Four to Allocate Wind Rights*, 46 SAN DIEGO L. REV. 207 (2009) (examining property rights disputes emerging due to competition for wind energy).

¹³⁶ See Alexandra Klass & Elizabeth J. Wilson, *Climate Change, Carbon Sequestration, and Property Rights*, 2010 U. ILL. L. REV. (forthcoming), available at <http://ssrn.com/abstract=1371755> (follow “One-Click Download” hyperlink).

¹³⁷ For example, although the beach renourishment project at issue in *Stop the Beach Renourishment, Inc. v. Florida Department of Environmental Protection*, No. 08-1151 (U.S. Dec. 2, 2009), was not designed as a climate change adaptation measure, the case is representative of the property disputes likely to arise as communities take measures to enhance coastal technological and natural resources to defend against storm surge. See Transcript of Oral Argument at 3, *Stop the Beach Renourishment*, No. 08-1151 (on file with author). The case arises out of the Florida Supreme Court’s decision in *Walton County v. Stop the Beach Renourishment, Inc.*, 998 So. 2d 1102 (Fla. 2008), *cert. granted*, 129 S. Ct. 2792 (2009) (No. 08-1151), in which the court found a state beach renourishment statute that fixed property boundaries for littoral property owners did not constitute a taking of property without just compensation. *Id.* at 1121. For an in-depth discussion of the case, see Donna R. Christie, *Of Beaches, Boundaries and SOBs*, 25 J. LAND USE & ENVTL. L. (forthcoming 2009), available at <http://ssrn.com/abstract=1483348> (follow “One-Click Download” hyperlink).

limited success,¹³⁸ it is likely to be in the more discrete, small-scale context of adaptation in which the common law will have reason to evolve.

Of course, the common law ought to develop in this respect to serve the purposes of the common law. Nuisance law, for example, polices unreasonable use of property in particular contexts,¹³⁹ and the public trust doctrine protects important but limited public interests in water resources.¹⁴⁰ They are by no means doctrines on which we can rest all or most of climate change adaptation law, and I am not suggesting we violate the basic underpinnings of the common law in order to get climate change adaptation mileage out of them. Rather, it seems inevitable that many nuisance, public trust, and other claims like this are going to be made—claims that one property owner can't take actions that substantially impair the climate change adaptation profile of other property owners or the public—and that courts are highly unlikely to (and should not) throw the claims out on motions to dismiss. The litigation grist mill will gear up to resolve these claims, and new ground is likely to be covered to further the traditional common law interests of efficient use of property.

I will come clean here, however, and confess full awareness that an important secondary effect of any movement of the common law along these lines, perhaps more important than the evolution of relationships defined by common law, will be the corollary Justice Scalia established in *Lucas* that public environmental law can move in behind the common law evolutionary step to establish more comprehensive regulatory regimes without pushback from takings claims.¹⁴¹ In this sense the development of the common law of climate change adaptation may liberate the public environmental law of adaptation to do more than it otherwise could have. Notwithstanding that the underlying rationale for evolution of the common law I am suggesting rests in economic efficiency and cost internalization, this prospect sends shivers down the backs of libertarians and free market environmentalists.¹⁴²

¹³⁸ Although several such pieces of litigation have overcome motions to dismiss on a variety of grounds, none has advanced to the merits of the public nuisance, private nuisance, trespass, negligence, unjust enrichment, fraudulent misrepresentation, or civil conspiracy claims. See *Comer v. Murphy Oil USA*, 585 F.3d 855, 860 (5th Cir. 2009) (reversing lower court's granting of motion to dismiss), *reh'g granted en banc*, No. 07-60756, 2010 WL 685796 (5th Cir. Feb. 26, 2010); *Connecticut v. Am. Elec. Power Co.*, 582 F.3d 309, 315 (2d Cir. 2009) (reversing lower court's granting of motion to dismiss); *Native Vill. of Kivalina v. Exxon Mobil Corp.*, No. C 08-1138 SBA, 2009 WL 3326113, at *1 (N.D. Cal. Sept. 30, 2009) (granting motion to dismiss). For legal commentary on the use of common law principles in mitigation litigation, see Daniel Farber, *Basic Compensation for Victims of Climate Change*, 38 *Env'tl. L. Rep.* (Env'tl. Law Inst.) 10,521 (2008); Daniel A. Farber, *Tort Law in the Era of Climate Change, Katrina, and 9/11: Exploring Liability for Extraordinary Risks*, 43 *VAL. U. L. REV.* 1075 (2009); David A. Grossman, *Warning Up to a Not-So-Radical Idea: Tort-Based Climate Change Litigation*, 28 *COLUM. J. ENVTL. L.* 1 (2003); Hilary Sigman, *Legal Liability as Climate Change Policy*, 155 *U. PA. L. REV.* 1953 (2007).

¹³⁹ See Grossman, *supra* note 138, at 53.

¹⁴⁰ See Ruhl & Salzman, *supra* note 132, at 225.

¹⁴¹ *Lucas*, 505 U.S. 1003, 1029–30 (1992).

¹⁴² See James L. Huffman, *Beware of Greens in Praise of the Common Law*, 58 *CASE W. RES. L. REV.* 813, 813 (2008) (describing the use of the common law to protect natural capital “as a Trojan horse—a gift to free marketeers and property rights supporters that is not what it appears to be”).

I refer their complaints to Justice Scalia, who, after all, planted this Trojan horse in *Lucas*; my interest is only in ensuring that common law doctrine incorporates the immense economic value of ecosystem services the same way it does other economic attributes of property. Climate change adaptation is in all likelihood going to be the catalyst for that to happen with uncharacteristic speed for the common law.

C. Trend Three: Accelerated Merger of Water Law, Land-Use Law, and Environmental Law

Water law scholars, Professor Dan Tarlock in particular, were the first to focus attention on climate change adaptation policy,¹⁴³ and land-use law is well represented among the now broader scope of legal scholarship engaging adaptation.¹⁴⁴ There is good reason both of these fields have become prominent topics in the adaptation mix—land-use and water allocation decisions are likely to be the hottest of hot button issues as climate change effects take hold over the landscape.

The intersection between land-use law, water law, and environmental law is nothing new, making “the interrelationship of water resources and land use . . . one of the hottest topics in land-use today.”¹⁴⁵ Many contemporary large-scale problems involve all three fields of law working in a complex amalgam, making it difficult to characterize the problem as about land use, water allocation, or the environment.¹⁴⁶ Climate change will rapidly move the three fields of law even closer together, likely to the point that it will be meaningless in many contexts to think of them as separate fields of law and policy.

It is no surprise that water law scholars were the first movers on climate change adaptation, as water will likely be the first vital natural

¹⁴³ Tarlock’s work during the 1990s forged the discipline of climate change adaptation law by focusing on international and domestic legal regimes for allocation of water resources. See A. Dan Tarlock, *How Well Can International Water Allocation Regimes Adapt to Global Climate Change?*, 15 J. LAND USE & ENVTL. L. 423 (2000); Tarlock, *supra* note 3; A. Dan Tarlock, *Western Water Law, Global Warming, and Growth Limitations*, 24 LOY. L.A. L. REV. 979 (1991).

¹⁴⁴ This includes, for example, proposals to adopt a Netherlands-style land-use system for coastal areas. See Damien Leonard, *Raising the Levee: Dutch Land Use Law as a Model for U.S. Adaptation to Climate Change*, 21 GEO. INT’L ENVTL. L. REV. 543 (2009).

¹⁴⁵ Craig Anthony (Tony) Arnold, *Is Wet Growth Smarter Than Smart Growth?: The Fragmentation and Integration of Land Use and Water*, 35 ENVTL. L. REP. (ENVTL. LAW INST.) 10,152, 10,154 (2005); see also Christine A. Klein et al., *Modernizing Water Law: The Example of Florida*, 61 FLA. L. REV. 403, 448–57 (2009) (“[In planning for the future, a critical challenge for states] lies in providing appropriate links between land use planning (typically at the local level) and water resource planning (typically at the state level).”).

¹⁴⁶ See, e.g., Jody Freeman & Daniel A. Farber, *Modular Environmental Regulation*, 54 DUKE L.J. 795 (2005) (discussing the Bay-Delta watershed in northern California); Holly Doremus & A. Dan Tarlock, *Fish, Farms, and the Clash of Cultures in the Klamath Basin*, 30 ECOLOGY L.Q. 279, 306–16 (2003); Wiersema, *supra* note 102, at 1265–82 (discussing the Chesapeake Bay).

resource hit hard by climate change.¹⁴⁷ Consider Milly et al.'s summary of the climate change impacts scenario for water resources:

[S]ubstantial anthropogenic change of Earth's climate is altering the means and extremes of precipitation, evapotranspiration, and rates of discharge of rivers. Warming augments atmospheric humidity and water transport. This increases precipitation, and possibly flood risk, where prevailing atmospheric water-vapor fluxes converge. Rising sea level induces gradually heightened risk of contamination of coastal freshwater supplies. Glacial meltwater temporarily enhances water availability, but glacier and snow-pack losses diminish natural seasonal and interannual storage.

Anthropogenic climate warming appears to be driving a poleward expansion of the subtropical dry zone, thereby reducing runoff in some regions. Together, circulatory and thermodynamic responses largely explain the picture of regional gainers and losers of sustainable freshwater availability that has emerged from climate models.¹⁴⁸

The bottom line is that in some regions of the nation communities with adequate or marginally adequate existing access to freshwater supplies will find themselves high and dry. The move mode of adaptation strategies may be viable for some small communities, but it is more likely that substantial cities such as Los Angeles and Phoenix will, understandably, prefer to stay where they are, meaning they will have to resort to the resist and transform strategies. The resist strategy would likely involve searching for new supplies, such as desalination and more water transfers, and more intensive conservation measures.¹⁴⁹ In addition to shifts in regional industrial and agricultural profiles, the transform strategy may involve taking a serious look at the continued viability of applying what is now centuries old water law to questions of allocation and conservation of water resources.¹⁵⁰

¹⁴⁷ See CAL. NATURAL RES. AGENCY, *supra* note 31, at 79–92; U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 1, at 41–52.

¹⁴⁸ Milly et al., *supra* note 97, at 573 (citations omitted).

¹⁴⁹ See Robin Kundis Craig, *Water Supply, Desalination, Climate Change, and Energy Policy*, 23 PAC. MCGEORGE GLOBAL BUS. & DEV. L.J. (forthcoming 2010), available at <http://ssrn.com/abstract=1418675> (follow “One-Click Download” hyperlink) (desalination); Noah D. Hall & Bret B. Stuntz, *Climate Change and Great Lakes Water Resources: Avoiding Future Conflicts with Conservation*, 31 HAMLINE L. REV. 639 (2008) (conservation); Klein et al., *supra* note 145, at 457–67 (examining the demands for reform of water transfer law).

¹⁵⁰ A growing number of water law scholars have argued that climate change adaptation will demand fundamental reforms of domestic water-allocation law and water property rights. See Adell Amos, *Freshwater Conservation in the Context of Energy and Climate Policy: Assessing Progress and Identifying Challenges in Oregon and the Western United States*, 12 U. DENV. WATER L. REV. 1 (2008); John T. Andrews et al., *California Water Management: Subject to Change*, 14 HASTINGS W.-NW. J. ENVTL. L. & POL’Y 1463 (2008); Robin Kundis Craig, *Adapting Water Law to Public Necessity: Reframing Climate Change as Emergency Response and Preparedness*, 11 VT. J. ENVTL. L. (forthcoming 2010), available at <http://ssrn.com/abstract=1528963> (follow “One-Click Download” hyperlink); Joseph W. Dellapenna, *Adapting Riparian Rights to the Twenty-First Century*, 106 W. VA. L. REV. 539 (2004); Joseph W. Dellapenna, *Climate Disruption, the Washington Consensus, and Water Law Reform*, 81 TEMP. L. REV. 383 (2008); Joseph W. Dellapenna, *Developing Suitable Water Allocation Law for Pennsylvania*, 17 VILL.

In either case, however, the fact that entire major cities and regions will be on the line makes it likely that getting water to them will rise to the top of adaptation law and policy priorities, leading to intensified controversies between urban and rural areas as well as between states and regions of the nation.¹⁵¹ Environmental impacts of these adaptive strategies, we can hope, will be integrated in the decision making, but in all likelihood managing for environmental effects will take a back seat to keeping urban communities and regional economies alive.

On the flip side, some regions of the nation presently lacking adequate water resources will benefit from climate change through increased precipitation, runoff, and recharge.¹⁵² The new abundance of water will open up opportunities, such as increased agricultural capacity and room for residential and industrial development. Indeed, it may be critical to the *national* adaptation strategy that the regions climate change blesses with more water adapt specifically to provide a secure food supply and industrial base. Once again, we can hope that the environmental impacts of these adaptive uses of “new water” will be integrated into water resources development decisions. And so as not to repeat the mistakes of the “old water” regions that were experiencing supply stress well before climate change (and will be in crisis mode), one also can hope that the water law of these newly wetter regions will strike a different path to ensure more efficient use and allocation.¹⁵³ The bottom line, however, is that to the extent our national food supply and industrial capacity are put in jeopardy as a

ENVTL. L.J. 1 (2006); Holly Doremus & Michael Hanemann, *The Challenges of Dynamic Water Management in the American West*, 26 UCLA J. ENVTL. L. & POL'Y 55 (2007); Brian E. Gray, *Global Climate Change: Water Supply Risks and Water Management Opportunities*, 14 HASTINGS W.-NW. J. ENVTL. L. & POL'Y 1453 (2008); Noah D. Hall et al., *Climate Change and Freshwater Resources*, NAT. RESOURCES & ENV'T, Winter 2008, at 30; Kathleen A. Miller, *Climate Change and Water in the West: Complexities, Uncertainties and Strategies for Adaptation*, 27 J. LAND RESOURCES & ENVTL. L. 87 (2007); A. Dan Tarlock, *Water Law Reform in West Virginia: The Broader Context*, 106 W. VA. L. REV. 495 (2004). Some of these changes in domestic law will be driven by adaptation pressures put on cross-border water regimes the United States has established with and Mexico and Canada. See Kibel, *supra* note 2, *passim*.

¹⁵¹ See Robert W. Adler, *Climate Change and the Hegemony of State Water Law*, 29 STAN. ENVTL. L.J. 1, 40-45 (2010) (examining the potential interstate and interregional conflicts); Klein et al., *supra* note 145, at 448 (“Surprisingly fierce conflicts have developed as rapidly urbanizing regions of the states seek to capture water resources of wetter, slower-growing areas.”). Water law experts believe these interjurisdictional conflicts will put stress on settled patterns of water law federalism, most likely leading to an increased federal role supplanting traditional state dominance. See Adler, *supra*, at 49-60; Robin Kundis Craig, *Adapting Water Federalism to Climate Change Impacts: Energy Policy, Food Security, and the Allocation of Water Resources*, 5 ENVTL. & ENERGY L. & POL'Y J. (forthcoming 2011), available at <http://ssrn.com/abstract=1555944> (follow “One Click Download” hyperlink).

¹⁵² See Nat'l Drought Mitigation Ctr., *What Is Drought? Drought and Climate Change*, <http://drought.unl.edu/whatis/cchange.htm> (last visited Apr. 18, 2010) (pointing out that some regions might experience beneficial gains in agricultural production resulting from adequate precipitation).

¹⁵³ See Jonathan H. Adler, *Water Marketing as an Adaptive Response to the Threat of Climate Change*, 31 HAMLIN L. REV. 729 (2008) (discussing greater use of water markets to resolve allocation questions); Craig, *Adapting to Climate Change*, *supra* note 133 (exploring how public trust doctrines can be used to adapt water rights law for climate change).

result of a new hydroclimatic regime, getting water to the right places will be the priority and the environmental impacts of doing so will often be of secondary concern.

Where water is and isn't influences land-use decisions. The altered freshwater regime discussed above, therefore, will lead not only to new water law developments but also to profound land-use decisions in regions moving from wet to dry or dry to wet. Professor Tony Arnold has explored the increasingly intimate connection between land-use law, water law, and environmental law that existed well before this hydroclimatic shift. His assessment is that "[l]and use regulation and planning have taken an 'environmental turn': a pervasive and inescapable attention to the impact of land use and land development on the natural environment."¹⁵⁴ This effect unquestionably will grow in importance as climate change moves water resources around the nation in ways never before contemplated. As we chase water, temperature, and other resources to develop new agricultural districts or expand existing ones, and as people move to locate new employment and residential opportunities, new land-use decisions will be made. As Arnold's work suggests, with tighter integration of land and water concerns these new land-use decisions, we can hope, will be fused closely with environmental management in mind. Yet while environmental impacts will nest within these merged water allocation and land-use domains, the question will be under what priority.

Above all else, however, one has to believe that sea level rise will trigger a phenomenal series of land-use decisions for coastal communities. Assuming cities like Miami and New York plan to weather the century of climate change adaptation, they will need a new land-use vision. One author suggests, for example, that national land-use law will be needed,¹⁵⁵ while another offers the Dutch levee land-use system as a new land-use model for the coastal United States.¹⁵⁶ Clearly, this ultimate resist mode adaptation strategy would be an immense infrastructure project for any community, implicating property rights, land-use, and environmental concerns in a mix unlike any they have previously encountered. Moreover, smaller coastal communities may not have the resources to erect this kind of substantial coastal barrier, and will have to rely on transform strategies such as increased use of natural coastal resources for dampening the effects of sea level rise. Some communities may simply yield to the sea and recede landward, which would raise a host of land-use and property rights issues.¹⁵⁷ In all these and other possible scenarios, land, water, and the environment will intersect in ways that will demand new forms of land-use regimes.¹⁵⁸

¹⁵⁴ Arnold, *supra* note 145, at 10,152.

¹⁵⁵ See Catherine J. LaCroix, *Land Use and Climate Change: Is It Time for a National Land Use Policy?*, 35 *ECOLOGY L. CURRENTS* 124 (2008).

¹⁵⁶ See Leonard, *supra* note 144.

¹⁵⁷ See Jessica A. Bacher, *Yielding to the Rising Sea: The Land Use Challenge*, 38 *REAL EST. L.J.* 96 (2009).

¹⁵⁸ As with water allocation law, a growing number of land-use scholars argue for fundamental reform of land-use law to respond to the needs of climate change adaptation. See John R. Nolon & Jessica A. Bacher, *Climate Change, Zoning and Transportation Policy*,

It is hard to say what the position of environmental law will be when embedded in this new land and water policy mix. It is possible that in some contexts, particularly the coastal contexts, the division between the three fields will truly cease to exist and lawyers will be practicing a new breed called “costal adaptation law.” But it is not clear how the environment will be represented. On the one hand, it may be pragmatic to reconnect what were once fragmented areas of law, but through their merger environmental interests could get lost in the amalgam. We can promise to be vigilant about securing the environment its due priority, but the prospects of Los Angeles without water and Miami knee deep in the wrong kind are likely to focus policy attention more on getting the adaptive strategy in place and less on worrying about its impacts on the environment.

*D. Trend Four: Incorporation of a Human Rights Dimension in
Climate Change Adaptation Policy*

Just as climate change impacts will be felt unevenly across the globe, so too is the capacity to adapt unevenly distributed. In both cases, unfortunately, it is the least developed countries that drew the short straw—they will feel climate change more severely and have the least capacity to reduce vulnerability and boost resilience.¹⁵⁹ This double whammy effect has led the international law community to characterize global adaptation policy as a human rights issue.¹⁶⁰ Indeed, the vast majority of legal scholarship on climate change adaptation focuses on international law and international relations addressing four principal facets of this human rights dimension—the responsibilities of developed nations to 1) assist the adaptation efforts of least developed nations,¹⁶¹ 2) assist the adaptation efforts of small island

36 REAL EST. L.J. 211, 213 (2007); Porras, *supra* note 18, at 595; Heike Schroeder & Harriet Bulkeley, *Global Cities and the Governance of Climate Change: What Is the Rule of Law in Cities?*, 36 FORDHAM URB. L.J. 313, 321 (2009).

¹⁵⁹ See WORLD BANK, *supra* note 47, *passim*.

¹⁶⁰ See Simon Caney, *Cosmopolitan Justice, Rights and Global Climate Change*, 19 CANADIAN J.L. & JURISPRUDENCE 255 (2006); John H. Knox, *Climate Change and Human Rights Law*, 50 VA. J. INT'L L. 163, 165 (2009); John H. Knox, *Linking Human Rights and Climate Change at the United Nations*, 33 HARV. ENVTL. L. REV. 477 (2009); Siobh en McInerney-Lankford, *Climate Change and Human Rights: An Introduction to Legal Issues*, 33 HARV. ENVTL. L. REV. 431 (2009); Stephen Tully, *The Contribution of Human Rights as an Additional Perspective on Climate Change Impacts Within the Pacific*, 5 N.Z. J. PUB. & INT'L L. 169 (2007).

¹⁶¹ Sumudu Atapattu, *Global Climate Change: Can Human Rights (and Human Beings) Survive This Onslaught?*, 20 COLO. J. INT'L ENVTL. L. & POL'Y 35, 66 (2008); Edward Cameron, *The Human Dimension of Global Climate Change*, 15 HASTINGS W.-NW. J. ENVTL. L. & POL'Y 1, 14 (2009); Daniel H. Cole, *Climate Change, Adaptation, and Development*, 26 UCLA J. ENVTL. L. & POL'Y 1, 3 (2008); Mark A. Drumbl, *Poverty, Wealth, and Obligation in International Environmental Law*, 76 TUL. L. REV. 843 (2002); Daniel A. Farber, *The Case for Climate Compensation: Justice for Climate Change Victims in a Complex World*, 2008 UTAH L. REV. 377, 413 (2008); Paul G. Harris, *The European Union and Environmental Change: Sharing the Burdens of Global Warming*, 17 COLO. J. INT'L ENVTL. L. & POL'Y 309, 326 (2006); Paul L. Joffe, *Conscience and Interest: Law, Rights, and Politics in the Struggle to Confront Climate Change and the New Poverty*, 6 RUTGERS J.L. & PUB. POL'Y 269, 270 (2009); Marc Limon, *Human Rights and Climate Change: Constructing a Case for Political Action*, 33 HARV. ENVTL. L. REV. 439, 455

nations,¹⁶² 3) assist the adaptation efforts of indigenous people,¹⁶³ and 4) assist the migration efforts of people from these three communities who are displaced by climate change notwithstanding adaptation assistance.¹⁶⁴

While the United States will surely be at center stage as those “climate justice” issues play out in the international community dialogue on climate change adaptation,¹⁶⁵ a domestic version of the human rights dimension of adaptation policy is likely to emerge as well. Even before climate change came into the picture, an environmental justice theme emerged around the inequitable burdens the poor and people of color have sustained in terms of disproportionate exposure to pollutants, proximity to industrial sites and contaminated lands, and limited access to environmental amenities.¹⁶⁶ And from the aftermath of Hurricane Katrina in New Orleans and other hard-hit

(2009); Ann Prouty, *The Clean Development Mechanism and Its Implications for Climate Justice*, 32 COLUM. J. ENVTL. L. 513, 539 (2009); Edith Brown Weiss, *Climate Change, Intergenerational Equity and International Law*, 9 VT. J. ENVTL. L. 615, 627 (2008).

¹⁶² See William C. Burns, *Global Warming—The United Nations Framework Convention on Climate Change and the Future of Small Island States*, 6 DICK. J. ENVTL. L. & POL’Y 147, 175 (1997); John Crump, *Snow, Sand, Ice, and Sun: Climate Change and Equity in the Arctic and Small Island Developing States*, 8 SUSTAINABLE DEV. L. & POL’Y 8 (2008); Alexander Gillespie, *Small Island States in the Face of Climatic Change: The End of the Line in International Environmental Responsibility*, 22 UCLA J. ENVTL. L. & POL’Y 107, 121–22 (2004); Susan Glazebrook, *Human Rights and the Environment*, 40 VICTORIA U. WELLINGTON L. REV. 293, 342 (2009).

¹⁶³ See Randall S. Abate, *Climate Change, the United States, and the Impacts of Arctic Melting: A Case Study in the Need for Enforceable International Environmental Human Rights*, 43A STAN. J. INT’L L. 3, 71–72 (2007); James D. Ford, *Supporting Adaptation: A Priority for Action on Climate Change for Canadian Inuit*, 8 SUSTAINABLE DEV. L. & POL’Y 25 (2008); Donald M. Goldberg & Tracy Badua, *Do People Have Standing? Indigenous Peoples, Global Warming, and Human Rights*, 11 BARRY L. REV. 59, 61 (2008); Jesse Hohmann, *Igloo as Icon: A Human Rights Approach to Climate Change for the Inuit?*, 18 TRANSNAT’L L. & CONTEMP. PROBS. 295 (2009); Marguerite E. Middaugh, *Linking Global Warming to Inuit Human Rights*, 8 SAN DIEGO INT’L L.J. 179, 207 (2006); E. Rania Rampersad, *Indigenous Adaptation to Climate Change: Preserving Sustainable Relationships Through an Environmental Stewardship Claim & Trust Fund Remedy*, 21 GEO. INT’L ENVTL. L. REV. 591, 613 (2009); Rebecca Tsosie, *Indigenous People and Environmental Justice: The Impact of Climate Change*, 78 U. COLO. L. REV. 1625, 1676 (2007); Erika Zimmerman, Comment, *Valuing Traditional Ecological Knowledge: Incorporating the Experiences of Indigenous People into Global Climate Change Policies*, 13 N.Y.U. ENVTL. L.J. 803, 846 (2005).

¹⁶⁴ See Ben Saul & Jane McAdam, *An Insecure Climate for Human Security? Climate-Induced Displacement and International Law*, in HUMAN SECURITY AND NON-CITIZENS (Alice Edwards & Carla Ferstman eds., forthcoming 2010), available at <http://ssrn.com/abstract=1292605> (follow “One-Click Download” hyperlink); McAdam, *supra* note 80 (manuscript at 27); Kara K. Moberg, Comment, *Extending Refugee Definitions to Cover Environmentally Displaced Persons Displaces Necessary Protection*, 94 IOWA L. REV. 1107, 1113 (2009).

¹⁶⁵ For an overview, see INT’L HUMAN RIGHTS LAW CLINIC, UNIV. OF CAL. BERKELEY SCH. OF LAW, PROTECTING PEOPLE AND THE PLANET: A PROPOSAL TO ADDRESS THE HUMAN RIGHTS IMPACTS OF CLIMATE CHANGE POLICY (2009), available at http://www.law.berkeley.edu/files/IHRLC/Protecting_People_and_the_Planet.pdf (proposing a process to address the human rights impacts of climate change policy).

¹⁶⁶ For background on environmental justice, see CLIFFORD RECHTSCHAFFEN ET AL., ENVIRONMENTAL JUSTICE: LAW, POLICY & REGULATION (2d ed. 2009); THE LAW OF ENVIRONMENTAL JUSTICE: THEORIES AND PROCEDURES TO ADDRESS DISPROPORTIONATE RISKS (Michael B. Gerrard & Sheila R. Foster eds., 2d ed. 2008).

areas has emerged a similar theme of disaster justice.¹⁶⁷ As a report by the Congressional Black Caucus Foundation suggested as early as 2004, climate change will be a catalyst for fusing these two related movements into one focused on securing a human rights dimension to domestic climate change adaptation policy.¹⁶⁸ Where and how equitably will adaptation capital such as seawalls be deployed and financed? How will the health of low-income urban populations vulnerable to heat waves and pollution be protected? Who will get the water in areas drying out? For areas transforming with climate change, how will redevelopment and job creation play out across the community? If the only option is to move, how will low-income populations manage that?

Only a few legal scholars have addressed even the tip of the iceberg of this looming question of *domestic* climate justice policy,¹⁶⁹ and in general “the national debate on climate change policies has given insufficient attention to their environmental justice implications.”¹⁷⁰ Partly this may be due to the fact that the United States on balance does not fare that badly under generally accepted climate change scenarios, certainly not when compared to many other countries.¹⁷¹ But that is just on balance. A recent study from the University of Southern California’s Program for Environmental and Regional Equity identifies how imbalances in vulnerability to climate change impacts and access to climate change adaptation resources will create a domestic “climate gap” in the United States, with communities of color and low-income on the short end.¹⁷² Of principal concern are heat waves, increased air pollution, access to basic necessities, reduced job opportunities, and protection and recovery from

¹⁶⁷ For background on disaster policy and disaster justice, see DANIEL A. FARBER ET AL., *DISASTER LAW AND POLICY* (2d ed. 2009).

¹⁶⁸ See CONG. BLACK CAUCUS FOUND., *AFRICAN AMERICANS AND CLIMATE CHANGE: AN UNEQUAL BURDEN* (2004), available at http://www.rprogress.org/publications/2004/CBCF_REPORT_F.pdf.

¹⁶⁹ See, e.g., Maxine Burkett, *Just Solutions to Climate Change: A Climate Justice Proposal for a Domestic Clean Development Mechanism*, 56 *BUFF. L. REV.* 169 (2008); Jacqueline P. Hand, *Global Climate Change: A Serious Threat to Native American Lands and Culture*, 38 *Envtl. L. Rep. (Envtl. Law Inst.)* 10,329 (2008); Alice Kaswan, *Environmental Justice and Domestic Climate Change Policy*, 38 *Envtl. L. Rep. (Envtl. Law Inst.)* 10,287 (2008) [hereinafter Kaswan, *Domestic Climate Change Policy*]; Alice Kaswan, *Reconciling Justice and Efficiency: Integrating Environmental Justice into Domestic Cap-And-Trade Programs for Controlling Greenhouse Gases*, in *ETHICS, ENERGY, AND CLIMATE CHANGE* (Denis G. Arnold ed., forthcoming 2010), available at <http://ssrn.com/abstract=1442165> (follow “One-Click Download” hyperlink); Robert R.M. Verchick, *Adaptation, Economics, and Justice*, in *ECONOMIC THOUGHT AND U.S. CLIMATE CHANGE POLICY* (David Driesen ed., forthcoming 2010) (on file with author); Robert R.M. Verchick, *Adaptive Justice*, in *CLIMATE CHANGE: A READER*, *supra* note 115. For a discussion of how some prominent figures in the religious evangelical community have begun to portray climate change as a human rights issue, see John Copeland Nagle, *The Evangelical Debate over Climate Change*, 5 *U. ST. THOMAS L.J.* 53 (2008).

¹⁷⁰ Kaswan, *Domestic Climate Change Policy*, *supra* note 169, at 10,288.

¹⁷¹ See U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 1, *passim*.

¹⁷² See RACHEL MORELLO-FROSCH ET AL., *THE CLIMATE GAP: INEQUALITIES IN HOW CLIMATE CHANGE HURTS AMERICANS & HOW TO CLOSE THE GAP* (2009), available at http://college.usc.edu/pere/documents/The_Climate_Gap_Full_Report_FINAL.pdf.

extreme weather events.¹⁷³ Professor Alice Kaswan offers a flavor of how the already established environmental justice community has incorporated the climate justice theme to address these concerns:

In the climate change context, environmental justice groups are beginning to articulate overarching principles. . . . Recognizing the particular vulnerability of the poor and people of color, a number of the principles focus on the potential consequences of climate change and the critical importance of reducing GHG emissions. Several other principles focus on the implications of climate change policies, including a call for adaptation assistance for poor communities, as well as compensation for workers and others impacted by the potential economic costs of climate change policies. The environmental justice movement's participatory goals are reflected in the call for community participation. The principles express caution about the emergence of international and national carbon markets. California environmental justice groups have been even more critical of market-based approaches.¹⁷⁴

What lessons come out of this emerging theme of *domestic* human rights for *domestic* environmental law? One seems inevitable and critical to bear in mind—that it will be important to define the human right of climate justice and distinguish it from the concept that there is a human right to a certain level of environmental quality.¹⁷⁵ With respect to the adaptation side of climate policy, climate justice articulates not a right to environmental quality, but rather a right to equitable distribution of the benefits of climate change adaptation, which may or may not align with environmentalist norms of minimum conditions of environmental quality. Equitable distribution of climate adaptation resources and protections may not always fulfill conventional environmental protection norms such as conserving ecosystems and imperiled species, as, for example, when seawalls or beach renourishment may be needed to protect human communities unable to transform or move, or when water may need to be transferred to sustain urban populations of poor and people of color who have no options. This is not to say that climate justice will not promote environmental protection, but primarily when doing so serves climate justice interests. Climate justice, in other words, is first and foremost about protecting the poor and people of color, not the environment.

¹⁷³ See *id.* at 7–18.

¹⁷⁴ Kaswan, *Domestic Climate Change Policy*, *supra* note 169, at 10,289 (footnotes omitted).

¹⁷⁵ For some discussion of the latter, see Stephen T. Del Percio, *Linking the Environment and Human Rights: A Global Perspective*, 29 WM. & MARY ENVTL. L. & POL'Y REV. at v (2005); Monique Hardin, *The Human Right to a Healthy and Safe Environment: The Right of Displaced Hurricane Katrina Survivors to Return Home with Dignity and Justice*, 101 AM. SOC'Y INT'L L. PROC. 85 (2007); Barry E. Hill et al., *Human Rights and the Environment: A Synopsis and Some Predictions*, 16 GEO. INT'L ENVTL. L. REV. 359 (2004); Dinah Shelton, *Human Rights and the Environment: What Specific Environmental Rights Have Been Recognized?*, 35 DENV. J. INT'L L. & POL'Y 129 (2006).

E. Trend Five: Catastrophe and Crisis Avoidance and Response as an Overarching Adaptation Policy Priority

Generally speaking, people are not in favor of catastrophes and crises. Yet the synergistic effects of changes in variability of storm, flood, drought, and fire events with absolute changes in sea level, temperature, and other climate features will lead to higher risks of catastrophic events and pandemic crises. People will demand protection.

This is not Chicken Little calling. Even relatively conservative scenarios of increased mean surface temperature lead to significant increases in risk of catastrophic events and pandemic health and safety crises. California's adaptation strategy plan, for example, details high-level risk potentials involving a wide array of factors including heat waves,¹⁷⁶ disease vectors,¹⁷⁷ coastal extreme weather events,¹⁷⁸ water shortages,¹⁷⁹ food security,¹⁸⁰ fires,¹⁸¹ and infrastructure damage.¹⁸² Researchers anticipate numerous localized and reversible "disasters" involving these effects, as well the possible "mega-catastrophe"—"an event that is global in scale and has a high degree of irreversibility" and which, notwithstanding its low probability, "may account for a large portion of expected losses" from climate change.¹⁸³ Catastrophes of this magnitude could be triggered either as climate regimes cross nonlinear thresholds¹⁸⁴ or "the possibility that a series of more localized disasters could trigger other disasters, and that this cascade of consequences could become severe enough to create a mega-catastrophe. This could include national security concerns, since a

¹⁷⁶ See CAL. NATURAL RES. AGENCY, *supra* note 31, at 39. See generally JONATHAN M. SAMET, ADAPTING TO CLIMATE CHANGE: PUBLIC HEALTH 7–10 (2009), available at <http://www.rff.org/RFF/Documents/RFF-Rpt-Adaptation-Samet.pdf> (discussing the health consequences of heat waves).

¹⁷⁷ See CAL. NATURAL RES. AGENCY, *supra* note 31, at 37.

¹⁷⁸ See *id.* at 70. See generally DAVID KLING & JAMES N. SANCHIRICO, RES. FOR THE FUTURE, AN ADAPTATION PORTFOLIO FOR THE UNITED STATES COASTAL AND MARINE ENVIRONMENT 7 (2009) (discussing the problems caused by "elevated and more frequent extreme sea levels").

¹⁷⁹ See CAL. NATURAL RES. AGENCY, *supra* note 31, at 82. See generally ALAN P. COVICH, EMERGING CLIMATE CHANGE IMPACTS ON FRESHWATER RESOURCES: A PERSPECTIVE ON TRANSFORMED WATERSHEDS (2009), available at <http://www.rff.org/rff/documents/RFF-Rpt-Adaptation-Covich.pdf> (discussing socioeconomic and biotic adaptation strategies designed to protect freshwater resources).

¹⁸⁰ See CAL. NATURAL RES. AGENCY, *supra* note 31, at 96. See generally ANTLE, *supra* note 49 (discussing the effects climate change will have on the agriculture industry and how, through political planning and support, farmers and ranchers will be able to adjust to climate change and continue with sustainable operations).

¹⁸¹ See CAL. NATURAL RES. AGENCY, *supra* note 31, at 111.

¹⁸² See *id.* at 123. See generally JAMES E. NEUMANN & JASON C. PRICE, ADAPTING TO CLIMATE CHANGE: THE PUBLIC POLICY RESPONSE: PUBLIC INFRASTRUCTURE (2009), available at <http://www.rff.org/rff/documents/RFF-Rpt-Adaptation-NeumannPrice.pdf> (assessing the threats that climate change poses for public infrastructure and discussing how to respond to those threats).

¹⁸³ CAROLYN KOUSKY ET AL., RESPONDING TO THREATS OF CLIMATE CHANGE MEGA-CATASTROPHES (Res. for the Future, Discussion Paper No. 09-45-REV, 2009), available at <http://www.rff.org/documents/RFF-DP-09-45.pdf>.

¹⁸⁴ See *id.* at 4; see also David E. Adelman, *The Challenge of Abrupt Climate Change for U.S. Environmental Regulation*, 58 EMORY L.J. 379 (2008).

series of weather-related disasters could trigger political destabilization, mass migration, or violence.¹⁸⁵

Responding to this suite of risks, which will be demanded of both public and private actors, is likely to include adaptation methods and mechanisms to reduce vulnerability and enhance resilience, measures that in many cases will not be environmentally friendly.¹⁸⁶ On the table for consideration, one can imagine, will be environmentally intrusive adaptation initiatives such as seawalls, coastal armoring, water diversions, increased energy demand, new dams, relocated agriculture, removing habitat of disease vectors, new or raised levees, and other technological fixes that today receive intensive scrutiny under environmental laws and opposition from environmental protection interests.¹⁸⁷

Measures like these when taken today, however, are implemented primarily as conveniences to ease urban life and prop up suburban and coastal property values, not as matters of necessity.¹⁸⁸ We can afford to entertain tough environmental standards and slowed-down approval procedures in that context, but as such measures are put into the climate change adaptation policy mix they will be portrayed as facilitating urgent and necessary adaptation strategies, particularly those built around the resist and transform modes, not as environmental intrusions to be contested until all the environmental impacts are fully accounted for. And to the extent people flee areas experiencing heightened risk of catastrophe and crisis notwithstanding improved technologies, the move mode of adaptation imposes its own set of environmental stresses.

Although other nations are moving forward with planning and policy for this scale of damage control¹⁸⁹ and some climate policy scholars have offered

¹⁸⁵ KOUSKY ET AL., *supra* note 183, at 4. The Central Intelligence Agency has established the Center on Climate Change and National Security to study “the national security impact of phenomena such as desertification, rising sea levels, population shifts, and heightened competition for natural resources.” Press Release, Cent. Intelligence Agency, CIA Opens Center on Climate Change and National Security (Sept. 25, 2009), <https://www.cia.gov/news-information/press-releases-statements/center-on-climate-change-and-national-security.html> (last visited Apr. 18, 2010).

¹⁸⁶ See KOUSKY ET AL., *supra* note 183, at 12 (stating that in addition to drastic emissions reduction and geengineering, the third option for managing catastrophe risks will be “various large-scale adaptation measures that would reduce the consequences of mega-catastrophes or short-circuit the cascading of more localized disasters”).

¹⁸⁷ See Baldwin, *supra* note 18, at 782 (“Unwavering faith in technology to defeat the effects of climate change induces society to discount too heavily the possibility of catastrophe, so that when disaster does occur, communities that are unprepared to face the challenge will inevitably suffer the greatest losses. Understanding this tendency, communities must embrace the benefits of technology in adaptation and recognize that it represents part of the solution—and not the only mechanism—for combating the impacts of climate change.” (footnote omitted)).

¹⁸⁸ See, e.g., Michael Perry, *Coastal Homes Face Huge Losses from Rising Sea*, REUTERS, Sept. 3, 2009, <http://www.reuters.com/article/idUSTRE58209B20090903> (last visited Apr. 18, 2010). See generally Baldwin, *supra* note 18, at 783 (discussing societal tendency to cling to “industrial, commercial, and residential activities” poorly suited to the areas they are located in).

¹⁸⁹ See, e.g., IRISH ACAD. OF ENG'G, IRELAND AT RISK: CRITICAL INFRASTRUCTURE (2009).

thoughtful adaptation policy models,¹⁹⁰ outside of a few states' fledgling planning initiatives¹⁹¹ the United States has compiled close to zero in the way of coordinated anticipatory adaptation policy for managing the risk *in the United States* of climate change catastrophe and crisis.¹⁹² Our existing disaster management regime, moreover, was not designed around risk causes and consequences of this complexity and potential physical and geographic magnitude:

Despite the potential of both the Disaster Mitigation Act and the Coastal Zone Management Act, neither law is specifically designed to address the nation's ability to adapt to climate change. Moreover, the lack of solid connections between and at various levels of government provides a significant barrier to the integration of land use management and other mitigation and response strategies. Within the U.S. system, confusion in planning and response is far more common than coordinated efforts and clearly delineated roles. As a result, an effective federal approach to mitigation requires a law similar to the Disaster Management Act but one that was specifically written to address climate change adaptation.¹⁹³

This is a direct result of the adaptation deficit, not some rationalized decision to adopt a wait-and-see reactive adaptation orientation.¹⁹⁴ There is much catching up to be done.

I am headed here in much the same direction as with climate justice policy, which is a form of risk management for particular populations: Environmental law will be one among many players in the design of climate change catastrophe and crisis risk management. As the United Nations has suggested,

¹⁹⁰ See United Nations Dev. Programme, *A Climate Risk Management Approach to Disaster Reduction and Adaptation to Climate Change*, in ADAPTATION TO CLIMATE CHANGE, *supra* note 4, at 229, 230.

¹⁹¹ See CAL. NATURAL RES. AGENCY, *supra* note 31.

¹⁹² The first comprehensive impacts study designed to guide national policy for climate change catastrophes and crises, among other climate change problems, is from 2009. See U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 1.

¹⁹³ Leonard, *supra* note 144, at 557–58 (footnotes omitted). For other legal commentary on this theme, which focuses in particular on water crises, see Joseph W. Dellapenna, *International Water Law in a Climate of Disruption*, 17 MICH. ST. J. INT'L L. 43 (2008); Gabriel Eckstein, *Water Scarcity, Conflict, and Security in a Climate Change World: Challenges and Opportunities for International Law and Policy* (Tex. Tech Univ. Sch. of Law Legal Studies Working Paper Group, Paper No. 2009-01), available at <http://ssrn.com/abstract=1425796> (follow "One-Click Download" hyperlink); Charles W. Gould, *The Right to Housing Recovery After Natural Disasters*, 22 HARV. HUM. RTS. J. 169 (2009); A. Dan Tarlock, *Water Scarcity, Fear Mitigation, and International Water Law*, 31 HAMLIN L. REV. 703 (2008); Lindsay F. Wiley, *Adaptation to the Health Consequences of Climate Change as a Potential Influence on Public Health Law and Policy: From Preparedness to Resilience*, 15 WIDENER L. REV. (forthcoming 2010), available at <http://ssrn.com/abstract=1474844> (follow "One-Click Download" hyperlink). For an overview of existing disaster law and policy, see FARBER ET AL., *supra* note 167.

¹⁹⁴ The wait-and-see reactive adaptation orientation is not generally regarded as an effective risk management strategy for climate change. See United Nations Dev. Programme, *supra* note 190, at 247 ("Any approach to risk management and adaptation should be essentially prospective or anticipatory, and promoted in the very short term.")

[T]he complexity of risk-generating processes, the range of socio-economic and environmental considerations that would come into play, and the diverse and complex nature of the social intervention required, requires the search for coherence and coordination

... The complexity of risk contexts demands increased integration, harmonization, and cooperation between until now separate concerns, caucuses and interest groups.¹⁹⁶

Environmental law will need to find its footing in this new policy landscape, and given the high stakes for people it will not likely be the policy realm calling the shots. If dengue fever comes to Florida,¹⁹⁶ all bets are off.

F. Trend Six: Frequent Reconfigurations of Transpolicy Linkages and Tradeoffs at All Scales and Across Scale

The breadth and magnitude of problems associated with climate change, only some of which I have surveyed above, have led to calls for nations to assume a “war” mentality to combat the causes and consequences.¹⁹⁷ What is meant, of course, is that the steps necessary to bring climate change under control may require public and private measures on a scale similar to that of wartime. Indeed, that may very well be necessary, but the war usually held in mind in these policy proposals has been one against greenhouse gas emissions. The war on climate change, however, will not begin and end with mitigation—adaptation will be its other theater.

The adaptation front of this war is going to be fundamentally different from the mitigation front. The enemy in the mitigation war is easy to identify—greenhouse gas emission sources—so the battles will be over modifying behavior and technology to win the day. By contrast, the adaptation war, known in the adaptation theory literature as “mainstreaming” adaptation,¹⁹⁸ has climate change itself as the enemy. We’re not fighting only ourselves, in other words, we’re fighting something much bigger and over which we will have little control for at least this century. More akin to the Hundred Years War than an intense and swift battle, in this

¹⁹⁵ *Id.*

¹⁹⁶ This is a very real probability. See U.S. ENVTL. PROT. AGENCY, CLIMATE CHANGE AND FLORIDA 3 (1997) (“[W]arming and other climate changes may expand the habitat and infectivity of disease-carrying insects, increasing the potential for transmission of diseases such as malaria and dengue (‘break bone’) fever.”).

¹⁹⁷ See, e.g., Lisa Heinzerling & Frank Ackerman, *Law and Economics for a Warming World*, 1 HARV. L. & POLY. REV. 331, 359 (2007) (“A twenty-first-century war on climate change, if the nation and the world should choose to fight it, will create a new round of technologies and industries”); *War-Like Plan Needed to Tackle Climate Change, Summit Told*, ABC NEWS ONLINE (Austl.), Apr. 17, 2007, <http://www.abc.net.au/news/newsitems/200704/s1888593.htm> (last visited Apr. 18, 2010) (“An American weather expert has told a water summit in Sydney that global warming is such an enormous problem [that] the world needs to go on a war footing to fight it.”).

¹⁹⁸ See Burton, *supra* note 19, at 94; Saleemul Huq & Hannah Reid, *Mainstreaming Adaptation in Development*, in ADAPTATION TO CLIMATE CHANGE, *supra* note 4, at 313.

fight we resist, transform, and move over the long-term. That's why it's called *adaptation*.

As my previous five trends have begun to suggest, however, there is a lot more to how we fight in the adaptation theater of the war on climate change than will fit under the umbrella of environmental law.

Adaptation to climate change does not occur in isolation from the influence of other forces, but instead occurs amid a complex set of economic (micro and macro), social and institutional circumstances which establish a location-specific context for human-environment interactions. In effect, there are many 'non-environmental' factors which impede or mediate change in human systems¹⁹⁹

This complex of policy linkages will take place over three broad, interconnected dynamics that will challenge the ability of law to continue to operate on the premise of "stationarity" in social and economic affairs. The first will involve feedback between various fronts of climate change adaptation policy as local, state, federal, and private institutions attempt to mainstream adaptation strategies as a flow of coordinated decisions linking environmental policy with national security, immigration, trade, public health, finance, foreign aid, tax, social welfare, business policy, and housing policies, to name just a few, and do so across all governance scales.²⁰⁰ Legal scholarship has begun to explore the depth to which the evolution of these transpolicy linkages will disrupt and reorder legal and policy domains that have depended on a relatively stable envelope of policy space within which the domestic legal world has worked over time.²⁰¹

The second major dynamic will be the interaction of climate change adaptation policy holistically with other major global change drivers. Chief among these, according to an interdisciplinary team of researchers, will be increasing antibiotic resistance; increasing economic, social, and

¹⁹⁹ Smithers & Smit, *supra* note 15, at 17.

²⁰⁰ See generally U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 1, *passim* (discussing the political and geographical scales at which adaptation decisions must be made to address climate change).

²⁰¹ In addition to the numerous references to such work provided in *supra* Parts II.A–E, see, for example, FREDERICK M. ABBOTT, INNOVATION AND TECHNOLOGY TRANSFER TO ADDRESS CLIMATE CHANGE: LESSONS FROM THE GLOBAL DEBATE ON INTELLECTUAL PROPERTY AND PUBLIC HEALTH (Int'l Ctr. for Trade & Sustainable Dev., Issue Paper No. 24, 2009), available at <http://ictsd.org/downloads/2009/07/innovation-and-technology-transfer-to-address-climate-change.pdf> (focusing on pharmaceutical technology); Kevin L. Doran, *Climate Change Risk Disclosure: A Sector by Sector Analysis of SEC 10-K Filings from 1995–2008*, 34 N.C. J. INT'L L. & COM. REG. (forthcoming 2010), available at <http://ssrn.com/abstract=1416279> (follow "One-Click Download" hyperlink) (corporate disclosure policy); Ans Kolk & Jonatan Pinkse, *Business and Climate Change: Key Challenges in the Face of Policy Uncertainty and Economic Recession*, MGMT. ONLINE REV., May 2009, available at <http://ssrn.com/abstract=1433037> (follow "One-Click Download" hyperlink) (exploring the implications of the "economy-climate-policy nexus" on the business sector); Andrew Morris et al., *Green Jobs Myths*, 16 MO. ENVTL. L. & POL'Y REV. 326 (2009) (exploring the implications of climate change policy in the employment sector); Perry E. Wallace, *Global Climate Change and the Challenge to Modern American Corporate Governance*, 55 SMU L. REV. 493 (2002) (corporate law).

ecological connectivity; rising human numbers and urbanization; increasing per capita resources use; nuclear proliferation; international terrorism; energy, food, and water crises; declining fisheries; increasing ocean acidification; and emerging diseases.²⁰² These “intertwined global-scale challenges spawned by the accelerating scale of human activity” are “outpacing the development of institutions to deal with them and their many interactive effects.”²⁰³

The third major dynamic integrates the international dimension of climate change adaptation into national policy, as the United States loses its global hegemonic position and thus increasingly must set its national adaptation policy with other nations’ adaptation strategies taken into account. Some nations will hoard resources, some will send people outward, some will become unstable politically, some will become belligerent to neighbors, and so on. A number of international law scholars have identified this aspect of climate change policy as being perhaps the most vexing for the United States given the existing degree of fragmentation in international law and relations and the history of the United States’s self-proclaimed exceptionalism in our posture with other nations.²⁰⁴

Domestic policy decisions about whether and how to resist, transform, or move at local and regional scales thus will necessarily intersect a wide and dynamic array of policy realms. Environmental law, to the extent it retains a distinct identity in this complex, transpolicy, multiscale network of decision making, will be but just one player. Moreover, like any complex network system, the linkages between components and between scales of components will evolve over time, meaning environmental law better stay alert and, like the Red Queen, run hard just to stay in place.

My ultimate message in this may be unsettling to environmentalists: Climate change adaptation policy is going to transcend environmental law quickly and decisively. Environmental law will be competing with a shifting array of other adaptation policy demands possessing potentially greater

²⁰² See Brian Walker et al., *Looming Global-Scale Failures and Missing Institutions*, 325 SCI. 1345, 1345 (2009).

²⁰³ *Id.*

²⁰⁴ See Harro Van Asselt et al., *Global Climate Change and the Fragmentation of International Law*, 30 LAW & POL’Y 423 (2008); Cinnamon Piñon Carlarne, *Good Climate Governance: Only a Fragmented System of International Law Away?*, 30 LAW & POL’Y 450 (2008); Bonnie Docherty & Terry Giannini, *Confronting a Rising Tide: A Proposal for a Convention on Climate Change Refugees*, 33 HARV. ENVTL. L. REV. 349 (2009); Meinhard Doelle, *Linking the Kyoto Protocol and Other Multilateral Environmental Agreements: From Fragmentation to Integration?*, 14 J. ENVTL. L. & PRAC. 75 (2004); Ben Saul, *Climate Change, Conflict and Security: International Law Challenges*, 9 N.Z. ARMED. FORCES L. REV. 1 (2010), available at <http://ssrn.com/abstract=1485175> (follow “One-Click Download” hyperlink) (examining security threats associated with climate change and how international environmental law can respond); Ben Saul, *Climate Change, Resources Scarcity and Distributive Justice in International Law*, in REVELING IN THE WILDS OF CLIMATE LAW (R. Lyster ed., forthcoming 2010), available at <http://ssrn.com/abstract=1484340> (follow “One-Click Download” hyperlink); Lindsay F. Wiley, *Healthy Planet, Healthy People: Integrating Global Health into the International Response to Climate Change*, J. ENVTL. L. & LITIG. (forthcoming 2010), available at <http://ssrn.com/abstract=1489564> (follow “One-Click Download” hyperlink).

urgency and importance. Unlike mitigation policy, where environmental law is setting the agenda,²⁰⁶ in adaptation policy environmental law is more likely to be told its place in line. This will be a hard pill to swallow, for environmental law has long positioned itself as the arbiter of what is good and bad development. For many people, however, adaptation fundamentally is not about development—it is about survival. It seems highly unlikely, therefore, that adaptation policy, as an amalgam of dozens of interests and needs ranging from urgent to critical, is going to anoint environmental law as its czar.

So what is environmental law to do? Adapt!

G. Trend Seven: Shift from “Front-End” Decision Methods Relying on Robust Predictive Capacity to “Back-End” Decision Methods Relying on Active Adaptive Management

Environmental law has positioned itself over time as a gatekeeper of development and infrastructure projects by imposing the requirement that a comprehensive environmental impact assessment be conducted prior to final government approval of the project under relevant permitting programs, the classic example being the National Environmental Policy Act (NEPA).²⁰⁶ At the same time, environmental law, as part of the broader field of regulatory law, has also incorporated (often less than willingly) the discipline of cost-benefit analysis as the comprehensive gatekeeper test for the merits of development and infrastructure projects.²⁰⁷ The details of both

²⁰⁵ See *supra* note 1 and accompanying text.

²⁰⁶ National Environmental Policy Act of 1969, 42 U.S.C. §§ 4321–4370 (2006). NEPA requires all federal agencies to “include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on—(i) the environmental impact of the proposed action, [and] (ii) any adverse environmental effects which cannot be avoided should the proposal be implemented.” *Id.* § 4332(2)(C). This provision also requires statements on alternative actions, short- and long-term implications, and “any irreversible and irretrievable commitments of resources.” *Id.* § 4332(2)(C)(iii)–(v). The Council on Environmental Quality (CEQ), responsible for issuing regulations implementing NEPA’s mandated environmental impact statement procedure for federal agencies, requires agencies to consider the impacts of direct effects, indirect effects, and cumulative impacts. The CEQ has defined *direct effects* as effects “which are caused by the action and occur at the same time and place,” 40 C.F.R. § 1508.8(a) (2009), *indirect effects* as effects “which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable,” *id.* § 1508.8(b), and *cumulative impacts* as

the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Id. § 1508.7.

²⁰⁷ See, e.g., CASS R. SUNSTEIN, THE COST-BENEFIT STATE: THE FUTURE OF REGULATORY PROTECTION (2002).

methodologies are intricate, and neither is free of criticism.²⁰⁸ All that matters for my purposes are their two central attributes: 1) they are, as Professors Rob Glicksman and Sidney Shapiro put it, “front-end” decision tools comprehensively conducted *and concluded* prior to making the decision final,²⁰⁹ and 2) as such they rely on a robust capacity to predict and assess environmental impacts of a project and the project’s overall costs and benefits. For example, regulations promulgated under the ESA provide for consultations between the U.S. Fish and Wildlife Service (FWS) and other federal agencies about the effects of their actions on protected species. These regulations require FWS to “[e]valuate the effects of the action and cumulative effects” and decide “whether the action, taken together with cumulative effects, is likely to jeopardize the continued existence of listed species.”²¹⁰ Section 404 of the Clean Water Act (CWA)²¹¹ similarly requires the Corps to predict future cumulative effects and to integrate that prediction into its decision whether or not to permit developments that involve filling of wetlands.²¹²

For purposes of climate change adaptation policy, the demand for predictive capacity will be the Achilles’ heel for the application of conventional environmental impact assessment and cost-benefit analysis. As previously discussed, the impacts of climate change necessitating human and environmental adaptation will be excruciatingly difficult to predict.²¹³ Nonlinearities in change dynamics, environmental feedback properties, and the interactions of social and ecological responses will soon exceed the boundaries of environmental stationarity that have allowed environmental impact assessment and cost-benefit analysis to maintain what reliability and

²⁰⁸ For critiques of using cost-benefit analysis in environmental and natural resources decision contexts, see FRANK ACKERMAN & LISA HEINZERLING, PRICELESS: ON KNOWING THE PRICE OF EVERYTHING AND THE VALUE OF NOTHING (2004); Frank Ackerman & Lisa Heinzerling, *Pricing the Priceless: Cost-Benefit Analysis of Environmental Protection*, 150 U. PA. L. REV. 1553 (2002); David Driesen, *Distributing the Costs of Environmental, Health and Safety Protection: The Feasibility Principle, Cost-Benefit Analysis, and Regulatory Reform*, 32 B.C. ENVTL. AFF. L. REV. 1 (2005); David Driesen, *Is Cost-Benefit Analysis Neutral?*, 77 U. COLO. L. REV. 335 (2006); Thomas O. McGarity, *A Cost-Benefit State*, 50 ADMIN. L. REV. 7 (1998); Sidney A. Shapiro & Christopher H. Schroeder, *Beyond Cost-Benefit Analysis: A Pragmatic Reorientation*, 32 HARV. ENVTL. L. REV. 433 (2008).

²⁰⁹ See SIDNEY A. SHAPIRO & ROBERT L. GLICKSMAN, RISK REGULATION AT RISK: RESTORING A PRAGMATIC APPROACH (2003); Sidney A. Shapiro & Robert L. Glicksman, *The Missing Perspective*, ENVTL. F., Mar.–Apr. 2003, at 42, 43.

²¹⁰ 50 C.F.R. § 402.14(g)(3)–(4) (2009). The agency defines cumulative effects as “those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area.” *Id.* § 402.02.

²¹¹ Federal Water Pollution Control Act, 33 U.S.C. §§ 1251–1387 (2006).

²¹² *Id.* § 1334. Statutory policies allow the Corps to issue general permits for disposal of fill material in navigable waters covering classes of activities the agency determines “are similar in nature, will cause only minimal adverse environmental effects when performed separately, and will have only minimal cumulative adverse effect on the environment.” *Id.* § 1344(e)(1). Corps regulations for project-specific fill permits require the agency to conduct “an evaluation of the probable impacts, including cumulative impacts, of the proposed activity.” 33 C.F.R. § 320.4(a)(1) (2009).

²¹³ See *supra* Part II.

credibility they have. Indeed, even before climate change adaptation became a pressing need, the challenges of front-end environmental impact assessment were evident in ecological contexts increasingly understood to be exceedingly complex.²¹⁴ For example, a 1997 guide on considering cumulative effects under NEPA explains that “[d]etermining the cumulative environmental consequences of an action requires delineating the cause-and-effect relationships between the multiple actions and the resources, ecosystems, and human communities of concern. Analysts must tease from the complex networks of possible interactions those that substantially affect the resources.”²¹⁵ The guide advises analysts to “gather information about the cause-and-effect relationships between stresses and resources” and to develop “a conceptual model of cause and effect Networks and system diagrams are the preferred methods of conceptualizing cause-and-effect relationships.”²¹⁶

We simply don't have the tools to apply that methodology to climate change adaptation and produce comprehensive front-end environmental impact assessments that will prove reliable over the long term. As noted previously, for example, the Intergovernmental Panel on Climate Change (IPCC) estimates of climate change impacts made just three years ago, already are proving to have overshoot and undershot observed changes.²¹⁷ Regional impact studies remain very coarse in detail,²¹⁸ and this is even more the case at local scales.

One of the main messages to emerge from the past decade of synthesis and assessments is that while climate change is a global issue, it has a great deal of regional variability. There is an indisputable need to improve understanding of climate system effects at these smaller scales, because they are often the scales of decision making in society. Understanding impacts at local scales will also help to target finite resources for adaptation measures.²¹⁹

With respect to the last point made—targeting finite resources for adaptation—cost-benefit analysis fares no better than environmental impact assessment in the climate change adaptation world. The IPCC, for example, has concluded that “[t]he literature on adaptation costs and benefits remains quite limited and fragmented in terms of sectoral and regional coverage.”²²⁰ The upshot is that

²¹⁴ See generally Daniel A. Farber, *Probabilities Behaving Badly: Complexity Theory and Environmental Uncertainty*, 37 U.C. DAVIS L. REV. 145, 148–55 (2003) (discussing the problems with uncertainty in environmental law); Ruhl, *supra* note 99, at 954–67 (addressing the complexities inherent to environmental law and the environment).

²¹⁵ COUNCIL ON ENVTL. QUALITY, *CONSIDERING CUMULATIVE EFFECTS UNDER THE NATIONAL ENVIRONMENTAL POLICY ACT*, at vi (1997).

²¹⁶ *Id.* at 38.

²¹⁷ See *supra* note 6.

²¹⁸ See U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 1, at 107–52 (providing regional studies for the United States).

²¹⁹ *Id.* at 154.

²²⁰ INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 2, at 724.

adaptation costs and benefits are usually embedded within climate damage functions which are often extrapolated from a limited number of regional studies. Furthermore, the source studies which form the basis for the climate damage functions do not always reflect the most recent findings. As a result, these studies offer a global and integrated perspective but are based on coarsely defined climate change and adaptation impacts and only provide speculative estimates of adaptation costs and benefits.²²¹

The greatest impediment to relying on conventional front-end comprehensive cost-benefit analysis in the climate change adaptation context will be what Carolyn Kousky and Roger Cooke of Resources for the Future describe as the “unholy trinity” of fat tails, tail dependence, and microcorrelations:²²²

These are distinct aspects of loss distributions, such as damages from a disaster or insurance claims. With fat-tailed losses, the probability declines slowly, relative to the severity of the loss. Tail dependence is that propensity of dependence to concentrate in the tails, such that severe losses are more likely to happen together. Micro-correlations are negligible correlations between risks which may be individually harmless, but very dangerous when aggregated. These three phenomena—types of catastrophic and dependent risks—undermine traditional approaches to risk management.²²³

The double whammy effect of the loss of predictive capacity in both environmental impact assessment and cost-benefit analysis will materialize when climate change adaptation decisions confront choices between different adaptation technologies and between anticipatory and reactive adaptation orientations. If both the environmental impacts and the overall costs and benefits are difficult to predict, how useful will these comprehensive front-end methodologies be? For example, should coastal communities build seawalls, and if so how high, or should they rely on enhanced coastal wetlands as a natural capital solution, or should they move inland? It is difficult to say if we cannot reliably predict ultimate sea level rise and its inshore impacts *and* if the relationship between storm surge

²²¹ *Id.* at 727; *see also* EUROPEAN ENV'T AGENCY, *supra* note 47, at 7 (“[T]here is currently very little quantified information on these costs, and further work is urgently needed to build the evidence base to facilitate informed, cost effective and proportionate adaptation in Europe.”).

²²² *See* CAROLYN KOUSKY & ROGER M. COOKE, THE UNHOLY TRINITY: FAT TAILS, TAIL DEPENDENCE, AND MICRO-CORRELATIONS (Res. for the Future, Discussion Paper No. 09-36-REV, 2009).

²²³ *Id.* at 1; *see also* KOUSKY & COOKE, *supra* note 120, *passim* (applying these concepts specifically to climate change adaptation); Daniel A. Farber, Uncertainty (Feb. 18, 2010) (unpublished manuscript), *available at* <http://ssrn.com/abstract=1555343> (follow “One Click Download” hyperlink) (describing analytic tools for assessing potential climate change catastrophic outcomes). Aggregated microcorrelations have been described as leading to the “Jenga effect,” named after the game in which players stack pieces into a tower and then remove them, one by one, stacking the removed pieces on the top of the tower. *See* Peter C. de Ruiter et al., *Food Web and Ecology: Playing Jenga and Beyond*, 309 *Sci.* 68, 68 (2005). With skilled players, the structure can stay standing for quite awhile, but at some point one more piece removed or stacked on top leads to a sudden crash of the entire structure. Food web dynamics exhibit this effect. *Id.*

protection and area of coastal wetlands is nonlinear and thus not detected or anticipated early in the history of gains or losses.²²⁴

Recognizing these limitations, legal scholars have begun to question the efficacy of using conventional comprehensive front-end environmental impact assessments and cost-benefit analyses in climate change adaptation decisions.²²⁵ The alternative they propose, however, is not to ditch environmental impact assessment and cost-benefit analysis and go blindly forward, but rather to shift their methodological fundamentals toward a more adaptive “back-end” approach. The critical component of this approach is to scale back (but not abandon) the comprehensive front-end focus, which assumes all effects can be predicted and assessed before the decision, and introduce formal follow-up mechanisms demanding that the decision maker integrate new information into an ongoing decision adjustment process. As Professor Daniel Farber explains,

One of NEPA’s major flaws, which climate assessment needs to avoid at all costs, is the absence of dynamic learning. NEPA does not require agencies to perform later checks on their EIS predictions, and agencies do not generally do so. . . .

....

Without the check provided by such feedback, overly optimistic predictions can result.²²⁶

Farber works through this and other lessons learned from the NEPA experience to outline a more dynamic, learning oriented decision process he calls “climate impact assessments.”²²⁷

²²⁴ See Edward B. Barbier et al., *Coastal Ecosystem-Based Management with Nonlinear Ecological Functions and Values*, 319 SCI. 321 (2008) (examining the policy difficulties flowing from such nonlinearities).

²²⁵ See Baldwin, *supra* note 18, at 771 (environmental impact assessments); Daniel A. Farber, *Adaptation Planning and Climate Impact Assessments: Learning from NEPA’s Flaws*, 39 ENVTL. L. REP. (Envtl. Law Inst.) 10,605 (2009) [hereinafter Farber, *NEPA’s Flaws*] (environmental impact assessments); Daniel A. Farber, *Modeling Climate Change and Its Impacts: Law, Policy, and Science*, 86 TEX. L. REV. 1655 (2008); Robert L. Glicksman, *Global Climate Change and the Risks to Coastal Areas from Hurricanes and Rising Sea Levels: The Costs of Doing Nothing*, 52 LOY. L. REV. 1127 (2006) (cost-benefit analysis); Douglas Kysar, *Climate Change, Cultural Transformation, and Comprehensive Rationality*, 31 B.C. ENVTL. AFF. L. REV. 555 (2004) (cost-benefit analysis).

²²⁶ Farber, *NEPA’s Flaws*, *supra* note 225, at 10,610.

²²⁷ See *id.* at 10,607–14; see also Caleb W. Christopher, *Success by a Thousand Cuts: The Use of Environmental Impact Assessment in Addressing Climate Change*, 9 VT. J. ENVTL. L. 549, 592 (2008) (proposing adaptive approaches for NEPA in the climate change context). To be sure, there remains considerable value in retaining a front-end component of environmental assessments to anticipate climate change impacts, particularly to the extent doing so helps to increase public awareness and internalize consideration of climate change impacts in federal agencies and state, local, and private actors whose actions are subject to NEPA and its state law equivalents. See Michael B. Gerrard, *Climate Change and the Environmental Impact Review Process*, NAT. RESOURCES & ENV’T, Winter 2008, at 20 (surveying federal, state, and local

Of course, in order to be able to learn from the feedback provided through these climate impact assessments, decision making itself must gravitate to adaptive back-end methodologies. Indeed, well before climate change became a severe policy concern, scientists and lawyers in growing numbers called for greater use of the discipline of “adaptive management” in natural resources policy.²²⁸ The adaptive management strategy traces its origins to C.S. Holling’s critique of front-end predecisional approaches in his influential book from the late 1970s, *Adaptive Environmental Assessment and Management*.²²⁹ Holling and his colleagues found conventional environmental management methods, particularly the environmental impact assessment process under NEPA, at odds with the emerging model of ecosystems as complex, dynamic systems. Under the dynamic model of ecosystems, they concluded, management policy must put a premium on collecting information, establishing measurements of success, monitoring outcomes, using new information to adjust existing approaches, and possessing a willingness to change.²³⁰ Attempting to predict all the consequences of an action before deciding to go forward and then never looking back, they argued, was at odds with the adaptive management strategy.²³¹ Adaptive management theory thus rejects NEPA’s premise that all the cumulative effects caused by and affecting an action over time can be reliably predicted at the time the action is designed.²³² Yet effective adaptive management goes beyond that to promote active “learning while doing” in

assessment programs); Catherine J. LaCroix, *SEPA’s, Climate Change, and Corporate Responsibility: The Contribution of Local Government*, 58 CASE W. RES. L. REV. 1289, 1291 (2008). Toward that end, in February 2010 the White House Council on Environmental Quality, which develops general regulations and guidance for implementation of NEPA, issued draft guidance on how to evaluate the effects of climate change and greenhouse gas emissions in NEPA assessments. See Memorandum from Nancy H. Sutley, Chair, Council on Env’tl. Quality, to the Heads of Federal Departments and Agencies (Feb. 18, 2010), available at <http://www.whitehouse.gov/sites/default/files/microsites/ceq/20100218-nepa-consideration-effects-ghg-draft-guidance.pdf> (providing “Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions”). The overwhelming focus of the guidance, however, is on greenhouse gas emissions and evaluation of mitigation actions, with little attention to adaptation beyond stating the obvious that “[i]n cases where adaptation to the effects of climate change is important, the significant aspects of these changes should be identified in the agency’s final decision and adoption of a monitoring program should be considered.” *Id.* at 7.

²²⁸ See Mary Jane Angelo, *Stumbling Toward Success: A Story of Adaptive Law and Ecological Resilience*, 87 NEB. L. REV. 950, 955 & n.24 (2009).

²²⁹ C.S. HOLLING ET AL., *ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT* (C.S. Holling ed., 1978); see also Kai N. Lee & Jody Lawrence, *Adaptive Management: Learning from the Columbia River Basin Fish and Wildlife Program*, 16 ENVTL. L. 431, 442 n.45 (1986) (tracing the term “adaptive management” to Holling’s book).

²³⁰ See HOLLING ET AL., *supra* note 229, at 20, 47–48. For background on the adaptive management model, see Angelo, *supra* note 228; Holly Doremus, *Adaptive Management, the Endangered Species Act, and the Institutional Challenges of “New Age” Environmental Protection*, 41 WASHBURN L.J. 50 (2001); Bradley C. Karkkainen, *Panarchy and Adaptive Change: Around the Loop and Back Again*, 7 MINN. J.L. SCI. & TECH. 59 (2005); J.B. Ruhl, *Regulation by Adaptive Management—Is It Possible?*, 7 MINN. J.L. SCI. & TECH. 21 (2005).

²³¹ See HOLLING ET AL., *supra* note 229, at 133, 135.

²³² See *id.* at 135.

the implementation of decisions over time.²³³ Thus, an adaptive management plan must address how to handle new information and contingencies and adjust decisions accordingly.²³⁴

Adaptive management has evolved well beyond an idea. For example, FWS has portrayed it as an important practical tool that “can assist . . . in developing an adequate operating conservation program and improving its effectiveness.”²³⁵ Indeed, there is broad consensus today among resource managers and academics that adaptive management is the only practical way to implement ecosystem-scale resource management.²³⁶ Not surprisingly, the trend in climate change scholarship is moving in this direction as well. For prominent examples, Professor Robert Glicksman has broadly outlined how adaptive management would improve federal public lands management policies and implementation in the climate change context,²³⁷ Professor Alejandro Camacho has comprehensively detailed how adaptive management can be applied for climate change adaptation in natural resources management,²³⁸ and Professor Robin Kundis Craig has made adaptive management one of her principles of climate change adaptation policy implementation.²³⁹ Experts from environmental organizations, such as the Environmental Law Institute’s Carl Bruch, concur in the important role

²³³ PANEL ON ADAPTIVE MGMT. FOR RES. STEWARDSHIP ET AL., NAT’L RESEARCH COUNCIL, ADAPTIVE MANAGEMENT FOR WATER RESOURCES PROJECT PLANNING 22 (2004).

²³⁴ The National Research Council explains:

Adaptive management is not a “one size fits all” or a “cookbook” process, as experience with the concept and its related procedures to date is limited and evolving. There are multiple views and definitions regarding adaptive management, but elements that have been identified in theory and in practice are: management objectives that are regularly revisited and accordingly revised, a model(s) of the system being managed, a range of management options, monitoring and evaluating outcomes of management actions, mechanisms for incorporating learning into future decisions, and a collaborative structure for stakeholder participation and learning.

Id. at 2. For a thorough description of adaptive management theory and protocol, see *id.* at 19–32.

²³⁵ Notice of Availability of a Final Addendum to the Handbook for Habitat Conservation Planning and Incidental Take Permitting Process, 65 Fed. Reg. 35,242, 35,252 (June 1, 2000).

²³⁶ See Ronald D. Brunner & Tim W. Clark, *A Practice-Based Approach to Ecosystem Management*, 11 CONSERVATION BIOLOGY 48 (1997); Anne E. Heissenbuttel, *Ecosystem Management—Principles for Practical Application*, 6 ECOLOGICAL APPLICATIONS 730 (1996); Paul L. Ringold et al., *Adaptive Monitoring Design for Ecosystem Management*, 6 ECOLOGICAL APPLICATIONS 745 (1996). Indeed, the Ecological Society of America’s comprehensive study of ecosystem management treats the use of adaptive management methods as a given. See Norman L. Christensen et al., *The Report of the Ecological Society of America Committee on the Scientific Basis for Ecosystem Management*, 6 ECOLOGICAL APPLICATIONS 665 (1996).

²³⁷ See Glicksman, *supra* note 26, *passim*. “The land management agencies, in the planning process as well as in other contexts, must rely heavily on the management technique known as adaptive management.” *Id.* at 868 (emphasis omitted).

²³⁸ See Camacho, *supra* note 18, *passim*. Camacho calls for “an adaptive methodology for assessing and adjusting government decision making over time.” *Id.* at 64.

²³⁹ See Craig, *supra* note 18 (manuscript at 65–67) (utilizing the heading “Be Serious About Using Adaptive Management—and Change Both Natural Resources and Administrative Laws to Allow for It”).

adaptive management will play.²⁴⁰ Fully institutionalizing adaptive management in climate change adaptation policy, however, will require that environmental law relax its front-end gatekeeper grip as well as accommodate new forms of public participation and judicial review.²⁴¹ Yet given the serious limitations of using comprehensive front-end environmental impact assessment and cost-benefit analysis in the climate change adaptation context, this movement seems inevitable for environmental law to remain a viable player in adaptation decision making.

H. Trend Eight: Greater Variety and Flexibility in Regulatory Instruments

If adaptive management will be environmental law's methodology for climate change adaptation, what will be its instruments for adaptation decision implementation? Here environmental law's main concern will be managing the effects of adaptation measures on the environment, in particular how adaptation measures increase the scarcity of and competition for critical adaptation resources such as land, timber, minerals, and water. Given the need to shift resources and people around to bolster adaptive capacities, adaptation will be a resource-intensive undertaking no matter what blend of capital is used. For example, urban population growth over the past century has occurred on less than 3% of the earth's land surface, but that population accounts for 78% of carbon emissions, 60% of residential water use, and 76% of industrial wood use.²⁴² This kind of disproportionate impact from the aggregates of local and individual behaviors is likely to be experienced in many contexts of climate change adaptation.

As Professor Michael Vandenbergh has explored in a series of co-authored publications, climate law mitigation policy has moved quickly to lay blame for emissions primarily at the feet of power plants and the automotive industry, with far less attention being given to the more obvious low hanging fruit of emission sources—individuals' consumption decisions.²⁴³ Putting the onus of mitigation responsibility on corporate

²⁴⁰ See Carl Bruch, *The End of Equilibrium*, ENVTL. F., Sept.–Oct. 2008, at 30, 32 (“Incorporating adaptive management into laws and institutions can enhance the capacity of governance systems and ecosystems to adapt to changing climatic conditions, to develop and deploy new technologies and techniques.”).

²⁴¹ Administrative law scholars have identified the need to reform administrative law at fundamental levels if adaptive management is going to work. See Ruhl, *supra* note 230, at 46–53. An underlying concern with this direction of change, however, is in retaining accountability, participation, and transparency in decision making. See David L. Markell, *Slack in the Administrative State and Its Implications for Governance: The Issue of Accountability*, 84 OR. L. REV. 1 (2005); David Markell, *The Role of Spotlighting Procedures to Promote Citizen Participation, Transparency, and Accountability: Lessons from the CEC's Citizen Submissions Process*, 45 WAKE FOREST L. REV. (forthcoming 2010), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1553125 (follow “One-Click Download” hyperlink); David L. Markell & Tom R. Tyler, *Using Empirical Research to Design Government Participation Processes: A Case Study of Citizens' Roles in Environmental Compliance and Enforcement*, 57 KAN. L. REV. 1 (2008).

²⁴² See Nancy B. Grimm, *Global Change and the Ecology of Cities*, 319 SCI. 756, 756 (2008).

²⁴³ See Mark A. Cohen & Michael P. Vandenbergh, *Consumption, Happiness, and Climate Change*, 38 ENVTL. L. REP. (Envtl. Law Inst.) 10,834 (2008); Douglas A. Kysar & Michael P.

actors, while demanding little more of individual consumer choices than is found in reduce, reuse, recycle jingles, may be a necessary expedient to make mitigation politically viable, but it will be much harder for climate change adaptation policy to let individuals and local communities off the hook so easily. There is no easy policy bull's-eye in the form of concentrated sources of adaptation problems, as power plants and other industrial sources serve for mitigation policy. Adaptation policy, in other words, isn't going to be about crunching down on some discrete, readily identifiable behavior of environmental law's traditional industrial targets. Rather, for environmental law, climate change adaptation will be about policing the impacts of how hundreds of millions of people, millions of small businesses and farms, and hundreds of thousands of local communities respond to climate change in a multitude of decision contexts. Something far more dynamic, deep, and norm-shaping than regulating the pants off of big industry will be necessary to reach this level.

So far environmental law has not been very successful in this setting. The classic example is nutrient-laden runoff pollution from farms, which has led to the intractable problem of hypoxia in estuaries around the nation.²⁴⁴ Traditional command-and-control regulation has proven ineffective in such

Vandenbergh, *Introduction: Climate Change and Consumption*, 38 *Envtl. L. Rep. (Envtl. Law Inst.)* 10,825 (2008); Michael P. Vandenbergh et al., *Individual Carbon Emissions: The Low-Hanging Fruit*, 55 *UCLA L. REV.* 1701 (2008); Michael P. Vandenbergh & Anne C. Steinemann, *The Carbon Neutral Individual*, 82 *N.Y.U. L. REV.* 1673 (2007); see also John Dernbach, *Stabilizing and then Reducing U.S. Energy Consumption: Legal and Policy Tools for Efficiency and Conservation*, 37 *Envtl. L. Rep. (Envtl. Law Inst.)* 10,003 (2007) (discussing the success of Energy Star consumer products and residential energy efficiency); Alice Kaswan, *Climate Change, Consumption, and Cities*, 36 *FORDHAM URB. L.J.* 253, 255–68 (2009) (discussing per capita emissions and the need for change beyond the industrial sector); Albert C. Lin, *Evangelizing Climate Change*, 17 *N.Y.U. ENVTL. L.J.* 1135 (2009) (exploring the problem of changing individual behaviors and attitudes relevant to global warming); Symposium, *Climate Change and Consumption*, 38 *Envtl. L. Rep. (Envtl. Law Inst.)* 10,825 (2008).

²⁴⁴ According to the U.S. Geological Survey,

Excessive nutrients, in particular nitrogen and phosphorus, have resulted in the growth of large amounts of algae that decay and consume oxygen, thereby causing a zone of low dissolved oxygen or "hypoxic zone" in the Northern Gulf of Mexico. This can stress and cause death in bottom-dwelling organisms, threatening the economic and ecological health of one of the nation's largest and most productive fisheries.

U.S. Geological Survey, U.S. Dep't of the Interior, Mississippi River Basin and Gulf of Mexico Hypoxia, http://water.usgs.gov/nawqa/sparrow/gulf_findings/hypoxia.html (last visited Apr. 18, 2010). The most definitive study of the causes concludes that runoff from agricultural sources contributes 70% of the excess nutrients. See Richard B. Alexander et al., *Differences in Phosphorous and Nitrogen Delivery to the Gulf of Mexico from the Mississippi River Basin*, 42 *ENVTL. SCI. & TECH.* 822, 822 (2008), available at <http://pubs.acs.org/doi/pdf/10.1021/es0716103>. Hypoxia from agricultural runoff and urban sewage is expanding exponentially throughout the world as well, affecting 400 estuarine systems covering over 245,000 square kilometers. See Robert J. Diaz & Rutger Rosenberg, *Spreading Dead Zones and Consequences for Marine Ecosystems*, 321 *SCI.* 926, 926 (2008). See generally MINDY SELMAN ET AL., *EUTROPHICATION AND HYPOXIA IN COASTAL AREAS: A GLOBAL ASSESSMENT OF THE STATE OF KNOWLEDGE* (World Res. Inst., Policy Note No. 1, 2008), available at http://pdf.wri.org/eutrophication_and_hypoxia_in_coastal_areas.pdf (providing an overview of eutrophication and hypoxia).

contexts, where a multitude of actors' decisions, each individually negligible in effect, aggregate into massive problems over large spatial and temporal scales.²⁴⁵ It takes little imagination to envision how climate change adaptation could cascade into numerous such cumulative impact problems, necessitating a serious overhaul of instrument choice decisions at all governance scales.

In this regard, a growing number of environmental law scholars have gravitated to what has been dubbed New Governance theory, which turns "away from the familiar model of command-style, fixed-rule regulation by administrative fiat, and toward a new model of collaborative, multi-party, multi-level, adaptive, problem-solving" governance.²⁴⁶ The central organizing principles of New Governance theory are stakeholder participation, collaboration among interests, diversity of and competition between instruments, decentralization of governance structures, integration of policy domains, flexibility, and an emphasis on noncoerciveness and adaptation.²⁴⁷ Rigidly relying on fixed, uniform regulatory instruments, such as technology standards and regulatory prescriptions, forecloses adaptation to the kind of evolving, complex problems climate change adaptation will present. Governance institutions will need a broader array of instruments, ranging from "hard" prescriptive mandates to "soft" incentive- and information-based tools, to test for leverage over the more tractable attributes of climate change adaptation problems over time.

For example, as controversial as so-called compensatory mitigation has become under the nation's core wetlands protection law, section 404 of the CWA,²⁴⁸ extensive structural infrastructure is likely to be placed in riparian and coastal wetland areas to advance climate change adaptation, and flexible but effective compensatory mitigation instruments will be necessary to manage the environmental impacts of these projects. Sea level rise

²⁴⁵ See J.B. Ruhl & James Salzman, *Massive Problems in the Administrative State: Strategies for Whittling Away*, 98 CAL. L. REV. (forthcoming 2010) (manuscript at 4, 7), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1280896 (follow "One Click Download" hyperlink).

²⁴⁶ Bradley C. Karkkainen, "New Governance" in *Legal Thought and in the World: Some Splitting as Antidote to Overzealous Lumping*, 89 MINN. L. REV. 471, 473 (2004). For a sweeping overview of New Governance theory, one which Karkkainen, *supra* note 230, reviews, see Orly Lobel, *The Renew Deal: The Fall of Regulation and the Rise of Governance in Contemporary Legal Thought*, 89 MINN. L. REV. 342 (2004) [hereinafter Lobel, *The Renew Deal*]. For additional scholarship developing New Governance principles, see THE TOOLS OF GOVERNMENT: A GUIDE TO THE NEW GOVERNANCE (Lester M. Salamon ed., 2002); Cristie L. Ford, *New Governance, Compliance, and Principles-Based Securities Regulation*, 45 AM. BUS. L.J. 1 (2008); Alana Klein, *Judging as Nudging: New Governance Approaches for the Enforcement of Constitutional Social and Economic Rights*, 39 COLUM. HUM. RTS. L. REV. 351 (2008); Orly Lobel, *Setting the Agenda for New Governance Research*, 89 MINN. L. REV. 498 (2004); Lester M. Salamon, *The New Governance and the Tools of Public Action: An Introduction*, 28 FORDHAM URB. L.J. 1611 (2001); Michael Waterstone, *A New Vision of Public Enforcement*, 92 MINN. L. REV. 434 (2007).

²⁴⁷ See Lobel, *The Renew Deal*, *supra* note 246, at 371-404.

²⁴⁸ See J.B. Ruhl et al., *Implementing the New Ecosystem Services Mandate of the Section 404 Compensatory Mitigation Program—A Catalyst for Advancing Science and Policy*, 38 STETSON L. REV. 251, 256-59 (2009) (summarizing critiques).

would expose a number of large U.S. cities, such as Miami and Boston, to storm damage and, ultimately, inundation of low lying areas. It is unlikely that our society will abandon this level of investment, so engineers are already designing protection schemes. While non-structural “natural” protection measures may help at some locations, structural solutions will be required at others. As has been the case in the Netherlands, such solutions would likely involve extensive dredging and filling of coastal wetlands and alteration of other natural coastal features.²⁴⁹

The role of environmental law, if it is to contribute to climate change adaptation, cannot be to impede and obstruct such measures through rigid command-and-control mechanisms and endless litigation over the adequacy of front-end impact assessments. Rather, environmental law will contribute meaningfully if it delivers an adaptive process for “identify[ing] which areas of the coastline can adapt to changing sea levels, where non-structural measures can be employed, where engineered protection must be put in place and how the impacts of such construction can be mitigated.”²⁵⁰ Identifying and creatively responding to the needs of climate change adaptation is how environmental law can retain a vital role in the policy development process.²⁵¹

I. Trend Nine: Increased Reliance on Multiscalar Governance Networks

As mentioned previously, climate change mitigation policy has become fixated on the federalism question—which level or levels of governance should bear primary responsibility, or even preemptive authority, for instituting nationwide mitigation policy?²⁵² By contrast, “[t]here has been little if any discussion . . . about the appropriate roles of the states and the federal government in adapting to climate change.”²⁵³ Here again mitigation and adaptation differ substantially in how such fundamentals will be framed and resolved. Mitigation policy has the luxury of asking the federalism question in a relatively narrow context because, regardless of which scale prevails, it is all about the same goal—cutting down greenhouse gas concentrations in the atmosphere. Adaptation, by contrast, is about many different effects, varied across the nation, operating at many different and sometimes competing scales.

²⁴⁹ JESSICA B. WILKINSON ET AL., THE NEXT GENERATION OF MITIGATION: LINKING CURRENT AND FUTURE MITIGATION PROGRAMS WITH STATE WILDLIFE ACTION PLANS AND OTHER STATE AND REGIONAL PLANS 43 (2009) (noting the authors are from The Nature Conservancy and the Environmental Law Institute).

²⁵⁰ *Id.*

²⁵¹ Some New Governance measures will be rather straightforward, such as strengthening climate change risk disclosures by publicly traded companies under securities regulation. See Mark Latham, *Environmental Liabilities and the Federal Securities Laws: A Proposal for Improved Disclosure of Climate Change-Related Risks*, 39 ENVTL. L. 647 (2009).

²⁵² See *supra* note 24.

²⁵³ Farber, *supra* note 24, at 1.

In the mitigation context, debate over the federalism question is reminiscent of the well-known “Matching Principle,” which claims that “regulatory authority should go to the political jurisdiction that comes closest to matching the geographic area affected by a particular externality.”²⁵⁴ Yet it is difficult enough to conceive of which scale best does so for mitigation policy,²⁵⁵ searching for the right scale in adaptation policy is an even more complex undertaking.

On the one hand, the case for local and regional governance in adaptation policy is strengthened by the variations in climate change impacts across the landscape. Adaptation for Florida, where sea level rise is the primary threat,²⁵⁶ will not be what it is for Nevada, where even less water is the likely scenario.²⁵⁷ Even within many states, local impacts will be sufficiently varied as to demand specialized adaptation profiles.²⁵⁸ It seems unlikely that the federal government could effectively devise a national adaptation strategy that fulfills the needs of every state and local community. By contrast, a molecule of carbon dioxide causes the same impact on the climate system regardless of where it is emitted, hence there is no inherent reason why local and regional autonomy is necessary for mitigation policy to gain traction on causal factors. To be sure, mitigation policy will need to be attentive to regional and local interests just as conventional air pollution control has been, but the case for localism in adaptation policy goes well beyond this political consideration—it is a matter of physical reality. Not surprisingly, therefore, one finds legal scholarship on adaptation often focusing on local and regional scales.²⁵⁹

On the other hand, it is not as if the federal government has no stake in climate change adaptation as a matter of national interest. Some aspects of adaptation policy are inherently national in scope, such as immigration policy, a secure national food supply, conservation of marine resources, migratory species, and pandemic disease control. Moreover, how state and local governments respond to adaptation needs will inevitably aggregate socially and economically into nationwide impacts. Water scarcity may pit state against state even more than is the case already, hard-nosed resistance

²⁵⁴ Henry N. Butler & Jonathan R. Macey, *Externalities and the Matching Principle: The Case for Reallocating Environmental Regulatory Authority*, 14 YALE L. & POL’Y REV. 23, 53 (1996).

²⁵⁵ See Hari M. Osofsky, *Is Climate Change “International”? Litigation’s Diagonal Regulatory Role*, 49 VA. J. INT’L L. 585, 587 (2009) (suggesting greater emphasis on connections between governance institutions at different scales).

²⁵⁶ GOVERNOR’S ACTION TEAM ON ENERGY & CLIMATE CHANGE, STATE OF FLA., PHASE I REPORT: FLORIDA’S ENERGY AND CLIMATE CHANGE ACTION PLAN 55 (2007).

²⁵⁷ NEV. CLIMATE CHANGE ADVISORY COMM., FINAL REPORT 14 (2008).

²⁵⁸ See, e.g., Or. Dep’t of Energy, *Climate Change in Oregon*, <http://www.oregon.gov/ENERGY/GBLWRM/climhme.shtml> (last visited Apr. 18, 2010).

²⁵⁹ See, e.g., Lara Whitely Binder, *Preparing for Climate Change in the U.S. Pacific Northwest*, 15 HASTINGS W.-NW. J. ENVTL. L. & POL’Y 183 (2009); Alejandro E. Camacho, *Climate Change and Regulatory Fragmentation in the Great Lakes Basin*, 17 MICH. ST. J. INT’L L. 139 (2008); Colin Crawford, *Our Bandit Future? Cities, Shantytowns, and Climate Change Governance*, 36 FORDHAM URB. L.J. 211 (2009); John C. Dernbach, *Toward a Climate Change Strategy for Pennsylvania*, 12 PENN. ST. ENVTL. L. REV. 181 (2004); Porras, *supra* note 18, at 591 (focusing on the role of cities).

strategies in the face of increasingly severe weather may expose coastal cities to catastrophic risks, and movement of people between states could present new interstate conflicts. Yet outside of the issue of national policy toward adaptation in least developed nations, which has received considerable attention,²⁶⁰ few legal scholars have proposed comprehensive development of national domestic adaptation policies.²⁶¹

Attempting to resolve this tension to find the just right scale of governance for adaptation would be a futile undertaking—adaptation policy must operate at all scales in an interconnected network of decision making. Although it has not been focused on climate change adaptation policy, the emerging theory of Dynamic Federalism²⁶² has captured the attention of environmental law scholars for how it could address the multiscale attributes of other large-scale environmental problems, and it is likely to gain credence in the adaptation context as well. Under Dynamic Federalism, “federal and state governments function as alternative centers of power and any matter is presumptively within the authority of both the federal and the state governments.”²⁶³ The theory is not radical—it does not suggest overhauling the basic federal-state-local structure of governance. Rather, it explicitly calls for overlapping federal and state (and, through states, local) jurisdictions.²⁶⁴ Scholars of Dynamic Federalism reject the “minimal overlap”

²⁶⁰ See Saul & McAdam, *supra* note 164, at 5–7.

²⁶¹ Some examples include Robin Kundis Craig, *Climate Change, Regulatory Fragmentation, and Water Triage*, 79 U. COLO. L. REV. 825 (2008) (focusing on national policy for marine environment adaptation), and Leonard, *supra* note 144, at 560–62 (proposing a national land-use regime and infrastructure development for protection of coastal communities).

²⁶² See, e.g., Kirsten H. Engel, *Harnessing the Benefits of Dynamic Federalism in Environmental Law*, 56 EMORY L.J. 159, 161 (2006).

²⁶³ *Id.* at 176. As Kirsten Engel explains, “Alternatively named ‘empowerment federalism,’ ‘polyphonic federalism,’ ‘interactive federalism,’ ‘dynamic federalism,’ and even ‘vertical regulatory competition,’ this reconceptualization has come in the form of a cluster of theoretical proposals, all rejecting dual federalism and all emphasizing the benefits of overlapping federal and state power.” *Id.* (citations omitted). For additional scholarship developing Dynamic Federalism and related principles, see David E. Adelman & Kirsten H. Engel, *Adaptive Federalism: The Case Against Reallocating Environmental Regulatory Authority*, 92 MINN. L. REV. 1796 (2008); Robert B. Ahdieh, *From Federalism to Intersystemic Governance: The Changing Nature of Modern Jurisdiction*, 57 EMORY L.J. 1 (2007); Renee M. Jones, *Dynamic Federalism: Competition, Cooperation and Securities Enforcement*, 11 CONN. INS. L.J. 107 (2005); Robert A. Schapiro, *From Dualist Federalism to Interactive Federalism*, 56 EMORY L.J. 1 (2006); Robert A. Schapiro, *Toward a Theory of Interactive Federalism*, 91 IOWA L. REV. 243 (2005) [hereinafter Schapiro, *Toward Interactive Federalism*]; Robert B. Ahdieh, *Foreign Affairs, International Law, and the New Federalism: Lessons from Coordination* (Emory Univ. Sch. of Law, Law & Econ. Working Paper Group, Paper No. 08-30, 2008), available at <http://ssrn.com/abstract=1272967> (follow “One-Click Download” hyperlink).

²⁶⁴ Benjamin K. Sovacool, *The Best of Both Worlds: Environmental Federalism and the Need for Federal Action on Renewable Energy and Climate Change*, 27 STAN. ENVTL. L.J. 397, 448 (2008). Of course, overlap of authority can occur under dual federalism if federal and state authorities independently regulate the same problem, and under cooperative federalism when the federal government employs (or more accurately, coerces) state governments to implement federal standards. By contrast, overlap of authority under Dynamic Federalism is neither accidental nor coerced. Adelman and Engel explain that cooperative federalism

model in which there is a “particular allocation of at least primary regulatory authority between the states and the federal government,” replacing it with one “in which multiple levels of government interact in the regulatory process.”²⁶⁵ As a result, Dynamic Federalism “reject[s] the traditional static optimization model for an adaptive one.”²⁶⁶ As Professors David Adelman and Kirsten Engle explain, in a Dynamic Federalism strategy,

neither federal nor state governments limit themselves to what many legal scholars have deemed to be their appropriate domains. The federal government continues to regulate local issues, such as remediation of contaminated industrial sites, which have few direct interstate connections and few benefits from federal uniformity. At the same time, state and local governments are not content to confine their attention to issues of local concern, but are developing policies on environmental issues of national or even international scale, such as global climate change. Nor do environmental issues “stay” in the control of any particular level of government, but rather tend to pass back and forth between them like the proverbial football.²⁶⁷

Proponents of Dynamic Federalism have primarily focused on its advantages of plurality, dialogue, redundancy, accountability, and economies of scale.²⁶⁸ The key point relating to the federalism question in climate change adaptation policy is the theory’s overlapping, flexible distribution of authority between federal, state, and local agencies. Namely, while it may appear inefficient to have several agencies at different scales working away on some mutual adaptation policy problem,²⁶⁹ the built-in redundancy of Dynamic Federalism can provide significant benefits. It gives the overall system of governance more rather than less policy space,²⁷⁰ which surely will be needed for climate change adaptation. Having multiple

fares somewhat better with the dynamic school. The overlapping authority, although asymmetric, at least has the trappings of a dynamic system. Cooperative federalism nonetheless falls short from the point of view of the dynamic school. The federal laws and regulations are often, but not always, so comprehensive as to exclude for all practical purposes alternative approaches by the states.

Adelman & Engel, *supra* note 263, at 1812–13. Still, many commentators express faith in the ability of traditional cooperative federalism governance to respond effectively to climate change. See, e.g., Holly Doremus & W. Michael Hanemann, *Of Babies and Bathwater: Why the Clean Air Act’s Cooperative Federalism Is Useful for Addressing Global Warming*, 50 ARIZ. L. REV. 799 (2008).

²⁶⁵ Engel, *supra* note 262, at 161.

²⁶⁶ Adelman & Engel, *supra* note 263, at 1798.

²⁶⁷ *Id.* at 1796.

²⁶⁸ See *id.* at 1808; Schapiro, *Toward Interactive Federalism*, *supra* note 263, at 292–93; Sovacool, *supra* note 264, at 448–51.

²⁶⁹ See Jacob E. Gersen, *Overlapping and Underlapping Jurisdiction in Administrative Law*, 2006 S. CT. REV. 201, 214.

²⁷⁰ See Adelman & Engel, *supra* note 263, at 1817–18.

agencies working on a problem within overlapping scales can also promote synergy between the agencies and the formation of informal networks.²⁷¹

These properties resonate with the emerging theory of Transgovernmental Networks.²⁷² Transgovernmental Network theory was forged initially in the context of international law, where nation states, while still the most important actors, have increasingly disaggregated into component institutions sharing roles with nonsovereign bodies.²⁷³ Transgovernmental Network theory emphasizes the nonhierarchical horizontal and vertical networks that are built among the *officials* of those national and international institutions to exchange information, identify best practices, harmonize approaches, and enforce the overall international policy program.²⁷⁴ The movement toward Dynamic Federalism and New Governance at domestic, federal and state scales portends the same conditions that are giving rise to such networks in international contexts.²⁷⁵

Thus far, however, few commentators have examined the federalism question in the context of climate change adaptation, much less explored how the New Governance, Dynamic Federalism, and Transgovernmental Networks models could be usefully employed in tandem to forge adaptation institutions and instruments.²⁷⁶ Several commentators deal with the topic

²⁷¹ See *id.* at 1809–10 (summarizing literature suggesting that overlapping authority can promote initiative at one governance scale and spark other scales to follow promising policy innovations).

²⁷² Transgovernmental Networks theory emphasizes the role of “networks of similarly-situated technocrats” who work in many different governance units, and “conceive[s] of lawmaking as an organic enterprise, harnessing the technical expertise of bureaucrats who do not possess heady titles but nonetheless intimately understand the practical exigencies of their particular issue areas.” Janet Koven Levit, *A Bottom-Up Approach to International Lawmaking: The Tale of Three Trade Finance Instruments*, 30 YALE J. INT’L L. 125, 182 (2005). The seminal and still most comprehensive discussion of Transgovernmental Network theory is found in ANNE-MARIE SLAUGHTER, *A NEW WORLD ORDER* (2004). For additional scholarship developing Transgovernmental Network principles, see Neil Craik & Joseph DiMento, *Environmental Cooperation in the (Partially) Disaggregated State: Lessons from the Security and Prosperity Partnership of North America*, 8 CHI. J. INT’L L. 479, 484–92 (2008); Patrick X. Delaney, *Transnational Corruption: Regulation Across Borders*, 47 VA. J. INT’L L. 413 (2007); Jenia Iontcheva Turner, *Transnational Networks and International Criminal Justice*, 105 MICH. L. REV. 985 (2007); Eleanor D. Kinney, *The Emerging Field of International Administrative Law: Its Content and Potential*, 54 ADMIN. L. REV. 415, 425–27 (2002); Kal Raustiala, *The Architecture of International Cooperation: Transgovernmental Networks and the Future of International Law*, 43 VA. J. INT’L L. 1 (2002); Anne-Marie Slaughter, *The Accountability of Government Networks*, 8 IND. J. GLOBAL LEGAL STUD. 347 (2001); Christopher Whytock, *A Rational Design Theory of Transgovernmentalism: The Case of E.U.-U.S. Merger Review Cooperation*, 23 B.U. INT’L L.J. 1 (2005).

²⁷³ See SLAUGHTER, *supra* note 272, at 18, 22–23.

²⁷⁴ See *id.* at 19–22.

²⁷⁵ See Freeman & Farber, *supra* note 146, at 899 (“It is intriguing to see the supposedly hierarchical world of domestic regulation evolving in a direction reminiscent of modern international relations.”).

²⁷⁶ Grouping climate change mitigation with other large-scale massive problems, Jim Salzman and I have argued that the convergence of New Governance, Dynamic Federalism, and Transgovernmental Networks models fits well with the needs of mitigation policy. See Ruhl & Salzman, *supra* note 245 (manuscript at 8–9). We use coastal hypoxia as the primary example, however, and do not delve significantly into climate change adaptation. *Id.* (manuscript at

tangentially, their focus being mitigation,²⁷⁷ but only Professor Daniel Farber has offered a focused, albeit preliminary, examination of the federalism question devoted primarily to adaptation.²⁷⁸ Farber identifies two key issues—financing adaptation²⁷⁹ and the constitutional limits of federal authority²⁸⁰—while acknowledging much remains on the table for consideration. I share his conclusion that “all levels of government will be called upon to play a role in dealing with the impacts of climate change.”²⁸¹ How they are configured and coordinated is the looming question for environmental law.

J. Trend Ten: Conciliation

Environmental law is not omnipotent, though one would not gather so from the rhetoric of environmental law on climate change mitigation policy. To be sure, if our nation commits to significant reductions of greenhouse gas emissions, we are unlikely to meet that goal without implementing substantial controls on major emission sources as well as more intensive regulation of smaller sources and individuals, such as controls on buildings for energy efficiency, automobiles for emissions, and farms for land-use and livestock practices. That alone will demand a major deployment of legal resources extending well beyond environmental law. But some strident proponents of emissions regulation have described their agenda as far broader and deeper in scope and intensity. As they put it, “we must launch a thousand arrows immediately,”²⁸² and the arrows they have in mind are lawsuits under existing federal environmental laws such as the ESA, CWA, and NEPA.

46–49); see also Markell, *supra* note 35 (manuscript at 16) (using New Governance theory to explore climate change mitigation).

²⁷⁷ See, e.g., Glicksman, *supra* note 26, at 872–74 (exploring multiagency coordination for ecological management); Richard J. Lazarus, *Super Wicked Problems and Climate Change: Restraining the Present to Liberate the Future*, 94 CORNELL L. REV. 1153, 1156 (2009) (mentioning adaptation in connection with federal-state relations in climate change policy); Bradford C. Mank, *Protecting the Environment for Future Generations: A Proposal for a “Republican” Superagency*, 5 N.Y.U. ENVTL. L.J. 444 (1996) (suggesting the role of a federal “Superagency” for, among other things, climate change adaptation); Carol M. Rose, *Federalism and Climate Change: The Role of States in a Future Federal Regime—An Introduction*, 50 ARIZ. L. REV. 673 (2008) (recognizing the role of state and local governments in adaptation policy); Jared Snyder & Jonathan Binder, *The Changing Climate of Cooperative Federalism: The Dynamic Role of the States in a National Strategy to Combat Climate Change*, 27 UCLA J. ENVTL. L. & POL’Y 231 (2009) (containing scattered references to adaptation as a state and local concern).

²⁷⁸ See Farber, *supra* note 24.

²⁷⁹ See *id.* at 13–19.

²⁸⁰ See *id.* at 19–32.

²⁸¹ *Id.* at 33.

²⁸² Anna T. Moritz et al., *Biodiversity Baking and Boiling: Endangered Species Act Turning Down the Heat*, 44 TULSA L. REV. 205, 230 (2008).

I have contested this strategy as being legally, practically, and politically ill-advised.²⁸³ The ESA, for example, is not structured to provide effective greenhouse gas emissions control. Applying it would require isolating and linking emissions from, say, a power plant in Florida to effects on a distant climate-threatened species—a feat beyond scientific capacity.²⁸⁴ Saying that climate change globally threatens a species does not establish causal blame on any particular source of emissions; just the opposite, it lays blame on all sources. Using the ESA to sort through that quagmire, in addition to being legally untenable and beyond the capacity of the agencies that implement the statute, would in all likelihood make the statute more of a lightning rod for controversy than it already is.²⁸⁵

My fear is that the “thousand arrows” strategy will creep into environmental law’s approach to climate change adaptation as well. If the nation commits to greenhouse gas emission reductions, people, businesses, and governments will expect some regulation. If the nation commits to adaptation—and there seems little choice but to do so aggressively—people, businesses, and governments will expect *adaptation*. Climate change adaptation thus presents an opportunity for environmental law to break free from its culture of litigation and contestation and build back what that culture has eroded most—trust.²⁸⁶ Trust generally does not come about through threats to sue.

I am not suggesting that environmental law roll over to every seawall and water diversion project proposed in the name of adaptation. But environmental law has a choice to make and the luxury of making it early in

²⁸³ See J.B. Ruhl, *Climbing Mount Mitigation: A Proposal for Legislative Suspension of Climate Change “Mitigation Litigation,”* 1 WASH. & LEE J. ENERGY, CLIMATE & ENV’T (forthcoming 2010) (on file with author).

²⁸⁴ See Memorandum from Mark D. Myers, Dir., U.S. Geological Survey, to Dir., U.S. Fish & Wildlife Serv., and Solicitor, U.S. Dep’t of the Interior 1 (May 14, 2008), available at http://www.usgs.gov/global_change/docs/director_memo_14may08.pdf.

²⁸⁵ I provide a detailed discussion of what I believe is the poor fit between the Endangered Species Act (ESA) and greenhouse gas emission reduction policy in Ruhl, *supra* note 26, at 39–49. See also ROBERT MELTZ, CONG. RESEARCH SERV., USE OF THE POLAR BEAR LISTING TO FORCE REDUCTION OF GREENHOUSE GAS EMISSIONS: THE LEGAL ARGUMENTS 3–5 (2008) (laying out the legal basis for both positions); Matthew Gerhart, *Climate Change and the Endangered Species Act: The Difficulty of Proving Causation*, 36 ECOLOGY L.Q. 167, 171–82 (2009) (detailing the causation obstacles to using the ESA to regulate greenhouse gas emissions); John Kostyack & Dan Rohlf, *Conserving Biodiversity in an Era of Global Warming: An Environmental Community Perspective*, in ENDANGERED SPECIES ACT: LAW, POLICY, AND PERSPECTIVES 374, 388 (Donald C. Bauer & Wm. Robert Irvin eds., 2d ed. 2010) (concluding “such a use of the ESA has a number of inherent flaws” and “the Act simply cannot serve as a driver of GHG emissions reductions”). But see Ari N. Sommer, *Taking the Pit Bull off the Leash: Siccing the Endangered Species Act on Climate Change*, 36 B.C. ENVTL. AFF. L. REV. 273, 303–04, 307–08 (2009) (arguing that there is no significant obstacle to proving causation in a claim that greenhouse gas emissions cause injury to species in violation of the ESA).

²⁸⁶ See Bruch, *supra* note 240, at 35 (noting in an outline of key issues in “[t]he transition to adaptation” that “[i]t is first necessary to build trust”). For a general exposition on the lack of trust between the interests working in environmental policy, see Douglas A. Kysar & James Salzman, *Environmental Tribalism*, 87 MINN. L. REV. 1099 (2003) (exploring the contested nature of environmental law and policy).

the formulation of climate change adaptation policy—is it going to be about conflict or conciliation?

The other trends I have predicted suggest that it should be about conciliation. Fighting in court to hold on to preservationism defies the biological reality of climate change, whereas using environmental law to facilitate transitional strategies for species and ecosystems holds much promise (Trend One). Following the path of the common law to secure critical natural capital resources through regulation solidifies property rights rather than challenges them (Trend Two). Working with land-use and water law rather than standing alone will put environmental law at the core of adaptation policy rather than on the sidelines (Trend Three). Acknowledging the need to respond to climate justice and catastrophe risk management concerns, the necessary measures for which may not always be environmentally benign, will provide environmental law the chance to influence how these concerns are satisfied (Trends Four and Five). Participating in, rather than against, the complex policy mix that will form around adaptation keeps environmental concerns within the dialogue, not an afterthought (Trend Six). And recalibrating how environmental law uses instruments and institutions to fulfill its objectives will allow it to keep pace with the demand for an adaptive adaptation policy (Trends Seven through Nine). Conflict may be called for at times along the way to fulfilling these trends, but conciliation—the essence of which is overcoming distrust and hostility—must be environmental law's core norm for participating in climate change adaptation policy.

I fully expect some of the “thousand arrows” crowd to be repulsed by the theme of conciliation. Many of the battles environmental law has fought it had to fight just to get a toehold on development and infrastructure policy,²⁸⁷ and it is not easy to forget the wounds suffered. But climate change adaptation is not business as usual. It is no exaggeration to think that “[i]f society is faced with massive climate impacts . . . adaptation will become one of society's highest priorities.”²⁸⁸ Environmental law must treat it as such.

IV. CONCLUSION

Climate change adaptation is profoundly about the environment, but it is not profoundly about environmental law. Indeed, environmental law has a debt to repay to the nation's adaptation deficit. After more than a decade of demanding the nation's myopic and relentless attention to formulating mitigation policy as a supercharged form of pollution control law, environmental law has discovered adaptation. Yet, while environmental law now recognizes mitigation and adaptation as being joined at the hip, adaptation policy dialogue has thus far not allowed environmental law to

²⁸⁷ Cf. Cary Coglianese & Jocelyn D'Ambrosio, *Policymaking Under Pressure: The Perils of Incremental Responses to Climate Change*, 40 CONN. L. REV. 1411 (2008) (describing the prevalence of incremental environmental policymaking and the inherent problems it presents, particularly in the climate change context).

²⁸⁸ Farber, *supra* note 24, at 33.

stake adaptation as its domain. Rather, environmental law will have to earn its position in the multipolicy mix that will coalesce around the tremendously complex demands of climate change adaptation.

This take on climate change adaptation and environmental law may disappoint or offend those who view environmental law as a mighty weapon in the war against climate change. Recently, for example, the Environmental Law Institute asked a group of environmental law experts what environmental law will look like forty years from now.²⁸⁹ Some of the prognostications were quite optimistic. One respondent surmised, for example, that “[t]he field of environmental protection will have grown in importance and stature,”²⁹⁰ and another predicted that “[c]arbon sequestration will prove to be a success.”²⁹¹ One respondent believes “[i]n 2049, the practice of environmental law will be on the wane,” but only because “[t]he nation’s most pressing environmental challenges will have taken a dramatic turn for the better following bold actions in Congress, corporate board rooms, and communities across the country.”²⁹² Similarly, another respondent predicts that “[b]y the midpoint of the 21st century, government-driven environmental regulation will be on a path of increasing irrelevance,” but that will be so only because of the rise of “nongovernmental consensus standards driven by consumer demand and a robust and active market for pollutants and carbon.”²⁹³

I am not so sanguine. Certainly these predictions cannot be justified as mere extrapolations of current politics and social norms. I would be delighted to be proven wrong (and live to see it), thus making this Article all for naught. But I don’t see that in the cards. Rather, I have to agree with other respondents in conceiving the very real possibility that in 2049 mitigation policy will have come out of the box a watered-down weakling,²⁹⁴ that “environmental law will be a law of coping with crisis and urgent remediation,”²⁹⁵ and that we will be focused on “adaptation to a changing climate, evaluating geoengineering options, and addressing disputes over competition for increasingly scarce resources.”²⁹⁶

In that scenario, the more likely scenario, my prediction is that environmental law will have trifurcated into three distinct branches. One

²⁸⁹ See *In the Year 2049: What Will Environmental Protection Be Like 40 Years from Now?*, ENVTL. F., Nov.–Dec. 2009, at 46.

²⁹⁰ John C. Cruden, *Ten Reasons for Environmental Optimism*, ENVTL. F., Nov.–Dec. 2009, at 48, 48.

²⁹¹ Lee A. DeHihns, III, *Looking at the Percentages of Possibility*, ENVTL. F., Nov.–Dec. 2009, at 48, 48.

²⁹² Paul E. Hagen, *The End of the Environmental Profession*, ENVTL. F., Nov.–Dec. 2009, at 49, 49.

²⁹³ Sara Kendall, *The CFR Will Still Exist, but Markets Will Rule the Day*, ENVTL. F., Nov.–Dec. 2009, at 50, 50.

²⁹⁴ See Michael B. Gerrard, *Environmental Law in 2049: A Look Back*, ENVTL. F., Nov.–Dec. 2009, at 49, 49.

²⁹⁵ James Gustave Speth, *On One Hand, Danger, On the Other, Security*, ENVTL. F., Nov.–Dec. 2009, at 51, 51.

²⁹⁶ Michael P. Vandenberg, *Two Scenarios Offer Contrasting Futures for Field*, ENVTL. F., Nov.–Dec. 2009, at 51, 51.

will retain the conventional focus on pollution control and ecological conservation, but narrowed in the sense that it will have lost dominion over anything having to do with climate change. There will be some environmental issues, however, that go untouched by climate change, such as the level of toxins in groundwater and the regulation of mercury emissions from industrial sources. Environmental law will retain its vitality and relevance for those purposes. The other two branches will deal with climate change mitigation and adaptation, respectively. They are more likely, however, to be identified as the environmental components of mitigation and adaptation law rather than discrete bodies of environmental law.²⁹⁷ Whatever they are called, however, the environmental interests will share a very large table with a multitude of policy realms, and likely will not be seated at its head.

So I do not see climate change adaptation as necessarily a growth industry for environmental law, one that strengthens its force and expands its scope to match the massive problem the demands of adaptation will present. Rather, if the ten trends I have identified come true, the capacity of environmental law will be seriously tested, and it seems likely what we think of as environmental law will be dramatically transformed and likely constrained in its reach. Ironically, with the growth of climate change mitigation and adaptation legal regimes, both of which will form as amalgams primarily of economic and social policy goals and tradeoffs, it is likely that what lawyers think of fitting under the umbrella of “environmental law” in 50 or 100 years will be close to what environmental law was 40 years ago—mainly a narrow, technical realm of pollution control measures complemented by focused conservation programs. The story of environmental law in the century of climate change adaptation may be about a journey back to the future.

²⁹⁷ *Accord Bruch*, *supra* note 240, at 35 (outlining the key elements of “adaptation law”); John C. Dernbach & Seema Kakade, *Climate Change Law: An Introduction*, 29 ENERGY L.J. 1, 2 (2008) (describing the emergence of “climate change law” as “the intersection of several areas of law, including environmental law, energy law, business law, and international law”); Jacqueline Peel, *Climate Change Law: The Emergence of a New Legal Discipline*, 32 MELB. U. L. REV. 922, 924 (2008) (arguing that climate change law must be developed with an awareness of “the diverse disciplines (such as science, economics, and social science) that underpin conceptions of the climate change challenge”).
