ARTICLE

CLIMATE CHANGE AND BACKLASH

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INTRODUCTION

It is no understatement to say that climate change is *the* issue in environmental law in the United States and indeed the world today. It has been many years since a major environmental statute passed Congress[1]—but there is little doubt that some sort of climate change regulation bill will pass Congress in the foreseeable future.[2] There are ongoing global negotiations about a successor treaty to the current Kyoto protocol, which currently addresses climate change and greenhouse gas emissions.[3] In the European Union, there is now a functioning carbon trading market, developed as part of an EU-level regulatory program aimed at reducing the rate of increase in greenhouse gas emissions.[4]

This level of attention to climate change is fully warranted.

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[1] *See* Carol A. Casazza Herman et al., *Breaking the Logjam: Environmental Reform for the New Congress and Administration*, 17 N.Y.U. ENVTL. L.J. 1–2 (2008); Jonathan B. Wiener, *Radiative Forcing: Climate Policy to Break the Logjam in Environmental Law*, 17 N.Y.U. ENVTL. L.J. 210, 211–12 (2008).

[2] *See* Wiener, *supra* note 1, at 213; Victor B. Flatt, *Federal Climate Change Legislation: The Perspective from 2008*, 3 ENVTL. & ENERGY L. & POL'Y J. 195, 197–98 (2008) (noting features of current federal legislative proposals).

[3] *See* Wiener, *supra* note 1, at 213; Dot Earth Blog, Move Over Kyoto—Here Comes a 'Copenhagen Protocol,' http://dotearth.blogs.nytimes.com/2007/12/15/move-over-kyoto-here-comes-a-copenhagen-protocol/ (Dec. 15, 2007, 08:56 EST).

[4] European Union, *Emissions Trading System*, http://ec.europa.eu/environment/climat/emission/index_en.htm (last visited May 23, 2009).

There is now little doubt that our planet is getting warmer,[5] that the warming is primarily due to human emissions of carbon dioxide and other greenhouse gases,[6] and that warming will have serious and irreversible impacts on human and natural systems at a planetary scale.[7] Killer heat waves in Europe and elsewhere have been attributed to climate change.[8] Predictions of the nature and scale of the impacts from climate change are still quite uncertain, although there is a growing consensus that those impacts will be primarily negative,[9] will disproportionately affect the poorest human communities,[10] and likely will be devastating to the natural ecosystems humans ultimately depend on for survival.[11]

There is much more uncertainty about what, if anything, governments and societies should do to address climate change. Debates rage about the relative merits of adapting to the inevitable impacts of climate change versus attempting to mitigate and reduce the future impacts of climate change through reducing greenhouse gas emissions.[12] Other proposals are riskier, including efforts to use massive geo-engineering projects to manage the global climate and offset the impacts of greenhouse gases.[13]

One theme throughout these debates has been how difficult it will be to organize any effective, coordinated response to climate change.[14] The global nature of climate change increases the need for an international response to climate change. But, of course, the sovereign nature of the nation-state in modern international law

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[5] INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: SYNTHESIS REPORT 30–33 (2007) [hereinafter IPCC SYNTHESIS REPORT].

[6] *Id.* at 36–41.

[7] *Id.* at 45–54.

[8] *See* Myles Allen et al., *Scientific Challenges in the Attribution of Harm to Human Influence on Climate*, 155 U. PA. L. REV. 1353, 1389–94 (2007).

[9] IPCC SYNTHESIS REPORT, *supra* note 5, at 45–54.

[10] *See, e.g.*, Ruth Gordon, *Climate Change and the Poorest Nations: Further Reflections on Global Inequality*, 78 U. COLO. L. REV. 1559 (2007).

[11] IPCC SYNTHESIS REPORT, *supra* note 5, at 48, 50, 52.

[12] *See, e.g.*, Cass R. Sunstein, *The World vs. the United States and China? The Complex Climate Change Incentives of the Leading Greenhouse Gas Emitters*, 55 UCLA L. REV. 1675, 1676 & n.2 (2008) (noting the debate over whether to implement modest or aggressive carbon taxes).

[13] *See infra* notes 175–192.

[14] *See, e.g.*, Paul G. Harris, *Collective Action on Climate Change: The Logic of Regime Failure*, 47 NAT. RESOURCES J. 195, 214–15, 218–19 (2007) (noting that climate change presents a challenge much greater than that faced by the successful efforts to address ozone depletion, and providing a long list of obstacles to efforts to address the problem).

makes coordinated policy responses at the global level very challenging.[15] The fact that some countries—generally rich ones—are disproportionately responsible for past and current emissions, while other countries—generally poor ones—will be disproportionately responsible for future emissions, makes the development of a response even more challenging.[16] Poor developing countries argue that it is unfair to constrain their emissions without compensation, when they have not been the ones who benefitted from past emissions of greenhouse gases.[17] The tremendous uncertainty about the precise impacts of climate change only adds to the difficulty, as it complicates the understanding of how rapid and drastic our response must be and who will be the beneficiaries from any responses.[18]

My purpose in this paper is not to disagree with any of these assessments about the challenges that developing climate change policy will pose. Instead, it is (unfortunately) to add another challenge to that daunting list: the nature of climate change as a delayed harm. The full impact of all greenhouse gas emissions to this point in time has not been felt; instead, it will take decades or even centuries for that impact on the global climate system to be completely realized. This paper argues that this dynamic will make crafting climate change policy even more difficult.

Delayed harm is not a new concept in environmental law and related fields, such as torts. While scholars, courts, and legislatures have wrestled with its implications in a variety of ways, previous analyses have failed to identify one of the most significant problems for delayed harm regulations—the possibility

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[15] *Id.* at 212 (noting that collective action theory predicts the failure of the international community to develop a solution to climate change).

[16] *See, e.g.*, Sunstein, *supra* note 12, at 1688–90 (noting the challenges that equity arguments pose to developing an agreement); Gordon, *supra* note 10, at 1600–04 (noting the challenge of attempting to get developing and developed countries to reach agreement, in part because of the equity concerns); Kevin A. Baumert, Note, *Participation of Developing Countries in the International Climate Change Regime: Lessons for the Future*, 38 GEO. WASH. INT'L L. REV. 365, 365–67 (2006) (same).

[17] *See, e.g.*, Sunstein, *supra* note 12, at 1689; Henry Shue, *The Unavoidability of Justice*, *in* THE INTERNATIONAL POLITICS OF THE ENVIRONMENT 373 (Andrew Hurrell & Benedict Kingsbury eds., Clarendon Press 1992); Harris, *supra* note 14, at 212–13 (developing countries demanding side payments for participation in climate change regulation because of the historic patterns of emissions).

[18] *See, e.g.*, Baumert, *supra* note 16, at 369; Harris, *supra* note 14, at 211–12.

of a "backlash" against such regulations. That risk is very real in the context of climate change regulation, where it seems inevitable that there will continue to be serious negative impacts from climate change for the foreseeable future, even if draconian regulatory restrictions on greenhouse gas emissions are imposed.

Addressing the risk of backlash in the context of climate change policy, we can draw on our prior experiences with other delayed harms. Those lessons are unsettling—they indicate that even if we are able to overcome all of the challenges that exist to creating a policy structure to address climate change, it may be very difficult for us to maintain that policy structure over the long run precisely because climate change is a delayed harm. The upshot is that it may be necessary for us to take even riskier options to try and address climate change—such as research and investment into geo-engineering and carbon capture solutions—if we want to have a politically sustainable climate policy over the long run.

I begin by outlining the nature of delayed harms in environmental law, and show how climate change (and a number of other environmental policy areas that I will draw on in the paper) is an example of a delayed harm. I also briefly discuss why regulation—as opposed to liability solutions[19]—appears to be the solution that will be used in the context of national or global climate change regulation.

I then turn to developing 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. I demonstrate how backlash is a real phenomenon through the example of the implementation of the Endangered Species Act in the United States. I conclude by noting

[19] By liability solution, I mean a legal cause of action wherein an individual who is harmed by the actions of another can sue and is compensated in monetary damages for his or her harm.

that the risk of backlash appears to be high in the context of climate change regulation, but that the main debates about how to set up those regulatory systems have not addressed this problem at all.

I then explore ways in which policymakers might reduce the risk of backlash. Those tools include both efforts to "lock-in" the regulatory standards so that they are less vulnerable to repeal or rollback, and efforts to reduce the gap between the initiation of regulation and the improvement in environmental conditions. Those latter efforts involve policy tools that directly address the harm caused by human activities—restoration. I note the limits of restoration—limits of cost, time, and human knowledge. In the context of climate change, the time and costs of restoration efforts to adapt or even undo climate change may be enormous, if they are even technologically possible.

I conclude by trying to raise some notes of optimism: If we are aware of the problem of delayed harm, and the challenges it might pose to climate change policy, we can at least try to minimize those challenges. In particular, I believe that the delayed nature of climate change will necessarily require us to further explore four possible solutions. First, we may want to build support for climate change regulation, and decrease the risk of backlash, through regulatory policies that encourage the development of industries that benefit from climate change regulation. These industries can provide a counterweight to the economic interests that might push for repeal or retrenchment of regulations. Second, we need to consider adaptation—or efforts to ameliorate the effects of climate change on human and natural systems—as a partner to the climate policy strategy of reducing carbon emissions. Adaptation may be necessary to make emissions reductions (or as they are called in the climate policy literature, "mitigation") politically sustainable. Third, we may need to explore a wider range of research and development for technological and other options to "undo" the harm of greenhouse gas emissions, whether it is by directly removing greenhouse gases from the atmosphere, or by attempting to offset the impacts of those gases on the planetary climate system. Finally, we will need to consider how we measure and frame the harm of climate change —different kinds of metrics may allow us to reduce the risk of backlash in the future.

I. WHY CLIMATE CHANGE IS A DELAYED HARM PROBLEM WITH A DIFFICULT REGULATORY SOLUTION

The beginning of my analysis requires establishing a couple of simple points—first, describing what a delayed harm problem is, and showing that climate change is an example of it; and second, noting that regulation is the solution that policymakers likely will turn to in order to address climate change. After I establish this basic foundation, I will turn to examining the dynamics of backlash.

A. *Why Climate Change Is a Delayed Harm Problem*

I define "delayed harm" as an extended time delay between a human activity and the harm caused by that human activity.[20] While elements of delayed harm likely can be identified in almost every type of issue currently identified as "environmental," I begin with climate change, and also briefly discuss a few other examples that I will draw on throughout the paper.

Changes in the global climate are caused by human activity that results in the emission of greenhouse gasses into the atmosphere, most importantly carbon dioxide. However, the impact of the emission of a carbon dioxide molecule on the global climate is not an immediate one—instead, it takes years for the impacts to be fully felt. In particular, the increased global average temperature that is the most prominent aspect of climate change will take decades to be completely expressed.[21] The primary

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[20] Delayed harm has been identified by at least one scholar as one of the key characteristics of environmental problems. *See* Robert L. Rabin, *Environmental Liability and the Tort System*, 24 HOUS. L. REV. 27, 29–33 (1987). It has also been identified as one reason why environmental problems can prove so intractable. *See* J.B. Ruhl & James Salzman, Massive Problems in the Administrative State: Strategies for Whittling Away 25–27 (Mar. 26, 2009) (manuscript on file with author).

[21] *See* G.A. Meehl et al., *Global Climate Projections*, *in* CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS: CONTRIBUTION OF WORKING GROUP I TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 747, 822–831 (S. Solomon et al. eds., 2007) [hereinafter IPCC Climate Projections]. For the primary scientific literature on the topic see Pierre Friedlingstein & Susan Solomon, *Contributions of Past and Present Human Generations to Committed Warming Caused by Carbon Dioxide*, 102 PROC. NAT'L ACAD. SCI., U.S. 10832, 10835 (2005) ("[I]f emissions were set to zero by 2000, temperature would still keep increasing by another several tenths of a degree Celsius for another [approximately] 30 years" and "the current human generation is already committed to greater CO2-induced warming in decades to

reason is the "thermal inertia" of the oceans and ice caps—because water has a high heat capacity, it takes a significant amount of time for warming in the atmosphere to translate into warming of the liquid and solid water systems of the planet.[22] The result will not just be delayed warming for the planet as a whole, but also a delayed (though inevitable) rise in sea level as the oceans of the planet warm and expand, probably over a time frame of centuries.[23] Scientists characterize this phenomenon as "warming commitment" or "climate change commitment."[24] Of course, continued warming for the planet as a whole will mean the

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come than that observed today."); Richard T. Wetherald et al., *Committed Warming and Its Implications for Climate Change*, 28 GEOPHYSICAL RES. LETTERS 1535, 1537 (2001) (global temperature will continue to rise for approximately 20 years and 1 degree Celsius even if emission levels are stabilized); Gerald A. Meehl et al., *How Much More Global Warming and Sea Level Rise?*, 307 SCI. 1769, 1769 (2005) (predicting that "even if the concentrations of greenhouse gases in the atmosphere had been stabilized in the year 2000, we are already committed to further global warming of about another half degree and an additional 320 percent sea level rise caused by thermal expansion").

[22] *See* IPCC Climate Projections, *supra* note 21, at 822 (commitment of global climate system to warming is "mainly due to the thermal inertia of the oceans"). A related issue is the difficulty which policymakers face in trying to reduce atmospheric concentrations of greenhouse gasses. The problem here is that once emitted, a molecule of a greenhouse gas may spend an extended period of time in the atmosphere, continuing to cause change in the global climate system. *Id.* at 824 (noting that most greenhouse gases have atmospheric lifetimes over 100 years). As a result, even if emissions are substantially reduced, atmospheric levels of gasses such as carbon dioxide will continue to rise for an extended period of time. And even if emissions are eliminated, it may take decades or centuries for the carbon dioxide to be removed from the atmosphere (through natural activities such as photosynthesis). *See* Susan Solomon, et al., *Irreversible Climate Change Due to Carbon Dioxide Emissions*, 106 PROC. NAT'L ACAD. SCI., U.S. 1704, 1704–05 (2009) (carbon dioxide levels will continue at high levels for about 1000 years even if emissions are ended); Friedlingstein & Solomon, *supra* note 21, at 10832 (The level of future increases in global temperature, regardless of current emissions, depends "not only on the climate-system response time but also on the atmospheric lifetime of the radiative forcing agent in question."). Carbon dioxide is, in other words, a very persistent pollutant or harm, which creates additional challenges for efforts to resolve climate change.

[23] *See* IPCC Climate Projections, *supra* note 21, at 822–31 (listing potential impacts of warming commitment on sea level, ice caps, and other climate systems); T.M.L. Wigley, *The Climate Change Commitment*, 307 SCI. 1766, 1769 (2005) (noting that warming commitment will likely mean a "continued rise of [sea level of] about 10 cm/century for many centuries"); Meehl et al., *supra* note 21, at 1769.

[24] *See* IPCC Climate Projections, *supra* note 21, at 822; Wigley, *supra* note 23, at 1766.

continuation of additional negative impacts on human and natural systems.

Other examples of delayed harm exist throughout environmental law. For instance, there are the long-term health risks posed by a range of chemicals that people might be exposed to in the course of work, medical treatment, or while at home. Chemicals such tobacco, asbestos, and DES have all been linked to long-term health problems, sometimes with very small levels of exposure.[25] The latency periods for the health problems from these and similar chemicals can be measured in decades, and in the case of some chemicals such as DES, can be multi-generational.[26]

Another example also closely connected with human health concerns is the disposal of hazardous waste. Many hazardous chemicals remain highly toxic or dangerous for extended periods, and therefore require long monitoring periods and careful containment to ensure that they do not escape disposal sites and contaminate the broader environment.[27] Unfortunately, throughout much of the twentieth century, these kinds of precautions were rarely taken when hazardous chemicals were legally disposed of at approved sites, let alone illegally at unapproved sites.[28] As a

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[25] *See* Donald G. Gifford, *The Peculiar Challenges Posed by Latent Diseases Resulting from Mass Products*, 64 MD. L. REV. 613, 620–27 (2005) (noting litigation based on allegations of latent harms from a wide range of chemicals and products, including tobacco, asbestos, Agent Orange, lead paint, and DES).

[26] In the case of DES, daughters of mothers who took the drug while pregnant have faced increased risks of cancer and have had reproductive complications as a result of exposure in the womb. *See* Edward J. Schoen et al., *An Examination of the Legal and Ethical Public Policy Consideration Underlying DES Market Share Liability*, 24 J. BUS. ETHICS 141, 142 (2000). In the case of asbestos, individuals with long-term exposure often developed asbestosis soon after exposure but also faced an increased risk of cancer decades later. *See* Charles T. Greene, *Determining Liability in Asbestos Cases: The Battle to Assign Liability Decades After Exposure*, 31 AM. J. TRIAL ADVOC. 571, 572 (2008). Carcinogens frequently involve significant latency periods between exposure and the onset of cancer. *See generally* Michael Gaffney & Bernard Altshuler, *Public Health Implications of Carcinogenic Exposure Under the Multistate Model*, 124 AM. J. EPIDEMIOLOGY 1021 (1986).

[27] *See* DONALD W. STEVER, LAW OF CHEMICAL REGULATION AND HAZARDOUS WASTE §§ 5:90-91, 5:163-72, 7:40-41 (2007) (discussing Resource Conservation and Recovery Act regulations for protecting groundwater from accidental leakage from treatment, storage and disposal facilities and underground storage tanks and Safe Drinking Water Act regulations for deep well injection of hazardous wastes).

[28] The prototypical example of mismanagement of hazardous waste occurred at Love Canal, near Niagara Falls, New York. Between 1942 and 1954, Hooker

result, waste at these sites often leached from containers and gradually escaped through soil levels into groundwater aquifers. Over time, the result was the slow but steady contamination of a significant number of groundwater drinking sources in the United States.[29] However, discovery of the contamination would often not occur until decades after the waste had been disposed of, and usually long after the waste site itself had been closed or abandoned.[30]

Human impacts on endangered species and ecosystems also involve delayed harms—in particular, habitat destruction. Some individual animals may be killed when a particular piece of habitat is destroyed (for instance, nesting birds whose tree is cut down in the course of deforestation). Many animals may be able to flee the immediate impacts of habitat destruction, only to be left without adequate locations to shelter, feed, or reproduce in the future.[31] Other forms of habitat destruction are less obvious, and more insidious: human alteration of habitat might prevent reproduction of the species, but allow mature members to survive.[32] Habitat

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Chemical Corporation dumped pesticides and other chemical waste in an unlined, abandoned canal. Eventually, the dump was closed and covered and a residential neighborhood and school was built atop the site. *See* United States v. Hooker Chem. & Plastics Corp., 850 F. Supp. 993, 998 (W.D.N.Y. 1994). The public outrage when the waste was discovered and linked to significant health problems resulted in the passage of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980.

[29] Groundwater contamination has been detected in all fifty states, though the precise number of contaminated aquifers is unknown. Estimates in the 1980s placed the number between 1–2 percent of all usable aquifers. *See* Ruth Patrick, *What Should be Done to Mitigate Groundwater Contamination?*, 86 ENVTL. HEALTH PERSP. 239, 239 (1990).

[30] *See e.g.*, *Hooker Chem. & Plastics Corp.*, 850 F. Supp. at 998 (contamination discovered approximately twenty years after cessation of dumping); Interfaith Cmty. Org. v. Honeywell Int'l, Inc., 399 F.3d 248, 252 (3d Cir. 2005) (dumping of hazardous waste between 1895 and 1954 was not discovered until 1982, after the site had been closed); Raymond K. Hoxsie Real Estate Trust v. Exxon Educ. Found., 81 F. Supp. 2d 359, 361 (D.R.I. 2000) (groundwater contamination discovered in 1995, ten years after defendants had closed the site and purportedly removed all underground storage tanks).

[31] Plants and sessile animals (such as mussels) will of course be directly killed by habitat destruction.

[32] Examples here would include the flooding of habitat for freshwater mussels that allows adults to survive, but eliminates their ability to reproduce, *see* Eric Biber, *The Application of the Endangered Species Act to the Protection of Freshwater Mussels: A Case Study*, 32 ENVTL. L. 91, 101 (2002), and changes to patterns of fires in natural ecosystems that (either through the increase in fire or its decrease) prevent reproduction of tree species. *See* LENARD F. DEBANO ET

destruction might fragment the remaining habitat into scattered refuges, impairing travel between refuges, causing gradual destruction of species over time as individual populations in each refuge disappear due to disturbances, disease, or other chance events.[33] Thus, even if habitat destruction occurs only a single time to a finite degree, there may be an extended period during which species continue to decline as a result. Conservation biologists have termed this phenomenon "extinction debt."[34]

B. *Why Climate Change Likely Will Be Addressed Through Regulation*

As noted above, there is tremendous political activity focused on developing policy solutions to climate change. One option commonly pursued in environmental law is regulation. But as some legal scholars note,[35] tort law provides another major tool to address human activities that cause environmental harm: liability. In the context of climate change, commentators have divided sharply over whether liability solutions might be feasible, with the debate covering a wide range of issues.[36] The delayed harm nature of climate change is one of those reasons, because it makes it very difficult to draw causal connections between the activity and the

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AL., FIRE'S EFFECTS ON ECOSYSTEMS 197–99 (1998) (discussing reproductive adaptations of certain tree species to frequent fire, including serotiny (cones that open during fires to release seeds) and fire-stimulated germination of trees).

[33] This example is part of the metapopulation concept in conservation biology and ecology, which focuses on the importance of interaction among multiple populations in understanding the survival of a species. *See* FRED VAN DYKE, CONSERVATION BIOLOGY: FOUNDATIONS, CONCEPTS, APPLICATIONS 218 (2d ed. 2008).

[34] The seminal piece in the scientific literature is David Tilman et al., *Habitat Destruction and the Extinction Debt*, 371 NATURE 65 (1994). *See also* Guy Cowlishaw, *Predicting the Pattern of Decline of African Primate Diversity: An Extinction Debt from Historical Deforestation*, 13 CONSERVATION BIOLOGY 1183 (1999); Michael A. McCarthy et al., *Extinction Debts and Risks Faced by Abundant Species*, 11 CONSERVATION BIOLOGY 221 (1997); Craig Loehle & Bai-Lian Li, *Habitat Destruction and the Extinction Debt Revisited*, 6 ECOLOGICAL APPLICATIONS 784 (1996); Thomas Brooks & Andrew Balmford, *Atlantic Forest Extinctions*, 380 NATURE 115 (1996); Thomas M. Brooks et al., *Deforestation Predicts the Number of Threatened Birds in Insular South Asia*, 11 CONSERVATION BIOLOGY 382 (1997).

[35] "Free-market environmentalists" regularly argue that tort law should be more heavily relied upon to manage environmental problems. *See, e.g.*, Terry L. Anderson, *Enviro-Capitalism vs. Enviro-Socialism*, 4 KAN. J.L. & PUB. POL'Y 35, 38 (1995).

[36] *See infra* notes 42–45 and accompanying text.

harm.[37]

Causation can be challenging at a number of levels for delayed harms. Because of the delay between the activity and the harm, it may be difficult to establish as a theoretical point whether the activity in general causes the harm.[38] Delays of years or decades will make anecdotal evidence difficult to develop and more systematic evidence (such as epidemiological or laboratory studies) will either be impractical or confounded by a wide range of alternative causes.[39] Even if the general human activity that causes the delayed harm can be identified, there is the additional challenge of determining whether a specific action by particular individuals in the past caused the harm. Obviously, the delay creates problems with old, stale evidence.[40] Finally, it may be difficult or impossible to impose liability or responsibility on those who acted many years ago because individuals may have died, or corporations may be bankrupt.[41]

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[37] Several scholars have noted this general problem in the context of tort law. *See, e.g.*, Rabin, *supra* note 20, at 29–33; Michael D. Green, *The Paradox of Statutes of Limitations in Toxic Substances Litigation*, 76 CAL. L. REV. 965, 973–74 (1988); Jane Stapleton, *Compensating Victims of Diseases*, 5 OXFORD J. LEGAL STUD. 248, 250–52 (1985); Gifford, *supra* note 25, at 653.

[38] This is what scholars have called "general causation." *See* Margaret A. Berger, *Eliminating General Causation: Notes Towards a New Theory of Justice and Toxic Torts*, 97 COLUM. L. REV. 2117, 2122 (1997).

[39] See Robert F. Blomquist, *Emerging Themes and Dilemmas in American Toxic Tort Law, 1988–1991: A Legal Historical and Philosophical Exegesis*, 18 S. ILL. U. L.J. 1, 43 (1993) (noting this problem in general); Richard M. Cooper, *Saccharin—Of Risk and Democracy*, 40 FOOD DRUG COSM. L.J. 34, 52 (1985). This is a problem that has been particularly difficult in the context of "toxic torts," or suits for liability against the manufacturers of products that are later found to have serious health implications, such as asbestos, tobacco, Agent Orange, and DES. *See, e.g.*, Ayers v. Jackson Twp., 525 A.2d 287, 301 (N.J. 1987); Rutherford v. Owens-Illinois, 941 P.2d 1203, 1218 (Cal. 1997).

[40] *See* Steven Shavell, *Liability for Harms Versus Regulation of Safety*, 13 J. LEGAL STUD. 357, 363 (1984) ("A second cause of failure to sue is the passage of a long period of time before harm manifests itself. This raises the possibility that by the time suit is contemplated, the evidence necessary for a successful action will be stale or the responsible parties out of business."). In the case of DES, the mothers who had taken the drug decades earlier often could not remember which company had sold the particular pills that they had taken, and prescription records were often either unhelpful or unavailable. *See* Schoen et al., *supra* note 26, at 142 (describing the problem); Hymowitz v. Eli Lilly, 539 N.E.2d 1069, 1072 (1989) (same); Gifford, *supra* note 25, at 653 (same); Stephen A. Spitz, *From Res Ipsa Loquitur to Diethylstilbestrol: The Unidentifiable Tortfeasor in California*, 65 IND. L.J. 591, 612 n.141 (1990) (noting that in one state, prescription records were only kept for five years).

[41] Shavell, *supra* note 40, at 370 (Where long latency periods exist, "the

Each of these three causation challenges are present in the context of climate change. While scientists have reached a consensus that human activities (namely the emission of carbon dioxide and other greenhouse gases) have caused and will cause changes in global climate systems, the delayed nature of the harm has helped make that scientific consensus the subject of a hotly debated and contested political battle, as various parties (often with strong interests in resistance to regulation of greenhouse gas emissions) have challenged the connection between human emissions and climactic changes.[42] It is even more difficult, and may be impossible, to connect the particular actions of particular parties (whether it be countries, corporations, or individuals) definitively to particular events. The carbon emissions from a given activity cannot be easily connected to particular climate

responsible individuals may have retired or died, or the firms themselves may have gone out of business."). This particular obstacle has been commonly associated with old or abandoned hazardous waste disposal sites, where the corporations that either managed the sites or used them often may have disappeared into a maze of state corporate records, unpaid filing fees, bankruptcy cases, or just vanished into the ether. *See* Al H. Ringleb & Steven N. Wiggins, *Liability and Large-Scale, Long-Term Hazards*, 98 J. POL. ECON. 574, 578 (1990) (discussing an empirical study finding evidence that in hazardous occupations with delayed harms, businesses tended to divest the hazardous activities into small businesses that have less resources available to pay claims). The result is that, once the site is discovered to be leaking many decades later, requiring millions of dollars of remediation costs, the original parties responsible are "judgment proof," even if they can be identified, leaving taxpayers with the cleanup bill. The federal hazardous waste remediation program, popularly known as "Superfund," has had to cover a significant amount of the costs of clean-ups for sites where there are no private parties that can be held liable for the waste disposal. *See* KATHERINE N. PROBST & DAVID M. KONISKY, SUPERFUND'S FUTURE: WHAT WILL IT COST? 103 (2001) (government paid for about 28 percent of all remediation costs at all National Priority List sites from fiscal year 1996 to fiscal year 2000); *see also* GENERAL ACCOUNTING OFFICE, SUPERFUND PROGRAM: CURRENT STATUS AND FUTURE FISCAL CHALLENGES 12 (2003) (providing historic cost data), *available at* http://www.gao.gov/new.items/d03850.pdf.

[42] One example of arguments that continue to question the anthropogenic connection to climate change are the claims that most of the current changes in climate are best explained by variations in sunspot activity. *See, e.g.*, Phil Chapman, *Sorry to Ruin the Fun, but an Ice Age Cometh*, THE AUSTRALIAN, Apr. 23, 2008 (discussing correlation between sunspot cycle and the Earth's climate) http://www.theaustralian.news.com.au/story/0,25197,23583376-7583,00.html; Peter N. Spotts, *Are Sunspots Prime Suspects in Global Warming?*, CHRISTIAN SCI. MONITOR, Sept. 27, 2007, at 13 (discussing the controversy over the role of sunspots in global climate change), *available at* http://www.csmonitor.com/2007/0927/p13s03-sten.html.

harms in part because it will take decades for the full impact of those emissions to be realized. But it will be impossible to prove that those harms that might happen fifty years later are not the result of later (or perhaps earlier) emissions. If it takes decades for the full impacts of a particular set of emissions of carbon dioxide to be felt, it will be difficult to disentangle the impacts of that output from the preceding or subsequent emissions. The delayed nature of climate change also means that many of the parties responsible for our current dilemma are no longer available able to be held responsible.[43]

Thus, liability is not a clear answer to the climate change problem because of the difficulties of establishing causation. Some commentators have argued that these and other challenges can be overcome through various doctrinal moves in tort law, or the institution of administrative systems to compensate victims of climate change.[44] Many of those proposals involve adopting solutions made elsewhere in tort law to the causation problems

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[43] Even countries that were responsible for historic greenhouse gas emissions, such as the Soviet Union and Yugoslavia, have disappeared.

[44] *See, e.g.*, David A. Grossman, *Warming up to a Not-So-Radical Idea: Tort-Based Climate Change Litigation*, 28 COLUM. J. ENVTL. L. 1, 22–58 (2003) (discussing possible problems of causation, preemption, standing, and remedies in climate change tort litigation and providing doctrinal solutions to each); Eduardo M. Peñalver, *Acts of God or Toxic Torts? Applying Tort Principles to the Problem of Climate Change*, 38 NAT. RESOURCES J. 563, 596–98 (1998) (proposing an administrative system as a solution to climate change); Thomas W. Merrill, *Global Warming as a Public Nuisance*, 30 COLUM. J. ENVTL. L. 293 (2005) (noting standing, federalism, preemption, and liability standard problems with litigation for climate change); David A. Dana, *The Mismatch Between Public Nuisance Law and Global Warming* (Northwestern University School of Law Pub. Law & Legal Theory Series, Paper No. 08-16, Law & Econ., Paper No. 08-05), *available at* http://ssrn.com/abstract=1129838 (noting standing and causation challenges to climate change litigation); Benjamin P. Harper, *Climate Change Litigation: The Federal Common Law of Interstate Nuisance and Federalism Concerns*, 40 GA. L. REV. 661 (2006) (noting causation, federalism, and preemption challenges to nuisance litigation); Jonathan Zasloff, *The Judicial Carbon Tax: Reconstructing Public Nuisance and Climate Change*, 55 UCLA L. REV. 1827 (2008) (arguing causation, federalism, and damages should not prevent successful litigation); Daniel A. Farber, *Basic Compensation for Victims of Climate Change*, 155 U. PA. L. REV. 1605, 1605–08 (2007) (arguing that an administrative compensation system that focuses on particular types of harm would be able to avoid causation problems). These debates are also playing out in ongoing climate change nuisance litigation. See Connecticut v. Am. Elec. Power Co., 406 F. Supp. 2d 265, 267 (S.D.N.Y. 2005) (dismissing climate change tort litigation based on political question doctrine); California v. Gen. Motors Co., No. C06-05755 MJJ, 2007 WL 2726871 at *6 (N.D. Cal. Sept. 17, 2007) (same).

created by delayed harms.[45]

In important ways, however, the debate over whether liability solutions will adequately address climate change is mostly an academic one. Perhaps in part because of the causation challenges that liability systems face in the context of climate change, combined with other factors (such as the difficulty of enforcing tort claim judgments on an international scale), the debate at the national and international level is focused entirely on what forms of regulatory systems will be developed to address climate change.[46] Most current proposals are variations on either a tax on

[45] A commonly proposed solution is to address the problems of identifying whose actions caused specific harms through the use of aggregate liability measures. This tool was first developed in the DES cases, where it was impossible for women who had taken the DES pills decades earlier to recall which company's pill they had used, and where pharmacy records no longer existed. Instead of undertaking costly efforts to fruitlessly determine which company's pill had caused which birth defect, many courts instead simply allocated liability among the companies according to their national market share. *See, e.g.*, Hymowitz v. Eli Lily & Co., 73 N.Y.2d 487, 502 (1989). A similar methodology could be used in the context of climate change, where liability for harm could be allocated by country or even large corporation according to the proportionate share of greenhouse gases emitted historically. *See* Farber, *supra* note 44, at 1637–40. However, some scholars question whether these various proposals can really make tort law a realistic alternative to address climate change. *See, e.g.*, Dana, *supra* note 44, at 3; Matthew D. Adler, *Corrective Justice and Liability for Global Warming*, 155 U. PA. L. REV. 1859 (2007) (questioning whether the corrective justice principles in tort law can support liability for climate change harms given the challenges of causation).

[46] For instance, comments by leading figures in Washington on climate change policy have focused overwhelmingly on regulatory solutions. *See, e.g.*, President Barack Obama, Address to Joint Session of Congress (Feb. 24, 2009), *available at* http://www.whitehouse.gov/the_press_office/Remarks-of-President-Barack-Obama-Address-to-Joint-Session-of-Congress (endorsing federal regulation of greenhouse gases); *Hearing on the U.S. Climate Action Partnership Before the H. Comm. on Energy and Commerce*, 111th Cong. 1 (2009) (opening statement of Rep. Henry Waxman), *available at* http://energycommerce.house.gov/Press_111/20080115hawopen.pdf (calling for regulatory action by federal government to reduce "uncertainty" facing business, including, presumably, tort liability); Press Release, Rep. John D. Dingell, Dingell Thanks UAW For Support: Autoworkers Rally to Support Comprehensive Energy Legislation (Jun. 27, 2007), *available at* http://www.house.gov/dingell/110/pr_070627_uaw.html) (statement by Rep. Dingell, former chair of House Energy and Commerce Committee, calling for federal regulatory action); Press Release, Sen. Dianne Feinstein, Senators Feinstein, Boxer, Klobuchar and Snowe Applaud EPA's Draft Rule-Making to Establish Greenhouse Gas Emissions Registry (Mar. 10, 2009), *available at* http://feinstein.senate.gov/public/index.cfm?FuseAction=NewsRoom.PressReleases&ContentRecord_id=F1888270-5056-8059-768B-A98D9CEB6838 (quoting Sens. Feinstein, Boxer and Snowe endorsing cap-and-trade); *see also Hearing on the Latest Global Warming*

the emission of carbon dioxide (and other greenhouse gases), or a "cap-and-trade" system in which permits to emit carbon dioxide are issued (or sold) to emitters, who can then trade among themselves.[47] The very fact that environmentalists, major

Science before the S. Comm. on Env't and Public Works, 111th Cong. 1 (2009) (opening statement of Sen. Inhofe), *available at* http://epw.senate.gov/public/index.cfm?FuseAction=Minority.PressReleases&ContentRecord_id=ae0baf71-802a-23ad-4ea8-43028aadf11a&Region_id=&Issue_id=) (castigating Congress for considering carbon regulatory programs).

[47] All of the leading climate change bills proposed in the 110th Congress focused on developing a regulatory system for climate change, whether it be cap-and-trade or a carbon tax. *See* Lieberman-Warner Climate Security Act, S. 2191, 110th Cong. (2008) (as reported by S. Comm. on the Env't and Public Works, May 20, 2008) (proposing cap-and-trade); Energy Independence and Security Act, H.R. 6, 110th Cong. (2007) (proposing changes in various regulatory standards and increased subsidies for energy research and conservation); Safe Climate Act, H.R. 1590, 110th Cong. (2007) (proposing cap-and-trade); Climate Stewardship and Economic Security Act, H.R. 4226, 110th Cong. (2007) (proposing cap-and-trade); Climate Market, Auction, Trust, & Trade Emissions Reduction System Act, H.R. 6316, 110th Cong. (2008) (proposing cap-and-trade); Global Warming Pollution Reduction Act, S. 309, 110th Cong. (2007) (proposing cap-and-trade). Some of these bills included provisions explicitly preserving state regulatory authority over carbon emissions, s*ee, e.g.*, H.R. 1590 § 705(b); H.R. 6316 § 405; S. 309 § 718, although it is unclear whether these savings clauses would be interpreted to include state nuisance claims. Other bills did not speak to whether the legislation would preempt state regulation, including state tort claims, leaving the issue open to debate. *See, e.g.*, *Courts Face Key Tests on Use of Torts to Fill Regulatory Gaps*, INSIDE CAL/EPA, Jan. 4, 2008 (noting importance of Supreme Court cases in determining federal preemption of state tort claims in environmental context, including climate change nuisance suits); *High Court Preemption Ruling May Bolster States' Climate Efforts*, CARBON CONTROL NEWS, Mar. 16, 2009 (same). Finally, Rep. Dingell, chair of the House Energy and Commerce Committee in the 110th Congress, released a set of principles for developing a federal climate change regulatory system that would include preemption of state regulation, presumably including state tort claims. *See* Dean Scott, *Legislation: House Energy Chairman Releases Draft Bill That Would Preempt State Climate Actions*, 39 ENV'T REP. 2018 (Oct. 10, 2008).

Bills for the current Congress are still being drafted as of publication date, but the discussion again has been entirely focused on a regulatory cap-and-trade strategy. The tentative draft for the Waxman-Markey climate change and energy bill creates a cap-and-trade regulatory system. *See* American Clean Energy & Security Act (discussion draft proposed Mar. 31, 2009), *available at* http://energycommerce.house.gov/Press_111/20090331/acesa_summary.pdf (summary of bill); http://energycommerce.house.gov/Press_111/20090331/acesa_discussiondraft.pdf (discussion draft of bill); *id.* at § 311 (creating cap-and-trade system). The discussion draft of the Waxman-Markey bill does include provisions explicitly preserving state regulatory authority, but provides no explicit mention of state nuisance tort claims. *Id.* at § 311 (creating § 721(c)(3) in a revised Clean Air Act, clarifying that greenhouse gas emission allowances do not provide exemptions from any other laws); *id.* (creating §

policymakers, Congress, and other actors are placing enormous political capital and energy into developing a regulatory system indicates a strong lack of faith that liability solutions will be the primary solution to the climate change policy. In short, liability solutions do not appear to be seriously on the agenda. Indeed, supporters of federal regulatory restrictions on carbon emissions have floated the idea of preempting state nuisance claims in order to obtain industry support for regulation.[48]

II. BACKLASH: THE CHALLENGE DELAYED HARMS POSE TO REGULATORY SYSTEMS

Whatever the merits of liability systems for addressing climate change, the reality appears to be that regulatory systems will be the preferred policy tool for managing greenhouse gases. Regulatory systems do have a substantial advantage over liability

723(b)(4) in a revised Clean Air Act that provides that penalties for violations of emissions limits do not preempt any other possible penalties); *id.* at §§ 334–35 (generally exempting state greenhouse gas laws from preemption under the revised Clean Air Act except for state greenhouse gas caps between 2012 and 2017). For discussions in general on the state of play in the current Congress, and the focus on cap-and-trade strategy see Ari Natter, *Legislation: House Committee Plans Legislation Combining Energy, Climate Change*, 40 ENV'T REP. 609 (Mar. 20, 2009). *See also* Katherine Skiba & Amanda Ruggeri, *On Climate Change, Henry Waxman Wants Congress to Act Now*, U.S. NEWS & WORLD REP., Mar. 11, 2009, *available at* http://www.usnews.com/articles/news/energy/2009/03/11/on-climate-change-henry-waxman-wants-congress-to-act-now.html; Ian Talley & Stephen Power, *Democrats In Senate Spar Over Climate*, WALL ST. J., Mar. 12, 2009, at A3 *available at* http://online.wsj.com/article/SB123679042118496965.html?mod=rss_US_News.

For additional discussion of the climate policy debate, focusing exclusively on the two types of regulatory options see Sujata Gupta et al., *Policies, Instruments and Co-operative Arrangements*, *in* CLIMATE CHANGE 2007: MITIGATION OF CLIMATE CHANGE, CONTRIBUTION OF WORKING GROUP III TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 747, 755–59, 778 (B. Metz et al. eds., 2007). *See also* Wiener, *supra* note 1, at 238–40 (summarizing the debate).

[48] *See Backers of CO2 Curbs Eye Liability Relief to Bolster Industry Support*, INSIDE EPA, Sept. 7, 2006. Relatedly, some supporters of nuisance litigation against utilities have indicated that a primary goal is to force the utilities to the bargaining table over developing a regulatory system. *See* Amanda Griscom, *Public Nuisance No. 1: A Bold Lawsuit May Have Utilities Reconsidering Their Fight Against Regs*, GRIST.ORG, July 30, 2004, http://www.grist.org/news/muck/2004/07/30/griscom-lawsuit/; John Carey & Lorraine Woellert, *Global Warming: Here Come the Lawyers*, BUSINESSWEEK, Oct. 30, 2006, at 34 ("In fact, the ultimate goal for environmentalists isn't necessarily to win cases but to ratchet up the pressure on business and politicians to impose mandatory curbs on greenhouse gas emissions.").

systems as a policy tool, particularly in the context of addressing delayed harms such as climate change—because regulations prohibit or restrict ex ante a category of activities without a need to show that particular acts have caused harm, they do not face the same kinds of challenges in establishing causation that liability systems face.[49]

There are, of course, serious obstacles to the creation of effective national or global regulatory systems to manage climate change. I have alluded to a number of them in the introduction. Academic and political debates have thus far focused on those challenges to getting a regulatory system up and running, and how those challenges might be overcome or managed,[50] but there has been little attention paid to another key question—how viable will the regulatory systems be that we establish to manage climate change. Can they be sustained politically, or will they be subject to political pressures that will cause them to be repealed or rolled-back?

I examine this second set of questions in this paper. The fundamental problem here comes from the nature of climate change as a delayed harm. The delay between the human activities that produce greenhouse gases and the full impact of those gases

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[49] *See, e.g.*, Neil K. Komesar, *Injuries and Institutions: Tort Reform, Tort Theory, and Beyond*, 65 N.Y.U. L. REV. 23, 30–31 (1990); Shavell, *supra* note 40, at 363.

[50] *See, e.g.*, Andrew Long, *International Consensus and U.S. Climate Change Litigation*, 33 WM. & MARY ENVTL. L. & POL'Y REV. 177, 179 (2008); Sunstein, *supra* note 12, at 1675 (noting the challenges to getting a regulatory system developed on a global scale, and exploring possible alternatives); Michael P. Vandenbergh, *Climate Change: The China Problem*, 81 S. CAL. L. REV. 905 (2008) (noting the challenge of getting China to adopt a climate change regulatory system and exploring options to overcome that challenge); Gordon, *supra* note 10, at 1600–04 (noting the challenge of attempting to get developing and developed countries to reach agreement, in part because of the equity concerns); Kirsten H. Engel & Scott R. Saleska, *Subglobal Regulation of the Global Commons: The Case of Climate Change*, 32 ECOLOGY L.Q. 183 (2005) (exploring how state and local regulatory efforts might prompt national or international regulatory efforts); J.R. DeShazo & Jody Freeman, *Timing and Form of Federal Regulation: The Case of Climate Change*, 155 U. PA. L. REV. 1499 (2007) (analyzing the interaction between state and federal climate change regulatory efforts, and how state actions might prompt federal regulation); Baumert, *supra* note 16, at 367; Anita M. Halvorssen, *Global Response to Climate Change—From Stockholm to Copenhagen*, 85 DENV. U. L. REV. 841, 857 (2008) (proposing ways to improve the global regulatory system); Wiener, *supra* note 1, at 211 & 213 (outlining various proposals for a climate regulatory system).

on the global climate system means that there will necessarily be a delay between the imposition of regulations restricting or prohibiting those activities and improvements in or stabilization of the global climate system. That delay creates the possibility of a political reaction against seemingly ineffectual regulations, and calls for repeal or dilution of such regulations. I call this phenomenon the possibility of "backlash."

A. *The Gap Between Regulation and Environmental Harm Reduction*

Backlash might exist because, even if a regulation completely succeeds in eliminating the human activity that causes a delayed harm (a wildly optimistic scenario, and perhaps undesirable in many circumstances in any case), the harm will continue to occur over an extended period of time in any case.

To see why this is the case, consider a scenario where a human activity (A) causes a harm (H) twenty years after it occurs. At Time 0, A begins. Twenty years later, the first incidence of H will occur. But even if within five years, regulations (R) are imposed and completely stop A, H will continue to occur due to the prior occurrences of A before the imposition of regulation. Indeed, H will continue for *twenty years* after the date of the imposition of R. See Figure 1.

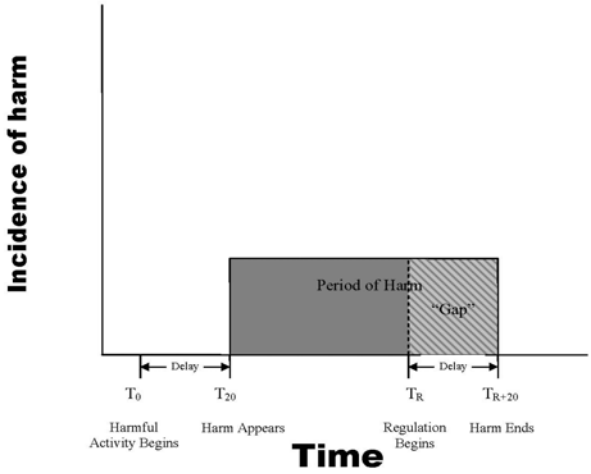

Figure 1: Simple Model of Delayed Harm and Regulation

This problem will be worse if there are cumulative or synergistic effects of A—for instance, if harms accumulate over time and persist (i.e., take an extended period of time to disappear after they have first been inflicted).[51] Figure 2 depicts a simple scenario where harms persist for an extended period of time (period P) after they are first inflicted by the harm-causing activity. In Figure 2, the harms accumulate in a linear manner throughout period P as they build up. Note that in this situation, even after regulation is imposed and the delay period passes, harm will continue to be felt (albeit at a decreasing rate) as the harm slowly dissipates. Moreover, if regulation happens earlier—as depicted in Figure 3—before the harm has peaked, the harm may continue to *increase* because of the combination of the delayed harm and the persistence of the harm.[52]

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[51] *See* Lisa Heinzerling, *Environmental Law and the Present Future*, 87 GEO. L.J. 2025, 2064–66 (1999) (noting that because persistent substances remain present in the environment for a long period of time, they may be more likely to cause harms far in the future, even if they do not cause harm immediately).

[52] There is another way in which the cumulative, persistent nature of the harms in Figures 2 and 3 create challenges for a policymaker. Because the harm accumulates over time, it may be many, many years until the full scope of the problem is understood by policymakers or the public. For instance, shortly after

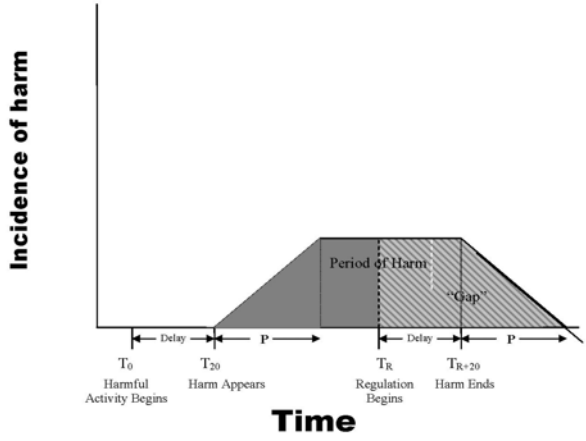

Figure 2: Simple Model of Persistent, Cumulative Delayed Harm and Regulation

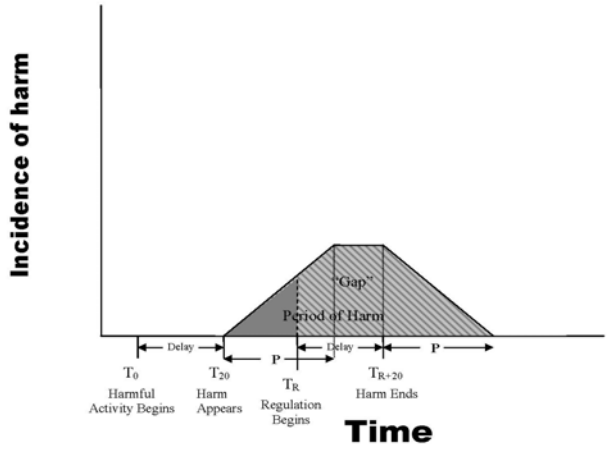

Figure 3: Simple Model of Persistent, Cumulative Delayed Harm with Early Regulation

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the harm is first detected, it may only be detected at low levels—making proof of causation difficult, and also perhaps leading policymakers to conclude that the level of harm is not "that high." It may take a significant rise in the level of harm to convince policymakers that the harm is worth regulating, but by that point (say, time R in Figure 2), a large amount of harm is "built in" and will occur inevitably (unless it can be remediated). For a discussion of this dynamic, see Gaffney & Altshuler, *supra* note 26, at 1028–29. *Cf.* William Ophuls, ECOLOGY AND THE POLITICS OF SCARCITY 120 (1977) (noting that exponential rises in environmental harm will result in rapid environmental changes that will outstrip the political system's ability to respond).

Consider hypothetical future climate change regulations as an example of this dynamic. There is no question that—absent steps to remove carbon from the atmosphere or to offset the warming impacts of carbon on the planet—the global average temperature will continue to increase even if draconian regulation drastically slashed all greenhouse gas emissions.[53] Indeed, because of the persistence of carbon dioxide in the atmosphere, with residence times in the centuries or millennia,[54] it is likely that the climate change will fall into the category depicted in Figures 2 and 3, where the harm may even continue to increase for a time after regulation, or at least will persist for a very long time frame after the regulatory system is implemented.[55]

Thus, imagine a future in which the international community has overcome the tremendous challenges of negotiating and implementing an effective greenhouse gas emissions regulatory system. The result has been drastic changes in the energy systems and economies of countries around the world. While it is possible (indeed likely) that there will be substantial benefits to important economic sectors from those changes (e.g., the massive development of renewable energy industries), it is also certain that there will be significant transition costs from those changes, and that certain countries and economic sectors (e.g., members of OPEC) will bear a disproportionate burden of those costs. Five to ten years after the implementation of the regulatory program, new reports come out showing that while carbon dioxide emissions have begun to drop significantly, the planetary temperature continues to rise, as do sea levels. A series of major hurricanes inflict devastating damage on densely populated coastal areas, and the populations of several dozen low-lying Pacific atolls have to be evacuated. A ten-year drought grips the American Southwest. Such a scenario might pose significant political challenges to a climate change regulatory system.

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[53] *See supra* notes 22–23, and accompanying text.

[54] *See* David Archer & Victor Brovkin, *The Millennial Atmospheric Lifetime of Anthropogenic CO_2*, 90 CLIMATIC CHANGE 283, 283 (2008); O. Boucher et al., *Implications of Delayed Actions in Addressing Carbon Dioxide Emission Reduction in the Context of Geo-engineering*, 92 CLIMATIC CHANGE 261, 262 (2009).

[55] This point was emphasized by a recent study that noted that harms due to carbon emissions would likely persist for *at least 1000 years* after the complete cession of those emissions. *See* Solomon et al., *supra* note 22, at 1705.

B. The Political Dynamics of Backlash

In light of the inevitable delay between regulation of the harm-causing activity and reduction or elimination of the environmental harm, there are two ways in which backlash might occur. First, the political dynamics of regulating activities that cause delayed harms in the first place are extremely challenging—and those dynamics might leave the regulatory system vulnerable to a counter-attack. Second, the fact that environmental conditions might remain poor or even continue to worsen could reduce the support for environmental regulations because of changes in attitudes about what level of environmental protection society should seek to achieve.

1. *The Weak Political Support for Delayed Harm Regulation*

Regulations to address delayed harms such as climate change will generally have limited political support, if only because the imposition of those regulations is more politically challenging than for run-of-the-mill environmental regulations. Those political challenges to the enactment of environmental regulation arise because years will usually pass before it becomes evident that the activity in question is causing environmental damage. Accordingly, those activities will often have become widespread within a community or society before the alarms are raised about the harms they are causing. At that point in time, the activities will likely be commonly accepted, perhaps even encouraged.[56] We then might expect that regulation to restrict—or especially prohibit—the activity will meet fierce political resistance.[57]

As an example, consider the imposition in the 1970s of regulatory programs in the United States that required motorists to regularly have their automobile emissions systems inspected and (if necessary) maintained (known by the shorthand term of "I/M programs"). I/M programs were required by the federal government as a tool to improve air pollution in the United

[56] *See* Heinzerling, *supra* note 51, at 2067–68 (noting importance of the formation of "habits" over long periods of time in the development of environmental law).

[57] *See* Cary Coglianese, *Social Movements, Law, and Society: The Institutionalization of the Environmental Movement*, 150 U. PA. L. REV. 85, 111–12 (2001) ("Americans' broad acceptance of environmental values does not translate into strong support for government policies to change citizens' behavior, particularly when it comes to energy consumption and driving habits.")

States.[58] These I/M regulations imposed a regulatory burden directly on the owners and operators of motor vehicles in many states around the country, a regulatory burden on an activity that most Americans consider their birthright.[59] It is perhaps no surprise, then, that the I/M programs have faced serious political resistance whenever they have been introduced, including significant delays by states in the implementation of their programs and violation of federally mandated deadlines.[60] I/M programs have even been adjusted to make sure that the failure rates for automobile emission systems were not so high as to

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[58] The federal Clean Air Act requires states to develop plans to ensure the attainment of minimum air quality standards, and those plans often must include programs to require automobile owners to perform regular inspections of their automobile emission systems and repair faulty systems. For an overview of the program, *see* Arnold W. Reitze, Jr. & Barry Needleman, *Control of Air Pollution From Mobile Sources Through Inspection and Maintenance Programs*, 30 HARV. J. ON LEGIS. 409, 411–414 (1993). The relevant statutory provisions are at 42 U.S.C. §§ 7501–7515. These requirements were first imposed in the 1970 Clean Air Act, and have been adjusted (and frequently expanded) in the revisions to the Clean Air Act since then. For the history of the various versions of the I/M program in the federal Clean Air Act, see Reitze & Needleman, *supra* at 414–24.

[59] *See* Arnold W. Reitze, Jr., *Controlling Automotive Air Pollution Through Inspection and Maintenance Programs*, 47 GEO. WASH. L. REV. 705, 739 (1979) (noting that I/M programs fall primarily on drivers, and arguing that this burden should be put more on manufacturers with stricter quality control standards).

[60] *See* Reitze & Needleman, *supra* note 58, at 416–17 (noting delays in implementation of I/M programs in states in 1970s and 1980s); Jerome Ostrov, *Inspection and Maintenance of Automotive Pollution Controls: A Decade-Long Struggle Among Congress, EPA and the States*, 8 HARV. ENVTL. L. REV. 139, 170–72, 174–75 (1984) (giving examples of political resistance in California and Maryland); Ora Fred Harris, Jr., *The Automobile Emissions Control Inspection and Maintenance Program: Making it More Palatable to "Coerced" Participants*, 49 LA. L. REV. 1315, 1319–25 (1989) (noting political resistance, explaining that "[m]uch can be said of the notion that one possible way of riling an American is for the federal government to threaten him or her about something which is thought—rightly or wrongly—to come within his or her personal domain"). The State of Pennsylvania's legislature even briefly prohibited the state government from expending funds on the implementation of an I/M program, leading to a lawsuit and contempt citation from a federal court. *See* Delaware Valley Citizens' Council for Clean Air v. Pennsylvania, 533 F. Supp. 869, 884 (E.D. Pa. 1982). For overviews of the history of the Pennsylvania litigation, *see* Ostrov, *supra* at 158–59; Harris, *supra* at 1338–43. Delays have continued to the present-day, in part as a result of ongoing resistance in some states to I/M programs. *See* U.S. GEN. ACCOUNTING OFFICE, AIR POLLUTION: DELAYS IN MOTOR VEHICLE INSPECTION PROGRAMS JEOPARDIZE ATTAINMENT OF THE OZONE STANDARD, 1–2, 5–6 (1998), *available at* http://www.gao.gov/archive/1998/rc98175.pdf.

jeopardize the political support for the system.[61]

Why is there so much resistance to the regulation of long-standing activities? Certainly, one reason is the economic costs from regulation of activities that cause delayed harm—activities that have been long-standing will likely be the basis for substantial economic investments.[62] Often, those economic losses will be concentrated in particular industries, or on particular companies, who will of course resist the imposition of regulation. If the benefits of regulation are broadly distributed across the entire public—as is often the case with many environmental regulations—then those who resist the regulation will have a substantial advantage in organization, lobbying, and access to the political system.[63] That organized resistance may make enactment of a regulation quite difficult.[64] That organized resistance could also support on-going opposition to the maintenance and implementation of the regulation. If there is a gap between regulation and improvement—as with delayed harms—that

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[61] *See* Reitze & Needleman, *supra* note 58, at 426 ("Because the public may react negatively to an excessive number of vehicles failing the first inspection, the cut points were originally set high enough to reduce emissions to meet atmospheric goals but low enough to be politically acceptable."); *see also* Reitze, *supra* note 59, at 720 (making same point). This is a pattern that arguably can be seen throughout all of environmental law—the development of which has often required the imposition of strict regulation on activities that previously were thought to be harmless and therefore without moral blame, leading to significant political or legal obstacles to the initial stages of enforcement. *See* KEITH HAWKINS, ENVIRONMENT AND ENFORCEMENT 11, 203–04 (1984) (study of water pollution enforcement in United Kingdom reaching these conclusions); *see also* Keith Hawkins & John M. Thomas, *The Enforcement Process in Regulatory Bureaucracies*, *in* ENFORCING REGULATION 3, 8 (Keith Hawkins & John M. Thomas eds., 1984) (making same point in general way); Robert A. Kagan, *On Regulatory Inspectorates and Police*, *in* ENFORCING REGULATION 37, 53–54, 56 (Keith Hawkins & John M. Thomas eds., 1984) (same, and also noting that it may result in more lenient enforcement).

[62] *See* Heinzerling, *supra* note 51, at 2067 (noting how activities may "become entrenched" because of economic investment and network effects).

[63] *See* Eric Biber, *The Importance of Resource Allocation in Administrative Law*, 60 ADMIN. L. REV. 1, 40–49 (2008).

[64] There are ways to address the political challenges faced by regulatory tools—at least with respect to setting up the regulatory program in the first place. One could provide either compensation or exceptions to the individuals who face the greatest interference with their prior activities by the regulation. Grandfather exclusions for existing uses will eliminate the largest sources of political opposition for the imposition of regulations to address delayed harms. *See* Christopher Serkin, *Existing Uses and the Limits of Land Use Regulations*, 84 N.Y.U. L. REV. (forthcoming 2009) (manuscript at 51–55).

opposition may be able to point to the apparent lack of success when calling for a decrease in standards or even repeal.

But there are likely also non-economic reasons why regulation of long-standing activities is so unpopular. In particular, cognitive psychology and behavioral economics provide two insights. The first is that individuals—whether in their personal capacity or through the political system—may systematically understate the importance of costs or harms that will be felt in the future. In other words, individuals may have extremely high discount rates, far higher than we would expect based on market discount rates. One could call this phenomenon myopia,[65] and it is a phenomenon that has been observed in real world consumer behavior.[66] In the context of delayed harm,

[65] The most commonly used term in behavioral economics is hyperbolic discounting, in which the discount rate changes (generally increasing) as the future benefit becomes more and more distant in time. *See* Andrew Green, *Self Control, Individual Choice, and Climate Change*, 26 VA. ENVTL. L. J. 77, 86–90 (2008).

[66] *See* George Lowenstein & Richard H. Thaler, *Anomalies: Intertemporal Choice*, 3 J. ECON. PERSP. 181, 182–83 (1989) (describing the concept and noting examples from consumer purchases of energy-inefficient appliances); *see also* Howard Kunreuther, *Disaster Mitigation and Insurance: Learning from Katrina*, 604 ANNALS AM. ACAD. POL. & SOC. SCI. 208, 208 (2006) ("Before a disaster, most homeowners, private businesses, and the public sector do not voluntarily adopt cost-effective loss reduction measures."); *id.* at 209–11 (providing evidence of failure of actors in disaster-prone areas to invest in cost-effective measures to reduce the risk of harm); *id.* at 212 ("In making decisions that involve cost outlays, individuals are often myopic and hence only take into account the potential benefits from such investments over the next year or two. . . . This tendency toward myopia is one of the most widely documented failings of human [decisionmaking]."). *See generally* Max H. Bazerman, *Climate Change as a Predictable Surprise*, 77 CLIMATIC CHANGE 179 (2006) (applying the myopia concept to climate change policymaking); Susan Block-Lieb & Edward J. Janger, *The Myth of the Rational Borrower: Rationality, Behavioralism, and the Misguided "Reform" of Bankruptcy Law*, 84 TEX. L. REV. 1481, 1544–46 (2006) (applying the myopia concept to consumer credit card choices); Kyle D. Logue, *The Current Life Insurance Crisis: How the Law Should Respond*, 32 CUMB. L. REV. 1, 30–32 (2001) (applying the myopia concept to consumer life insurance decisions); Barton H. Thompson, Jr., *Tragically Difficult: The Obstacles to Governing the Commons*, 30 ENVTL. L. 241, 262–65 (2000) (discussing the difficulties that myopia presents in efforts to avoid the tragedy of the commons); Jon D. Hanson & Kyle D. Logue, *The Costs of Cigarettes: The Economic Case for Ex Post Incentive-Based Regulation*, 107 YALE L.J. 1163, 1203–05 (1998) (discussing the myopia concept as applied to cigarette smokers); Daniel A. Farber & Paul A. Hemmersbaugh, *The Shadow of the Future: Discount Rates, Later Generations, and the Environment*, 46 VAND. L. REV. 267, 282–87 (1993) (discussing how policymakers might counter myopia in setting social discount rates).

myopia may lead members of the public to systematically understate the harms that will occur far in the future, such that they are unwilling to pay significant costs (whether in terms of direct monetary payments or in terms of regulation of ongoing activities) to avoid those harms. Politicians who are elected on (relatively) short time cycles such as every two to six years might respond to these public preferences by avoiding addressing delayed harm problems.[67] This problem is particularly exacerbated when the delayed harm is novel, such that there is unlikely to be any close personal experiences by most people of the harms that are being created.[68]

The myopia of the public that makes the imposition of regulatory measures difficult in the first place also may make the public less willing to wait for the promised results of regulation to appear. Thus, even if the economic and social costs of regulation may be more than offset by economic (or other benefits) from the elimination of future harms (i.e., the elimination of H at some point in the future, once the delayed harms have worked their way out of the system), the public may overly discount those future benefits. The popular reaction may well be: "What good is this burdensome/annoying/costly regulation doing? We're still in the same situation we were before."

The second insight is based on concepts variously known as "loss aversion," "status quo bias" or the "endowment effect."[69] The theory (based on experimental evidence) is that people are far more concerned about "losing" items to which they believe they currently have an entitlement than they are concerned about "gaining" items for which they never had any expectation of ownership or future ownership.[70] For instance, in one of the

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[67] *See generally* Christopher H. Achen & Larry M. Bartels, Musical Chairs: Pocketbook Voting and the Limits of Democratic Accountability (Sept. 8, 2004) (unpublished manuscript, on file with New York University Environmental Law Journal) (presenting evidence that voters primarily evaluate presidential incumbents based on their economic performance within the year prior to the election, ignoring the economic performance over the course of the four-year term, and arguing that this shows significant voter myopia).

[68] *See* Elke U. Weber, *Experience-Based and Description-Based Perceptions of Long-Term Risk: Why Global Warming Does Not Scare Us (Yet)*, 77 CLIMATIC CHANGE 103, 105, 109–111 (2006) (describing cognitive factors affecting risk perception in the context of climate change).

[69] *See* Heinzerling, *supra* note 51, at 2067–68 (noting how "status quo bias" may make the development of regulation more difficult).

[70] *See* Daniel Kahneman & Amos Tversky, *Choices, Voices, and Frames*, 39

seminal psychological studies of the "endowment effect," experimenters found that individuals consistently valued at a higher level items (such as coffee mugs) that they had in their possession, and valued at a lower level items that others possessed (but which they might be able to trade for).[71] In the context of delayed harms, people have the expectation that they will be able to undertake actions that were previously acceptable and commonplace, and that ability is being removed or restricted by new regulation.[72] People accordingly become upset, and are likely to

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AM. PSYCHOLOGIST 341 (1984) (describing "loss aversion" as an individual's use of risk-averse or risk-preferential behavior to minimize losses because those losses have a greater psychic impact than equivalent gains; also provides experimental data to support the theory); Amos Tversky & Daniel Kahneman, *Rational Choice and the Framing of Decisions*, 59 J. BUS. S251, S258–62 (1986) (same); Amos Tversky & Daniel Kahneman, *The Framing of Decisions and the Psychology of Choice*, 211 SCI. 453 (1981) (same); Richard Thaler, *Toward a Positive Theory of Consumer Choice*, 1 J. ECON. BEHAV. & ORG. 39, 44–47 (1980) (coining the term "endowment effect" to describe the greater weight the individuals may place on items they already own compared to identical items they do not own, and basing the effect in the "loss aversion" concept developed by Kahneman and Tversky); Daniel Kahneman et al., *Experimental Tests of the Endowment Effect and the Coase Theorem*, 98 J. POL. ECON. 1325, 1325 (1990) (providing experimental evidence in support of the endowment effect); William Samuelson & Richard Zeckhauser, *Status Quo Bias in Decision Making*, 1 J. RISK & UNCERTAINTY 7, 8–9, 35–36 (1988) (providing overview and experimental evidence for a "status quo bias" in which individuals generally value continuation of the status quo over the possibility of change); Raymond S. Hartman et al., *Consumer Rationality and the Status Quo*, 106 Q. J. ECON. 141, 143–44 (1991) (same).

[71] Kahneman, *supra* note 70, at 1329–38.

[72] There is evidence that the "endowment effect" is generally stronger for physical items that are in the possession of individuals and have some use value, as opposed to inchoate expectations of items or items used solely for exchange value. *See* Jeffrey J. Rachlinski & Forest Jourden, *Remedies and the Psychology of Ownership*, 51 VAND. L. REV. 1541, 1558–59 (1998) (summarizing these findings in the literature). Thus, the "endowment effect" might be weaker in the context of an intangible expectation to be able to undertake activities, as opposed to the right to control a particular piece of property. However, if the expectation to be able to undertake an activity is tied to the use of a particular piece of property owned by an individual—i.e., if an individual has an expectation that they will be able to develop a piece of real property that they currently own—then the "endowment effect" might be considerably stronger. In any case, the "status quo bias" identified in the literature appears to be much broader than simple ownership of physical items. Experimental studies have found that individuals have a preference towards the "status quo" in making decisions about which activities to pursue or which of many options to select in decision-making. *See* Samuelson & Zeckhauser, *supra* note 70 at 8–9; Russell Korobkin, *The Status Quo Bias and Contract Default Rules*, 83 CORNELL L. REV. 608 (1998) (discussing experiments finding status quo bias in negotiation of contract terms);

complain to their elected representatives—perhaps even vote them out—in order to protect those expectations.[73] The longer the activity has been occurring before the harm is discovered, the more serious the resistance might be.[74]

As an example of the potential importance of "status quo bias" in particular as an explanation for why delayed harm regulation is so unpopular, consider the controversy over the U.S. Food and Drug Administration's (FDA) proposed ban of the artificial sweetener saccharin in the late 1970s. Saccharin had been in wide use as a sweetener for decades, going back to the nineteenth century.[75] However, evidence in the late 1970s,

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see also Russell Korobkin, *The Endowment Effect and Legal Analysis*, 97 NW. U. L. REV. 1227, 1236 (2003) (noting that "individuals tend to prefer the status quo state of the world, all other things being equal, even when there is no enforceable legal entitlement or property right at issue").

[73] *See* Korobkin, *Endowment Effect*, *supra* note 72, at 1267 (developing the argument that the endowment effect means that "imposing new or more stringent regulations on existing entitlements will tend to be disfavored relative to regulating new entitlements"); Holly Doremus, *Takings and Transitions*, 19 J. LAND USE & ENVTL. L. 1, 21–23 (2003) (making a similar point); Cass R. Sunstein, *Endogenous Preferences, Environmental Law*, 22 J. LEGAL STUD. 217, 230–34 (1993) ("Because Americans have adapted their behavior to frequent use of the automobile, it is especially difficult to change their behavior in the direction of mass transit."); Jeffrey J. Rachlinksi, *The Psychology of Global Climate Change*, 2000 U. ILL. L. REV. 299, 307–08, 315–16 (arguing that status quo bias will make initiation of regulation of greenhouse gases particularly challenging).

[74] Experimental evidence of the endowment effect indicates that the longer an individual "owns" an item, the higher the value the individual places on that item. *See* Michal A. Strahilevitz & George Loewenstein, *The Effect of Ownership History on the Valuation of Objects*, 25 J. CONSUMER RES. 276, 285 (1998). Likewise, the longer that an individual is able to pursue an activity that they believe they may be entitled to do, the more resistance they may present to being told they can no longer pursue that activity. *See* Doremus, *supra* note 73, at 36 (arguing that more abrupt changes in government regulation are more likely to prompt political and judicial resistance to regulatory change).

One question is why the parties that suffer the adverse environmental consequences of the activity in question do not see that as a "loss" of an endowment they have previously enjoyed, i.e., the loss of environmental quality. The answer may be that much environmental harm tends to be gradual and dispersed, such that individuals do not perceive the changes to be a "loss." Thus, prevention of environmental harm becomes perceived as a gain by the beneficiaries of regulation, which is valued less than the loss of the ability to use property or undertake activities by the objects of regulation.

[75] Estimates were that "[a]bout 25–40 percent of the U.S. population consumed saccharin in some amount in foods and beverages." Cooper, *supra* note 39, at 37. The National Academy of Sciences estimated that daily per capita consumption was 32 mg at the time of the proposed ban. *Id.*

including a rodent study from Canada, provided support for the theory that saccharin was a carcinogen,[76] triggering a legal requirement for the FDA to ban it.[77] The result was a political firestorm.[78] Congress imposed a temporary moratorium on the saccharin ban, a moratorium that has continued to the present day.[79]

Of course, there was substantial economic investment in saccharin, which was the basis of a diet soft-drink industry worth hundreds of millions or billions of dollars in the 1970s.[80] But there

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The FDA had sought to ban saccharin as an unhealthful additive (due to concerns about impacts on the digestive system) in the first few years of the twentieth century, but initially ran into opposition from President Teddy Roosevelt, who was a regular user. When informed that his FDA Commissioner was considering banning the substance, Roosevelt reportedly replied: "You say saccharin is injurious to health? Why Doctor Risey gives it to me every day. Anybody who says saccharin is injurious to health is an idiot." The exchange happened shortly after the President supported the FDA's efforts to ban another substance, benzoate of soda, as a food additive. Richard A. Merrill & Michael R. Taylor, *Saccharin: A Case Study of Government Regulation of Environmental Carcinogens*, 5 VA. J. NAT. RESOURCES L. 1, 25–26 (1985). The FDA subsequently attempted to ban saccharin a few years later, but retreated after fierce political and legal resistance. *Id.* at 26–27.

[76] *See* Merrill & Taylor, *supra* note 75, at 32–48 for an overview of the history of the saccharin studies that led to the FDA's proposed ban. *See also* Cooper, *supra* note 39, at 38–40.

[77] Under the law at the time, the FDA was required to prohibit any "food additive" that it determined would cause cancer. *See* 21 U.S.C. § 348(c)(3)(A) (2006).

[78] *See* Merrill & Taylor, *supra* note 75, at 48–49 (1985) ("Reaction to FDA's announcement was immediate and shrill."); Cooper, *supra* note 39, at 45 ("The announcement [of the ban] produced a whirlwind of protest, beyond anything the agency had ever experienced in its history."); William B. Schultz, *The Bitter Aftertaste of Saccharin*, 40 FOOD DRUG COSM. L.J. 66, 75 (1985) ("The press . . . almost uniformly opposed the saccharin ban. Constituents flooded congressional offices with mail."). There were reports of public hoarding of saccharin-containing soft drinks after the announcement. Cooper, *supra* note 39, at 46–47. Members of Congress reported receiving thousands of letters, and the FDA received 40,000 protest letters. *Id.* at 47–48. Senator Edward Kennedy stated that "[n]o regulatory action in recent memory has so angered the American people as the decision by the Food and Drug Administration to begin the process of removing saccharin from the market." *Id.* at 34.

[79] Until 2000, the ban was connected to a labeling requirement indicating the possible danger that saccharin poses to human health. *See* Merrill & Taylor, *supra* note 75, at 52–59 (1985) (noting the history of the moratorium and the labeling requirement, and the moratorium's ongoing existence); Pub. L. No. 106-554, § 517, 114 Stat. 2763A-73 (repealing prior labeling requirement).

[80] *See* Cooper, *supra* note 39, at 46 (noting media reports that saccharin ban would affect a "two billion dollar-a-year industry" in the United States); *see also* Schultz, *supra* note 78, at 67 (noting lobbying on saccharin ban by soft-drink

have been many other chemicals—such as food additives and pesticides—that have been banned or refused entry to the United States market over the years, some with very substantial economic value.[81] But exemptions have not been created for those substances, either administratively, legislatively, or judicially. Nor have those prohibitions resulted in the dismantling of the general structures regulating or prohibiting cancer-causing chemicals in the United States.[82] The widespread public use of saccharin undoubtedly explains a significant part of why Congress made an exemption for this substance.[83]

While there are situations where, after regulation is implemented, resistance dissipates,[84] "endowment effects" and

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industry).

[81] Examples of economically-important chemicals banned or severely restricted in the United States due to health and environmental concerns include cyclamates (an artificial sweetener banned in the 1960s), Allan Mazur & Kevin Jacobson, *Looking Back: Cyclamate*, 10 RISK: HEALTH, SAFETY & ENV'T 95 (Spring 1999), PCBs (a compound used widely in electrical components), *see* Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions, 44 Fed. Reg. 31,514 (May 31, 1979), DES (a chemical given widely to livestock), *see* Richard A. Merrill, *FDA's Implementation of the Delaney Clause*: *Repudiation of Congressional Choice or Reasoned Adaptation to Scientific Progress?*, 5 YALE J. ON REG. 1, 27–28 n.149 (1988), and a number of important food color additives, *see id.* at 9.

[82] The Delaney Clause, the provision that the FDA interpreted as requiring it to ban saccharin, has been widely criticized as inflexible. *See*, *e.g.*, Thomas O. Henteleff, *"Modernizing" the Delaney Clause*, 38 FOOD DRUG COSM. L.J. 147 (1983). However, it remains essentially intact today (albeit infrequently used), at least with respect to food additives intentionally placed into the food supply, such as saccharin. It was modified to exclude pesticide residues, although it was replaced with a standard that is still quite strict, and arguably broader in the threats that it considers. *See* James S. Turner, *Delaney Lives! Reports of Delaney's Death Are Greatly Exaggerated*, 28 ENVTL. L. REP. 10,003, 10,018 (1998) (noting the continuation of the application of Delaney Clause); Merrill, *supra* note 81, at 9 (noting the infrequency of the application of the Delaney Clause to food additives).

[83] *See*, *e.g.*, Schultz, *supra* note 78, at 67 (noting lobbying strategy by soft drink industry to frame itself as "the champion of the consumer, by describing the issue as one of 'freedom of choice. . .'"); Merrill, *supra* note 81, at 31 ("The repudiation of its saccharin proposal taught FDA officials that some food ingredients enjoy a distinct status. Congress's rejection [of the saccharin ban] sent a clear message: some ingredients are too important to ban.").

[84] For instance, as drivers adapted to the existence of I/M programs, they became much less controversial and much more popular. *See* Ostrov, *supra* note 60, at 142 ("Although some motorists resent the perceived intrusion of the federal bureaucracy into their lives, once implemented, I/M need be no more intrusive or costly than the state safety inspections familiar to most."); *id.* at 141 n.25, 166, 168, 172, 182, 190 (quoting polling data from the late 1970s and early

"status quo bias" can also result in less support for regulatory systems even after they are enacted. An example is Measure 37 in Oregon, a voter-approved measure that required compensation for economic impacts of local and state land-use regulation, a measure that was passed in response to stringent state land-use regulations in Oregon.[85] While the land-use restrictions that Measure 37 responded to had been in place for years in many cases, the proponents of the measure were able to use stories of purportedly egregious regulation of everyday activities by landowners to persuade voters to support the proposition.[86] In the voter's pamphlet for the 2004 election, many of the arguments made by those who supported Measure 37 emphasized stories of individual landowners who were now unable to perform everyday activities on their property, such as rebuilding destroyed houses or businesses, constructing signs for businesses, or even landscaping.[87] Thus, even after implementation, legal restrictions

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1980s indicating general popular support for I/M programs that help improve air quality).

[85] *See* Blaine Harden, *Anti-Sprawl Laws, Property Rights Collide in Oregon*, WASH. POST, Feb. 28, 2005, at A1. For background on the Measure 37 controversy, see Sara C. Galvan, *Gone Too Far: Oregon's Measure 37 and the Perils of Over-Regulating Land Use*, 23 YALE L & POL'Y REV. 587 (2005) and Michael C. Blumm & Erik Grafe, *Enacting Libertarian Property: Oregon's Measure 37 and Its Implications*, 85 DENV. U. L. REV. 279 (2007). As an example of the stringency of Oregon's land-use requirements, the state had an "exclusive farm use" zone that "severely restricted the siting of dwellings on agricultural land and development of the land for any purpose other than farming." *Id.* at 293 & n.74.

[86] *See* Harden, *supra* note 85, at A1 (stating that voters supported Measure 37 because they began to perceive land-use restrictions as "restrictions on personal rights"); Blumm & Grafe, *supra* note 85, at 306 ("The proponents of Measure 37 were also extremely successful in their radio and television campaign, which spotlighted sympathetic individual land owners, including the elderly and the disabled, whose dreams of developing their land were allegedly thwarted by seemingly extreme or arbitrary government action."); *id.* at 306 n.148 (noting television advertisement highlighting "a $15,000 citation of a Portland homeowner for cutting down blackberry bushes in her backyard, and ranchers who were allowed to build on their ranch but were required to 'move out for four months of the year, so as not to disturb the wildlife'"). Prominent place in the initiative's campaign was given to an elderly woman who was unable to subdivide her property to allow her children to inherit part of her land. *See* Harden, *supra* note 85, at A1 ("Measure 37 was sold to voters last year as a matter of fairness. On ubiquitous radio ads, the frail, woebegone voice of Dorothy English, who bought land in 1953, explained how land-use laws had blocked her from dividing her 40 acres for her children.").

[87] *See* Blumm & Grafe, *supra* note 85, at 306–07 n.148 (providing a summary of the major examples in the ballot initiative); STATE OF OREGON,

that significantly impinged on the public's expectations to undertake long-standing regulations can remain politically vulnerable.

All of these reasons why delayed harm regulation is politically vulnerable in general also apply to climate change regulation. The great majority of greenhouse gas emitting activities come from activities that have been engaged in by humans for extended periods of time. Some of them—such as the use of fossil fuels to power automobiles or to produce electricity—have been going on for decades. Others—such as the clearance of forests for agriculture or emissions from livestock[88]—have been going on for centuries.

Thus, there are without question significant economic impacts from regulation of greenhouse gases, at least in the near term, and at least for particular industries and economic activities (e.g., oil and gas production). Those who are most affected in a negative

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VOTER'S PAMPHLET 105–06 (2008), *available at* http://www.oregonvotes.org/nov22004/guide/pdf/vpvol1.pdf (containing arguments about impact on ability of property owner to subdivide their land); *id.* at 107 (claim that family was prohibited from constructing a swing set because of land-use restrictions); *id.* at 108 (claim that land-use restrictions prevented operation of pumpkin farm and children's play area); *id.* at 109 (claim that land-use restrictions prohibited reconstruction of burned house, unless significant landscaping alterations were made); *id.* at 110 (claim that land-use restrictions prohibited the conversion of a structure to a "caretaker's house" on a small farm); *id.* at 111 (claim that land-use restrictions prohibited construction of a fence or disturbance of vegetation on residential property); *id.* at 112 (claim that land-use restrictions prohibited construction of sign along highway); *id.* at 114 (claim that land-use restrictions prohibited construction of church but would have allowed a "community center").

The provisions of Measure 37 also emphasize the importance of the expectations of landowners to undertake long-existing uses. One provision of Measure 37 that permitted the state and local governments to avoid compensation payments if they "allow[ed] the owner to use the property for a use permitted at the time the owner acquired the property." *See* Blumm & Grafe, *supra* note 85, at 325. A later ballot initiative that trimmed back on the scope of Measure 37 essentially restricted its coverage to small-scale residential development. *See id*. at 361–63 (describing Measure 49). This later change minimized the economic impacts of the provision, since much economic benefit from development comes from industrial, commercial, and large residential projects—again emphasizing the importance of the "endowment effect" to the political dynamic at work.

[88] *See* Pete Smith & Daniel Martino et. al., *Agriculture*, *in* CLIMATE CHANGE 2007, CONTRIBUTION OF WORKING GROUP III TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 501 (2007) (noting the contribution of livestock emissions to climate change through the release of methane).

way can be sure to mobilize effectively to prevent regulation, given their relatively small numbers and the stakes at issue. And, of course, we have already seen how effective major energy companies (for instance) have been in trying to prevent or delay climate change regulation. That opposition will not disappear overnight once the regulations are enacted, although some of it might be bought off with grandfather exemptions and side-payments.[89]

The myopia of individuals and our political system also makes climate change regulation difficult. The largest harms from climate change are most likely to occur in the future, sometimes far in the future. It will be extremely difficult to mobilize the public and the political system to address those far-distant harms or to maintain support for the regulations once they are enacted.[90]

Many of the activities that cause greenhouse gas emissions—automobile driving, certain agricultural methods, development of natural ecosystems, electricity use and production—have been integral and accepted parts of most peoples' lives around the world in one way, shape, or form.[91] The endowment effect or status quo bias therefore could be potentially enormous, making not just the initiation but also the maintenance of climate change regulation all the more difficult.[92]

2. *How Apparently Ineffective Regulation Might Cause a Backlash*

Regulation of activities that cause delayed harm is not just politically vulnerable because it often constrains long-standing activities. The gap between the initiation of regulation and the

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[89] Various tools in the current international system to address climate change (e.g., the Kyoto Protocol) have already adopted compensation programs, such as the Clean Development Mechanism (CDM). For discussion of the CDM, and problems with it, see Michael Wara, *Measuring the Clean Development Mechanism's Performance and Potential*, 55 UCLA L. REV. 1759 (2008).

[90] *See* Bazerman, *supra* note 66, at 185–86; Cass R. Sunstein, *On the Divergent American Reactions to Terrorism and Climate Change*, 107 COLUM. L. REV. 503, 545 (2007).

[91] *See* Deborah L. Rhode & Lee D. Ross, *Environmental Values and Behaviors: Strategies to Encourage Public Support for Initiatives to Combat Global Warming*, 26 VA. ENVTL. L. J. 161, 166 (2008) (noting the substantial changes in personal behavior for everyday activities that climate change regulation will likely require).

[92] *See* Green, *supra* note 65, at 89–90 (noting that habits of individuals may make changing behavior to address climate change extremely difficult).

change in environmental conditions also directly creates political problems for the regulatory system, perhaps based on a phenomenon similar to the "status quo bias." To the extent that people are used to the current global climate system, they might be willing to expend significant amounts of resources to protect it. However, if the climate system changes despite those expenditures, individuals may become used to those changes and even embrace them as the new "status quo".[93] They might then be relatively unwilling to expend significant resources to prevent additional changes.[94] The following passage makes this point in a poignant way in the context of conservation of biodiversity:

> It is easy for people not to miss what they never had and never saw. Consider the passenger pigeon. Two hundred years ago there were billions of them. It is estimated that one out of every two land birds in North America was a passenger pigeon. John James Audubon witnessed a flock that took three days to fly past him near Cincinnati in 1813. He described it as follows: 'The light of the noonday was obscured as by an eclipse.' Today there are none. But how many Americans are aware of what we lost, and how many of us feel that our lives have been diminished by the loss?
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> Similarly, a few hundred years ago sea turtles were so abundant that ships sometimes sank when they struck vast shoals of them. The turtles may have consumed more plants in the Caribbean than the herds of bison did on the plains. Today all marine turtle species are rare, but few of us miss them or are

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[93] *See* Matthew D. Zinn, *Adapting to Climate Change: Environmental Law in a Warmer World*, 34 ECOLOGY L. Q. 61, 96–97 (2007) (making the point that the massive environmental changes that climate change might cause might result in decreased political support for protecting the natural environment because of the elimination of the "status quo" endowment effect in favor of that natural environment).

[94] *See* Korobkin, *Endowment Effect*, *supra* note 72, at 1229 ("If the air is clean and gas expensive, you are more likely to prefer clean air and expensive gas to cheap gas and dirty air than you would if the air were dirty and gas cheap. . ."); Sunstein, *supra* note 73 at 236–37 ("In the environmental context, it might be hypothesized that the preference for environmental quality will be especially weak among people who have not been exposed to pristine areas, clean water, and clean air."); Cass R. Sunstein, *Selective Fatalism*, 27 J. LEGAL STUD. 799, 805, 819–22 (1998) (making similar arguments); Roger G. Noll & James E. Krier, *Some Implications of Cognitive Psychology for Risk Regulation*, 19 J. LEGAL STUD. 747, 765–67 (1990) (hypothesizing that if status quo bias is significant, then environmental preferences will be extremely path dependent, and "environmental risk policy must either avoid significant setbacks altogether or be very good indeed, overall, if people are to perceive policy progress").

even aware of the remarkable phenomenon that has been lost.[95]

Protection of endangered species often depends on "saving" species that are on the brink—but few people talk about restoring species to their full, prior extent or numbers.[96] In part, that is a question of feasibility, but it is also a question of what is considered "normal." It is not normal today for there to be "shoals" of sea turtles. The most we can consider is protecting the species that we have, perhaps at slightly higher levels so that they are less at risk of disappearing. While it is impracticable to restore species such as the passenger pigeon and the dodo that are truly extinct, there has been great resistance to restoration of species to locations where they were extirpated from, in part because the "status quo" no longer includes the existence of those species in those places.[97] Delayed harms reset the baseline by which we judge whether or not regulatory efforts are worthwhile—despite our best regulatory efforts, we may have moved into a new status quo. As the public adjusts to the new status quo, they may question why the regulatory efforts, which were intended to maintain a prior baseline, should continue to be pursued.[98]

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[95] Gordon H. Orians, *Nature and Human Nature*, 137 DAEDALUS 39, 48 (Spring 2008).

[96] *Cf.* Deborah Epstein Popper & Frank J. Popper, *The Great Plains: From Dust to Dust, a Daring Proposal for Dealing With an Inevitable Disaster*, 53 PLANNING 12 (1987) (proposing the removal of hundreds of thousands of residents, the conversion of much of the Great Plains to prarie, and the restoration of the buffalo population to pre-European settlement numbers). This "Buffalo Commons" proposal inspired a sharp negative reaction, perhaps showing the challenge that large-scale environmental restoration efforts face after the previous natural environment has been degraded or destroyed. *See, e.g.*, Lorna Thackeray, *Buffalo Commons Idea Lingers*, BILLINGS GAZETTE, June 21, 2005, *available at* http://www.trib.com/articles/2005/06/21/news/regional/66c51d24886c80bf87257026006eb6f3.txt (describing protests from Plains-region citizens against the idea of a Buffalo Commons); Anne Matthews, *The Poppers and the Plains*, N.Y. TIMES, June 24, 1990, § 6 (Magazine), at 8, *available at* http://www.nytimes.com/1990/06/24/magazine/the-poppers-and-the-plains.html (quoting negative reactions from local politicians).

[97] For an example of the resistance that develops to the restoration of long-extirpated species to an area, consider the fierce political and cultural resistance to the reintroduction of grey wolves to Idaho and Wyoming and the Southwest by the federal government in the 1990s. *See generally* DOUGLAS W. SMITH & GARY FERGUSON, DECADE OF THE WOLF: RETURNING THE WILD TO YELLOWSTONE (2005); MARTIN A. NIE, BEYOND WOLVES: THE POLITICS OF WOLF RECOVERY AND MANAGEMENT (2003).

[98] *See* Zinn, *supra* note 93, at 96–97 (arguing that the change in environmental baselines might lead the public to value the "cultural and economic status quo" as a more important endowment than the natural world,

In addition, "backlash" might occur if the gap between regulation and environmental improvement leads the public and political decisionmakers to question the causal link between the activity and the harm. As noted above, the delayed nature of the harm will often make the causal links between the activity and the harm tenuous. If termination of the activity has no apparent effect on the level of harm—and perhaps even is followed by a continued increase in the harm—then there may be questions about whether the causal linkage really exists. This questioning could be fatal to the maintenance of a costly regulatory program restricting or banning the activity—even if in fact there is an underlying causal connection between the activity and the harm.[99]

3. *Why Backlash Might Not Occur*

To be sure, backlash is not inevitable in all circumstances of environmental regulation of delayed harms. The failure of the regulatory process to immediately eliminate or even reduce environmental harm might instead inspire the political process to impose even stricter, more draconian regulations in a (futile) effort to speed up the elimination of harm. However, to the extent that the political resistance to the initiation of regulation is still strong,

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and that "*reductions* in environmental quality over time may also reinforce declining support for environmental protection") (emphasis in original). Fisheries and marine biologists have called this concept—in which changes in the natural environment over time due to human impacts change what society considers "natural" and therefore worth preserving—the "shifting baselines" phenomenon. *See* Daniel Pauly, *Anecdotes and the Shifting Baseline Syndrome of Fisheries*, 10 TRENDS ECOLOGY & EVOLUTION 430 (1995); *see also* Robin Kundis Craig, *Taking the Long View of Ocean Ecosystems: Historical Science, Marine Ecosystems, and the Oceans Act of 2000*, 29 ECOLOGY L. Q. 649, 656 (2002) (discussing how the phenomenon is important for understanding appropriate oceans policy); KATE WING, NATURAL RES. DEF. COUNCIL, KEEPING OCEANS WILD: HOW MARINE RESERVES PROTECT OUR LIVING SEAS, 3–4 (2001) (relying on this phenomenon to argue for the creation of marine reserves). For examples of how modern perceptions of the "healthy" state of various marine resources have been shaped by anthropogenic changes of the marine environment, see Jeremy B.C. Jackson, et al., *Historical Overfishing and the Recent Collapse of Coastal Ecosystems*, 293 SCI. 629, 629 (2001).

[99] Of course, the lack of immediate environmental improvement after the imposition of regulation might be because society has identified the wrong cause of the environmental harm. In other words, those who question the causal connection between the activity and the harm might be correct. The problem is that we would be unable to determine who is right for sure until the delay period has passed. This uncertainty might well play into the hands of those who oppose what has been perceived to be costly and burdensome regulation.

that political resistance may stand in the way of stricter regulation and would instead likely push the political system in the direction of relaxed regulation.[100]

Another reason that backlash might not occur is that regulation may result in a change in the underlying political dynamics. For instance, a new regulatory system might result in the creation of an entirely new industry devoted to managing, cleaning-up, eliminating, or preventing pollution. That industry might in turn become a significant political actor that is well-organized and well-mobilized—because the regulation has created concentrated benefits as well as imposed concentrated costs.[101] This new political landscape might result in successful resistance to the calls to roll back regulation despite the apparent lack of

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[100] We might be more likely to see this ratcheting up of regulatory standards (the opposite of backlash, as it were) in situations where the politics of the delayed harm is particularly friendly to regulation—for instance, in situations where the risk of harm in the future creates a sense of "dread" that leads the public to push for strict regulation, as in areas such as nuclear waste and hazardous waste disposal. *See supra* notes 103–105 and accompanying text.

[101] For instance, federal hazardous waste disposal and clean-up requirements have helped create a substantial industry focused on waste management, an industry that in turn has become a key participant in litigation over waste disposal regulations and in the lobbying over waste management standards. *See, e.g.*, Hazardous Waste Treatment Council v. U.S. Envtl. Prot. Agency, 886 F.2d 355 (D.C. Cir. 1989) (hazardous waste treatment trade association, in combination with environmental groups, challenging EPA hazardous waste regulations as insufficiently stringent); Chemical Waste Management v. U.S. Envtl. Prot. Agency, 976 F.2d 2, 6–7 (D.C. Cir. 1992) (same); Marc K. Landy & Mary Hague, *The Coalition for Waste: Private Interests and Superfund*, *in* ENVIRONMENTAL POLITICS: PUBLIC COSTS, PRIVATE REWARDS 67, 77–81 (Michael S. Greve & Fred L. Smith, Jr. eds., 1992) (noting the size and clout of the hazardous waste management industry, and its alliance with environmental groups in the legal and political realms); Todd Zywicki, *Environmental Externalities and Political Externalities: The Political Economy of Environmental Regulation and Reform*, 73 TUL. L. REV. 845, 858–60 (1999) (making similar points). The role that the hazardous waste management industry plays in environmental regulation is one example of a broader phenomenon that some commentators have described as a "Baptist and bootlegger" alliance between environmentalists and industry seeking stricter environmental regulation. *See, e.g.*, Bruce Yandle & Stuart Buck, *Bootleggers, Baptists and the Global Warming Battle*, 26 HARV. ENVTL. L. REV. 177, 185–90, 207–11 (2002) (describing the general dynamic and noting its application in the context of global warming policy, where renewable energy industries will benefit from subsidies); *see also* BRUCE A. ACKERMAN & WILLIAM T. HASSLER, CLEAN COAL/DIRTY AIR 117–19 (1981) (noting alliances between elements of the coal industry and environmental groups in the design of the Clean Air Act in the 1970s).

harm reduction. Indeed, as I will discuss shortly, policymakers could consciously rely on the creation of this type of new industry in order to reduce the risk of backlash in the future.[102]

There is a third reason that backlash might not occur, and it relates back to the behavioral economic issues covered earlier. There is some evidence that for certain kinds of harms that occur in the future, individuals overstate the impacts and are willing to pay more to avoid the harm (compared to what a rational-choice model would predict). This dynamic is known as "dread,"[103] and it appears to be most present when there are "perceived threats to physical health,"[104] or when the risk is an uncontrollable, novel, and potentially catastrophic risk.[105] Dread might outweigh myopia in the context of a range of environmental harms where human health impacts are of high salience, such as in areas as hazardous waste, where toxic substances pose a risk of cancer to particular communities, or nuclear facilities, where the risk of an accident can be dramatic. However, dread may be much less important in the context of environmental harms such as climate change or endangered species protection, where the impacts to individual physical health are less direct or non-existent, and harms are subtle and gradual to develop.[106] This conclusion is supported by the evidence that the public consistently rates climate change as a relatively low-level public concern.[107]

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[102] *See infra* notes 132–133 and accompanying text.

[103] *See* Heinzerling, *supra* note 51, at 2030–31 ("Laypeople also appear to care a great deal about whether a hazard threatens only this generation, or also future generations, and they appear to perceive the latter kind of hazard as riskier than the former."); *id.* at 2072 ("[C]itizens reserve a special dread for hazards posing latent risks and risks to future generations"); *see also* Robin Gregory and Robert Mendelsohn, *Perceived Risk, Dread, and Benefits*, 13 RISK ANALYSIS 259 (1993) (exploring the dread phenomenon).

[104] Heinzerling, *supra* note 51, at 2040.

[105] Weber, *supra* note 68, at 105, 112–13.

[106] *See* Sunstein, *supra* note 90 (making this point); Weber, *supra* note 68, at 112 (same); Rhode & Ross, *supra* note 91, at 171–73 (2008) (noting importance of visual evidence of environmental harm to raise public attention, and that in the absence of such evidence, the public may underestimate the importance of the risk of that harm); *see also* Jedediah Purdy, *Climate Change and the Limits of the Possible* 9–10 (Duke Law School Legal Studies Research Paper No. 217, 2008), *available at* http://ssrn.com/abstract=1259802 (noting importance of salience in inspiring political action in environmental law, and the lack of many salient events of environmental harm connected to climate change).

[107] *See* Rhode & Ross, *supra* note 91, at 165 (summarizing polling data showing public's relative lack of concern over global warming) ("The

Thus, the dynamic of backlash against regulation of activities of delayed harm is not a preordained conclusion. It is contingent on the particular political landscape of the particular human activity being regulated and the environmental harm that the regulation seeks to control.

C. *An Example of Backlash: The Endangered Species Act and Species Recovery*

As an example of why backlash is a non-trivial possibility despite these caveats, I turn to a real life example of backlash, the current critiques of the federal Endangered Species Act (ESA). The ESA is intended to provide regulatory protection to threatened and endangered species within the United States (and in limited circumstances, overseas as well) against the full range of threats that they face, including habitat destruction.[108] But, as noted above, one of the main challenges in biodiversity protection is that activities such as habitat destruction often take an extended period of time before the full harms are shown in declines of species populations.[109] Thus, it would be expected that even if the ESA results in full, complete, and effective prohibitions on human activities that cause harmful habitat destruction (which it emphatically does not),[110] there would nonetheless be a period of time in which the status of the protected species would continue to decline.

Indeed this is what the data for the ESA indicates has taken

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public's . . . perception that global warming does not pose a serious immediate threat to their quality of life, poses obvious policy challenges."); Sunstein, *supra* note 90, at 512–13 (providing similar data).

[108] Both Section 7 and Section 9 of the ESA have been interpreted to provide protections against some forms of habitat destruction. *See* Endangered Species Act, 16 U.S.C. § 1536(a)(2) (2008) (prohibition on federal activity that will "jeopardize" listed species or would "result in the destruction or adverse modification of" designated critical habitat); 16 U.S.C. § 1538(a)(1)(B) (2008) (prohibiting the "take" of any listed species by any person); 50 C.F.R. § 17.3 (2008) (interpreting "take" to include some forms of habitat destruction); Babbitt v. Sweet Home Chapter of Communities for a Great Oregon, 515 U.S. 687, 687 (1995) (upholding regulation defining take as including some forms of habitat destruction).

[109] *See supra* notes 31–34 and accompanying text.

[110] *See, e.g.*, Biber, *supra* note 32, at 118–134 (noting limited use of federal regulatory authority to prevent harm to endangered species). *See generally* Oliver A. Houck, *The Endangered Species Act and its Implementation by the U.S. Departments of Interior and Commerce*, 64 U. COLO. L. REV. 277, 279 (1993) (making similar points).

place. More than thirty-five years after it was enacted, well over 1,300 species have been listed as threatened or endangered, but only forty-six have been delisted, and of those, twenty-six were delisted either because the original listing was in error or because the species went extinct.[111] Even of the species currently listed that have not gone extinct, as of 2006 approximately one-third were still declining in population size.[112]

Critics of the ESA have jumped on these statistics to argue that the ESA is "broken," that the regulatory system just does not work and needs reforming.[113] Proposals for reform have ranged from calling for a prioritization or "triage" system whereby resources would be focused only a select number of species (leaving the rest presumably to go extinct)[114] to proposed bills that

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[111] *See* U.S. Fish & Wildlife Serv., Threatened & Endangered Species System, http://ecos.fws.gov/tess_public/TESSBoxscore (last visited July 21, 2008) (providing total number of species listed in the United States); U.S. Fish & Wildlife Serv., Threatened & Endangered Species System, Delisting Report, http://ecos.fws.gov/tess_public/pub/delistingReport.jsp (last visited July 21, 2008) (providing species delisted).

[112] *See* U.S. FISH & WILDLIFE SERV., REPORT TO CONGRESS ON THE RECOVERY OF THREATENED AND ENDANGERED SPECIES FISCAL YEARS 2005–2006, *available at* http://www.fws.gov/endangered/recovery/reports_to_congress/2005-6/2005-6%20Report.pdf. Another one-third of listed species were stable, the status of 23 percent was unknown, and 8 percent were improving. *Id.*

[113] *See, e.g.*, Nat'l Wilderness Institute, *Conservation Under the Endangered Species Act: A Promise Broken*, 7 NWI RESOURCE 1, 29–53 (1997) (arguing that the poor success rate of the ESA means radical reform or repeal of the ESA is required); Ike C. Sugg, *Caught in the Act: Evaluating the Endangered Species Act, Its Effects on Man, and Prospects for Reform*, 24 CUMB. L. REV. 1, 42 (1993) (same); CHARLES C. MANN & MARK L. PLUMMER, NOAH'S CHOICE: THE FUTURE OF ENDANGERED SPECIES 243–45 (1995) (same); Charles C. Mann & Mark Plummer, *Is Endangered Species Act In Danger?*, 267 SCI. 1256, 1256–57 (1995) (same); *see also* Holly Doremus & Joel E. Pagel, *Why Listing May Be Forever: Perspectives on Delisting under the U.S. Endangered Species Act*, 15 CONSERVATION BIOLOGY 1258, 1260–61 (2001) (noting this criticism but disagreeing with it). For an example of this critique by members of Congress, see *Hearing on H.R. 3824, Threatened and Endangered Species Recovery Act of 2005, Before the H. Comm. on Resources*, 109th Cong. 2 (2005) (statement of Rep. Richard Pombo, Chairman, H. Comm. on Resources) (where the primary sponsor Richard Pombo stated that "according to the Service, 77 percent of all the listed species have only achieved somewhere between zero and one quarter of their recovery goals," also asking "but after three decades of implementation, do these sound like the statistics of a successful law?"); s*ee also* H.R. REP. NO. 109-237 (2005) (accompanying a broad Endangered Species Act reform bill, which, although criticized by environmentalists, passed the House, but failed in the Senate).

[114] *See, e.g.*, MANN, *supra* note 113, at 226–31 (articulating this position); Donald A. Carr & William L. Thomas, *The Law and Policy of Endangered*

would significant reduce protection for all endangered species,[115] to calls for the effective repeal of the Act.[116] Others have focused more narrowly on claims of perverse incentives in the ESA's regulatory structure[117] or on arguments that the ESA inappropriately focuses on species rather than on broader ecosystems in need of protection.[118] There may well be validity to any and all of these critiques to the ESA. However, for our purposes, the key point is that all of the critiques can gain traction because they can point to an apparently poor track-record of success for the Act. Yet, as shown, that poor track-record might well have been inevitable, given the delayed nature of the harms of habitat destruction for endangered species.[119] Even the best-designed species preservation act in the world would still have resulted in the continued decline of many species if it only focuses on preventing the human activities that lead to harm.[120]

D. *A Warning About Future Climate Change Regulation*

Given all this, what might be the political reactions in the face of the negative news about the ongoing impacts of climate change —despite our best efforts to regulate greenhouse gases? Climate change does not create the same type of dread as (for instance)

Species Reauthorization: Noah's Choices and Ecological Mandarins, 25 ENVTL. L. 1281, 1289 (1995) (same).

[115] *See, e.g.*, H.R. 2275, 104th Cong. § 201(a)(3) (1995) (sponsored by Rep. Young (R-AK)). This bill would have limited regulation to direct physical harming of endangered species. *See also* S. 768, 104th Cong. § 403(B) (1995) (sponsored by Sen. Gordon (R-WA)) (containing a provision similar to the one described for H.R. 2275).

[116] *See, e.g.*, H.R. 2364, 104th Cong. (1995). This bill, sponsored by Rep. Shedegg (R-AZ), would have made the ESA strictly voluntary.

[117] *See, e.g.*, David S. Wilcove, *The Promise and Disappointment of the Endangered Species Act*, 6 N.Y.U. ENVTL. L.J. 275, 277–78 (1998).

[118] *See, e.g*, Jacqueline Lesley Brown, *Preserving Species: The Endangered Species Act Versus Ecosystem Management Regime, Ecological and Political Considerations, and Recommendations for Reform*, 12 J. ENVTL. L. & LITIG. 151, 178–82 (1997).

[119] For evidence that habitat destruction is a major cause of the decline of many endangered species, *see, e.g.*, Robbyn J.F. Abbitt and J. Michael Scott, *Examining Differences Between Recovered and Declining Species*, 15 CONSERVATION BIOLOGY 1274 (Oct. 2001).

[120] For a critique of the reliance on delisting numbers as a tool to evaluate the performance of the ESA, *see* Holly Doremus, *Delisting Endangered Species: An Aspirational Goal, Not a Realistic Expectation*, 30 ENVTL. L. REP. 10343 (2000); Doremus & Pagel, *supra* note 113, at 1260.

nuclear waste or carcinogenic substances, and the benefits of climate change regulation will be far in the future, beyond the myopic time frames of most citizens. A hypothetical climate change regulatory system will require painful changes in everyday behaviors, pain that is both economic and psychological. Yet that draconian regulation would not prevent serious impacts on human and natural systems from climate change (albeit impacts that might be still diffuse enough to not inspire dread).

In that context, there might well be significant calls for the weakening or elimination of the greenhouse gas regulation system as a "broken" one that should be "replaced," "fixed," or perhaps even repealed.[121] Even if those calls for statutory changes are unsuccessful, the political pressure may have a significant impact on the implementation on any regulatory system, leading administrative agencies to drag their feet and appropriations committees to underfund the statutory scheme.[122] Given the likely significant global costs of regulation, the number of actors involved, and their conflicting interests, the battle over whether the regulatory system is working or not is likely to be far messier and more challenging than the one over the ESA in the United States.

Backlash therefore might be a real possibility for future national or global climate change regulation. Yet the major current debates over policy options in the United States and at an international level do not even address this possibility. They currently focus on whether to adopt a carbon tax or a cap-and-trade system, but this discussion really does not address this fundamental problem with regulating delayed harms such as climate change.[123] Both regulatory systems will still be costly and challenging for economic and social systems to adjust to. The cost of both systems would be contrasted with a global climate system

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[121] *See supra* notes 113–120 and accompanying text.

[122] This dynamic is not infrequent in the context of environmental law. *See* Eric Biber, *The Importance of Resource Allocation in Administrative Law*, 60 ADMIN. L. REV. 1, 40–49 (2007); Richard J. Lazarus, *Super Wicked Problems and Climate Change: Restraining the Present to Liberate the Future*, 94 CORNELL L. REV. (forthcoming 2009).

[123] *See, e.g.*, Wiener, *supra* note 1, at 238–40 (overview of debate). *Compare, e.g.*, David Harrison Jr. et al., *Using Emissions Trading to Combat Climate Change: Programs and Key Issues*, 38 ENVTL. L. REP. NEWS & ANALYSIS 10367 (2008) (arguing for cap-and-trade), *with* Michael J. Zimmer, *Carbon Tax: Ready for Prime Time?*, 8 SUSTAINABLE DEV. L. & POL'Y 67, 78 (2008) (arguing for carbon tax).

that continues to worsen. Thus, both are equally vulnerable to the long-term possibility of repeal or "reform" because they will both appear not to be worth their cost.

III. CAN WE PREVENT BACKLASH?

What might we do to prevent backlash? Is there a way to reduce the risk that the gap between regulation and environmental improvement causes a repeal or rollback of the regulatory system? I identify two possible approaches to preventing backlash. One would be to make it more difficult for the regulatory system to be repealed—a "lock-in" system. The other would be to reduce the gap between regulation and environmental improvement so that there is less motivation to repeal the regulatory system in the first place. I explore each of these options in turn.

A. *Preventing the Repeal of Regulation: Locking-In Regulation, Norm-Shifting, Industry Lobbying, and Education*

First, consider efforts to "lock-in" the regulatory system when it is initiated to prevent the possibility of weakening standards in response to a backlash. To some extent, the very fact that there is substantial inertia in the legislative process might protect statutes against formal repeal, although, as noted above, the implementation process may result in underenforcement of the statutory system. There are ways for Congress to set up statutory systems to reduce these risks, but probably not eliminate them.[124]

To the extent that legal repeal is a threat, protection could be accomplished through legal means, such as the use of super-majority requirements for the repeal or change of environmental standards. The problem in the context of environmental regulation is that such a "constitutional" solution is probably infeasible. In many countries (including the United States), domestic environmental policymaking is made primarily or exclusively at the statutory level, where super-majority requirements are more or less impossible to impose or enforce.[125] And at the international

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[124] *See* Lazarus, *supra* note 122 (describing these possibilities in the context of potential climate change legislation).

[125] The basic rule is that one Congress can not bind future Congresses. *See, e.g.*, Village of Rosemont v. Jaffe, 482 F.3d 926, 937 (11th Cir. 2007).

Of course, at the administrative level one might try to "lock-in" climate change policy against efforts to change it short of legislative reforms. For

level, policymaking is generally conducted through treaty-making which provides individual countries the ability to unilaterally withdraw from the treaty requirements.[126] Short of these formal steps, there are other alternatives such as efforts to make it procedurally more difficult for Congress to change the statutory scheme, although there are limitations to the effectiveness of these alternatives.[127]

There might be non-legal means to "lock-in" regulatory requirements—in particular, social norms might be changed, making the harm-causing activity unacceptable.[128] The shifted norms would in turn shrink or eliminate any political pressure to scale back or repeal the regulation controlling or prohibiting the harm-causing behavior. Norm-shifting could be accomplished through educational efforts using schools, public service announcements, etc. Current examples of fairly successful environmental norm-shifting efforts in the United States include the Smokey Bear campaign by the U.S. Forest Service to encourage the safe use of fire in natural areas, and anti-littering campaigns.[129]

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instance, detailed standards written into the relevant statutes, procedural requirements that prevent the weakening of regulatory standards, and other tools might make the climate change regulatory policy relatively resistant to lobbying, mobilization, litigation and other non-legislative changes. *See* Noll & Krier, *supra* note 94, at 774 (noting that there are various "lash . . . to the mast" techniques to bind an administrative system to particular outcomes). However, none of these tools would prevent the legislature from altering the underlying standards.

[126] *See* Vienna Convention on the Law of Treaties art. 54, May 23, 1969, 1155 U.N.T.S. 331 (parties may withdraw from treaties at their discretion so long as it is in compliance with withdrawal protocol of treaties or otherwise in compliance with the Vienna Convention's requirements for withdrawal).

[127] *See* Lazarus, *supra* note 122 (exploring these options for potential climate change legislation).

[128] *See* Rhode & Ross, *supra* note 91, at 177–79 (noting the importance of norms in determining what kinds of behaviors will be changed to respond to environmental concerns)

[129] *See* Smokey Bear, http://www.smokeybear.com (last visited Apr. 5, 2009); *see also* SMOKEY BEAR GUIDELINES 2–5 (2009), *available at* http://www.smokeybear.com/downloads/Smokey_Bear_Guidelines.pdf (providing an overview of the U.S. Forest Service's Smokey Bear campaign); Keep America Beautiful, http://www.kab.org (last visited Apr. 1, 2009) (providing an overview of the "Keep America Beautiful" anti-littering ad campaign). One of the most famous examples of the Keep America Beautiful campaign was the famous "Crying Indian" ad, in which a Native American wept at the sight of litter on the landscape. *See* Ad Council, http://www.adcouncil.org/default.aspx?id=132 (last visited Apr. 1, 2009). For evidence of the success

There are problems with using norm-shifting as a solution however: First, it may take significant periods of time to fully shift norms about acceptable behavior, particularly for many of the long-standing and economically important activities that are the causes of climate change, such as driving motor vehicles, certain forms of agriculture, electricity usage, etc.[130] Second, norm-shifting is inherently "sticky" as a solution—norms are not only hard to shift, but they also become entrenched once they are shifted, and they can be overinclusive in the behavior they cover. Accordingly, we may lose an important amount of flexibility in our regulatory policymaking, as shifting norms (for instance) either require us to completely prohibit activities that might only require regulation or restriction, or prevent us from lowering regulatory standards if it becomes clear that the harm is not as serious as once thought.[131]

Another option would be to try and change the political dynamics that might lead to a backlash by encouraging the development of industries and economic investments that depend on the new regulatory system. As noted above, part of the risk of backlash arises because of the significant economic investment that has been made in the long-standing activities that are now subject to regulation—that investment provides both the motivation and the support for lobbying to undo regulation after it has been implemented. However, if the new regulatory system requires significant economic investment, it can inspire the

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of these campaigns (albeit evidence collected by the sponsors of the campaigns), *see* SMOKEY BEAR GUIDELINES, *supra*, at 5 (providing evidence of decline in number of fires started by human carelessness in the United States over the period of time of the campaign); *see also* R.W. BECK, LITERATURE REVIEW: LITTER: A REVIEW OF LITTER STUDIES, ATTITUDE SURVEYS, AND OTHER LITTER-RELATED LITERATURE 3-3 to -5 (2007), *available at* http://www.kab.org/site/DocServer/Litter_Literature_Review.pdf?docID=481 (noting decline in deliberate litter over the past 20 years and studies showing that 20 years into the campaign, Keep America Beautiful sites were more than 8 percent cleaner than non-KAB sites, with a similar improvement noted for Adopt-a-Highway sites).

[130] *See* WILLIAM OPHULS, ECOLOGY AND THE POLITICS OF SCARCITY 152–53 (W. H. Freeman and Co. 1977).

[131] Another risk with the use of norm-shifting as a tool is the possibility that policymakers are wrong about the causal connection between a human activity and the delayed harm. As noted above, the delay between activity and harm makes drawing the causal connection between the two difficult, and it is almost inevitable that at times, policymakers will incorrectly conclude that a causal connection exists. If such a mistake is made, and norm-shifting is used as a policy tool, it may be very difficult to undo the mistake.

creation of new businesses, industrial systems, employment opportunities, etc. The individuals and corporations that benefit from this new economic investment can provide a political base of support for the new regulatory system, even in the absence of immediate environmental benefits. An example of this trend is the rise of the modern waste disposal, recycling, and treatment industrial sector, a sector that has been fairly effective in maintaining political support for existing and even strengthened waste regulations (both of solid waste and hazardous waste).[132] To the extent that climate change regulation is able to encourage the development of (for instance) new industries in renewable energy, this dynamic may play a role in maintaining support for the regulatory system.[133]

Finally, education might be used as a limited tool to shift the political dynamic, short of fully shifting social norms. At the most basic level, policymakers might simply try to inform the public about the delayed nature of the harm they are seeking to address, and to alert the public that there will be a time lag between the initiation of regulatory efforts and the improvement in environmental conditions. In the context of climate change, these calls would be for the public to understand that even with the tremendous changes and costs that climate change regulation will entail, there will nonetheless continue to be significant adverse climate impacts because of the greenhouse gases that modern economies have already emitted. These education efforts might increase the patience of the public and reduce the risk of backlash. Another option for education would be to highlight the human health risks and consequences from climate change, seeking to overcome the possibility of myopia. The limitation here is that education efforts by the government, environmental groups, or other parties might be countered by publicity efforts from the interest groups seeking to undermine or eliminate regulation—in other words there is no guarantee that the education efforts in

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[132] *See supra* note 101.

[133] For instance, the development of solar and wind industries may create a lobbying group that would be able to continue support for a global warming regulatory system. *See* Yandle and Buck, *supra* note 101, at 207–11 (arguing that these industries already have substantial political clout and have used it to advance the creation of new subsidies to support them). *See also* Lazarus, *supra* note 122 (noting this possibility).

support of regulation will necessarily win out.[134]

B. *Shortening the Gap Between Regulation and Environmental Improvement*

The other option is directly attacking the "gap" between the initiation of regulation and the beginning of environmental improvement. This option requires a very different focus from most other environmental policymaking tools. Liability solutions focus on the activities that happened in the past to cause present or future harm, and impose liability on those activities (in part to deter future harm-causing activity). Regulatory solutions focus on eliminating or reducing the activities in the present and future. Instead, here we want to focus directly on the harm that has already been created by past human activity, and seek to ameliorate it, reduce it, or even eliminate it. This option is restoration. Restoration focuses on the harm, rather than the activity that caused the harm.[135]

The advantage of restoration efforts compared to liability and regulatory solutions is that they can directly address the "embedded" harm that has already been caused by prior human activity. Both liability solutions (through deterrence of future activity) and regulatory solutions (through direct prohibitions or restrictions of future activity) can help prevent the creation of additional harm in the future. But only restoration efforts can reduce the harm that has already been initiated by prior human actions but has yet to manifest itself.

There are a number of examples of restoration efforts in American environmental harm. For instance, the Superfund program provides for a federal response and clean-up program for relatively serious hazardous waste sites, with funding provided by a mix of tax receipts and contributions from parties who are liable for the waste.[136] The program has been very expensive, averaging

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[134] There is also the risk that appealing to the dread of the public to inspire rigorous climate change regulation might result in similar problems that norm-shifting can produce: an overshoot of regulation and/or overly sticky regulatory standards that are unresponsive to changes in environmental or social conditions.

[135] *See* Craig, *supra* note 98, at 674–75 ("Restoration is thus active healing rather than mere cessation of harm."); Joseph L. Sax, *The New Age of Environmental Restoration*, 41 WASHBURN L.J. 1, 6–7 (2001) (noting that restoration includes "repair of an existing problem," but also the undoing of long-standing damage).

[136] *See* 42 U.S.C. §§ 9604–06 (2000).

around $1.5 billion in expenditures each year.[137] However, the program has resulted in significant progress on the remediation of approximately 1,000 hazardous waste sites across the United States, out of a total of approximately 1,550 that have been designated as dangerous enough for federal intervention.[138] Considering that all of these sites were listed since the passage of Superfund in 1980, and considering the complexity of remediation at many of these sites, this is remarkable progress (though much remains to be done).[139]

Another example of restoration efforts to prevent future delayed harms in modern American environmental law is the recovery program of the federal Endangered Species Act.[140] Under the ESA, the duty of the federal government is not just to prevent species from going extinct, but to affirmatively take steps to recover species such that they no longer need protection under the act—what the ESA defines as "recovery" or "conservation."[141]

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[137] U.S. GEN. ACCOUNTING OFFICE, SUPERFUND PROGRAM: CURRENT STATUS AND FUTURE FISCAL CHALLENGES 3, 12 (2003), *available at* http://www.gao.gov/new.items/d03850.pdf; *see also* KATHERINE N. PROBST AND DAVID M. KONISKY, SUPERFUND'S FUTURE: WHAT WILL IT COST? 10 (2001).

[138] *See* U.S. EPA, FY 2007 SUPERFUND ANNUAL REPORT iv (2007) (noting that 1,030 sites had "completed construction" as of the end of fiscal year 2007); *see also* U.S. GEN. ACCOUNTING OFFICE, *supra* note 137, at 14 (2003). "Completed construction is the stage of the cleanup when physical construction of all cleanup remedies is complete and all immediate threats have been addressed." U.S. EPA, *supra*, at 7. Of course, there may be many more sites still to be added to the list that require remediation, and it is possible that the progress of the EPA in reducing the backlog of unremediated Superfund sites is due to the agency's reluctance to designate new sites for clean-up, in part because of budget constraints. *See id.* at 8 (chart showing relatively slow increase in new numbers of Superfund sites); PROBST AND KONISKY, *supra* note 137, at 81 (noting that a decision as to whether a site should be listed is in part a political one based on budgets).

[139] Commentators have also noted that, after a shaky and slow start in the early to mid-1980s, the Superfund program appears to have achieved a significant amount of progress and momentum in the clean-up process. *See* PROBST AND KONISKY, *supra* note 137, at 1 ("Now, a number of EPA's harshest critics are singing the Agency's praises.").

[140] For a general overview of the history of wildlife restoration efforts in the United States, see Holly Doremus, *Restoring Endangered Species: The Importance of Being Wild*, 23 HARV. ENVTL. L. REV. 1 (1999).

[141] *See* 16 U.S.C. § 1532(3) (2006) (defining "conservation" as "the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to [the ESA] are no longer necessary"); § 1531(b) (purpose of ESA is to provide for "conservation" of listed species); § 1531(c) (expressing the "policy of Congress that all Federal departments and agencies shall seek to conserve endangered

This statutory language provides the basis for the "recovery" programs of the two major federal agencies tasked with implementing the ESA, the U.S. Fish and Wildlife Service (FWS) and the National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries). Under those recovery programs, FWS and NOAA Fisheries conduct a range of activities to improve the status of listed species, including habitat restoration, captive breeding, predator control, research, and population monitoring.[142]

For purposes of this paper, what is most significant has been the way in which FWS and NOAA Fisheries have used the ESA's recovery programs to actively address the political problems of delayed harms. In response to the criticisms of the ESA as a "broken" act that has done little to help endangered and threatened species, both FWS and NOAA Fisheries have highlighted the success stories of their recovery programs.[143] In particular, FWS and NOAA Fisheries have made an effort to not only publicize their decisions to delist species because of recovery,[144] but also have made active efforts to accelerate the process of delisting species due to recovery.[145]

Of course, one could criticize the efforts of FWS and NOAA Fisheries as simple political posturing—public relations stunts to

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species and threatened species"); § 1533(f) (requiring Secretary of Interior, who manages the ESA, to "develop and implement plans (hereinafter . . . referred to as 'recovery plans') for the conservation and survival of endangered species and threatened species"); § 1536(a)(1) (requiring Secretary of Interior to fulfill purposes of ESA, which includes conservation of listed species, and all other federal agencies to use their "authorities in furtherance of the purposes of this chapter by carrying out programs for the conservation of endangered species and threatened species").

[142] *See* Federico Cheever, *The Road to Recovery: A New Way of Thinking About the Endangered Species Act*, 23 ECOLOGY L.Q. 1 (1996); U.S. FISH AND WILDLIFE SERV., ENDANGERED SPECIES RECOVERY PROGRAM (2008), *available at* http://www.fws.gov/endangered/factsheets/recovery.pdf.

[143] For example, FWS regularly publishes articles in its journal *Endangered Species Bulletin* highlighting recovery success stories and statistics. *See, e.g.*, U.S. FISH & WILDLIFE SERV., ENDANGERED SPECIES BULLETIN (Sept. 2007), *available at* http://www.fws.gov/endangered/bulletin/2007/ES_Bulletin_09-2007.pdf.

[144] *See, e.g.*, *id.* at 2 (interior cover with picture of Interior Secretary Kempthorne with a bald eagle at a public ceremony honoring the recovery and delisting of the bird).

[145] Federico Cheever, *Recovery Planning, the Court and the Endangered Species Act*, 16 NAT. RESOURCES & ENV'T 106, 106 (2001) ("In recent years, FWS has stepped up delisting efforts.").

highlight the few success stories within their implementation of the ESA. And there may be something to that. But there is also evidence that the government agencies implementing the ESA have put increasing emphasis in recovery in terms of their own resources.[146] It is not implausible that the increase in resources is connected to the efforts by FWS and NOAA Fisheries to respond to the critique of the "broken ESA".

Moreover, restoration efforts like the ESA's recovery program do seem to be a useful way to fundamentally address the problem of maintaining a regulatory program to address the problems of delayed harm. Recovery work is the only way that we will accelerate the day when species populations will be increasing instead of decreasing—and perhaps may be the only way in which we can prevent the extinction of some species. Recovery efforts can either reduce the overall level of harm during the "gap" period by reducing all harms a certain level, or perhaps shorten the "gap" period by completely remediating certain harms.[147] In either case, the benefit will be a smaller amount of harm after the regulatory program is introduced (either because the gap is a shorter time frame, or because harm levels are reduced during the gap).

[146] *See* J. Michael Scott et al., *By the Numbers*, *in* 1 THE ENDANGERED SPECIES ACT AT THIRTY: RENEWING THE CONSERVATION PROMISE 16, 33–34 (Dale D. Goble et al. eds., 2006) (showing increase in recovery expenditures from a low around 1989 of about $50,000 per listed species to over $150,000 per listed species in 2003).

[147] *See infra* Figures 4 and 5.

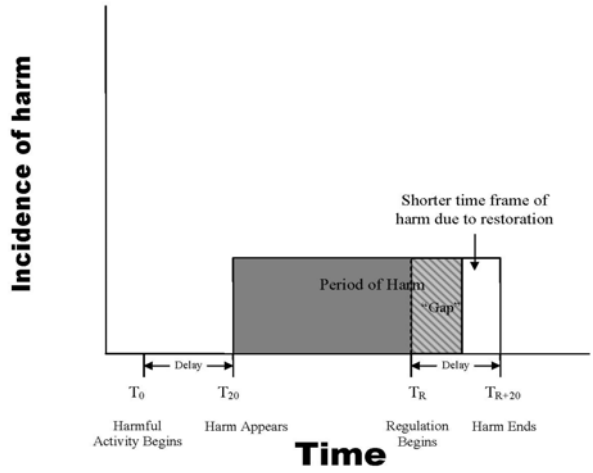

Figure 4: Restoration and Delayed Harm and Regulation (Shorter Time Frame)

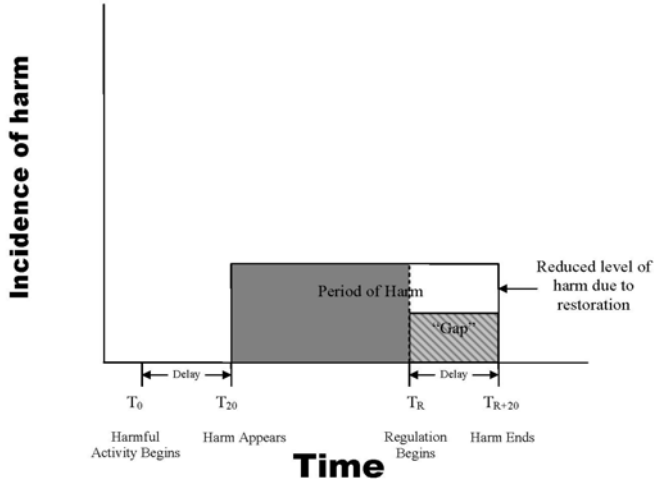

Figure 5: Restoration and Delayed Harm and Regulation (Less Harm)

C. *The Limits of Restoration: How Much Money? How Much Knowledge? How Much Time?*

Before I turn to examining how restoration might be useful as a solution to the risk of backlash in climate change policy, it is important to consider the possible limits of restoration. Is restoration a panacea for the possibility of backlash? What are the constraints on restoration, and what has its track record been?

A fundamental problem with restoration work is that it is often extremely costly. As noted above, hazardous waste site remediation at the federal level alone has cost approximately $1.5 billion per year since the mid 1980s. The sums are similarly enormous for endangered species recovery. FWS has developed estimates for how much it would cost to recover a fraction of the species listed under the ESA—for those 123 species, the total cost of recovery is estimated to be $2.6 billion, or $21 million per species.[148] If we extrapolate that estimate to all listed species, the total cost to recover all of the approximately 1300 species that are listed would be over $27 billion. And of course, the investment of these funds in the present to reduce harms in the future may be quite controversial and, perhaps, difficult to justify politically.[149]

But there are obstacles to restoration above and beyond the monetary cost. There are ample examples of restoration efforts—particularly in the context of endangered species—where the expenditure of large amounts of money appear so far to have had minimal impact on recovering listed species. In the past several years, Congress has appropriated hundreds of millions dollars in efforts to recover salmon populations in the Pacific Northwest and Alaska.[150] The results have been an impressive amount of habitat and management improvements to restore salmon populations.[151] Yet, most salmon populations remain far below historic levels—sometimes an order of magnitude below those levels—and in most cases have not substantially increased above their levels prior to the initiation of the recovery efforts in the late 1990s.[152] For many

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[148] Data compiled from U.S. FISH AND WILDLIFE SERV., REPORT TO CONGRESS ON THE RECOVERY OF THREATENED AND ENDANGERED SPECIES, FISCAL YEARS 2005–06 (2008).

[149] *See* Beth Baker, *Spending on the Endangered Species Act—too much or not enough?* 49 BIOSCIENCE 279, 279 (1999) (quoting congressional representatives questioning the large amount of money spent on recovery of species listed under the ESA).

[150] Between fiscal year 2000 and fiscal year 2006, Congress appropriated $590 million for the Pacific Coastal Salmon Recovery Fund. *See* U.S. DEP'T OF COMMERCE, NAT'L OCEANIC AND ATMOSPHERIC ADMIN., NAT'L MARINE FISHERIES SERV., 2007 REPORT TO CONGRESS: PACIFIC COASTAL SALMON RECOVERY FUND FY 2000–2006 i, 1 (2007) (giving totals overall and for each year). Substantial amounts of additional funds are provided by state matching grants. *Id.* at i, 3–4.

[151] *See id.* at ii (noting over 532,000 acres of habitat improved or made available and 11,000 stream miles improved or made accessible for salmon pursuant to salmon recovery efforts).

[152] *See id.* at 12 (ESA-listed salmon populations in Puget Sound and Olympic

of the populations that are closest to historical abundance, salmon breeding primarily occurs in hatcheries, indicating that the breeding habitat remains unsuitable for salmon populations despite the recovery efforts.[153]

Why might restoration efforts be apparently futile, despite significant resources? One possibility is that we simply lack knowledge to understand how to reverse the harm—and until we properly understand how the harm occurs, restoration will be costly and ineffective. In this light, the difference between the relative success for hazardous waste remediation and endangered species recovery might come down to the fact that hazardous waste analysis is simply easier than endangered species analysis. There is no question that the study of the movement of chemical compounds in underground aquifers and soil systems is exceedingly complex—different variables include the type of soil, the movement and type of the aquifer, the nature of the hazardous chemicals (often many different kinds) that are moving, and the interaction among those three factors.[154] But the complexity pales in comparison with our attempts to understand how complex ecological systems respond to a wide range of human activities.

Peninsula remain far below historic levels, with Puget Sound Chinook at around 40,000, compared to historical average at 600–800,000, and with trend lines showing only small increases in the past several years); *id.* at 14 (all ESA-listed salmon populations in lower Columbia River and Willamette River remain far below historic levels, with three of six populations still at less than 10 percent of historic levels, and trend lines only showing intermittent and unsustained increases); *id.* at 16–17 (for Interior Columbia River salmon populations, four of seven ESA-listed populations are less than 10 percent of historic abundance, and only three populations have sustained and substantial population increases); *id.* at 18 (population levels for Oregon Coast Coho salmon, not currently ESA-listed, have seen some increase since recovery efforts begun, but have begun to decline again); *id.* at 23 (while Central Valley Spring Chinook salmon have increased since recovery efforts have begun, Sacramento River Winter Chinook salmon have remained very low); *id.* at 25 (South-Central California Coast Steelhead salmon remain less than 1,000 compared to historic levels of 10–20,000).

[153] *Id.* at 14 (Eighty percent of Upper Willamette River Chinook salmon are hatchery raised, and 90 percent of Lower Columbia River Coho salmon are hatchery raised. Both populations are among the six populations with the highest population levels relative to historic abundance in the Lower Columbia River and Willamette River area.); *id.* at 16–17 (Five of seven ESA-listed salmon populations in Interior Columbia basin are more than 50 percent hatchery produced, including the three populations with sustained and substantial population increases.).

[154] For an overview of groundwater contamination analysis and remediation and its complexities, see C.W. FETTER, APPLIED HYDROGEOLOGY 472–504 (Robert A. McConnin ed., 3d ed. 1994).

To take the example of salmon again, to truly understand why salmon populations have crashed and continue to remain low, we would need to understand the life history of multiple salmon species; their interactions with both predator and prey species in the open ocean; how those salmon species (and their predator and prey species) are affected by changes in conditions in the open ocean; how those salmon species (both in terms of migration and breeding) are affected by changes in conditions in their riparian habitats; how activities as varied as dam construction and operation, logging, grazing, urbanization, pesticide use, and harvesting impact salmon species (and their predator and prey species); and many, many more factors.[155] This is a daunting task, even with limitless resources, and it appears to be a general problem in endangered species recovery.[156]

Another reason why restoration may be limited in its feasibility is present for both hazardous waste remediation and endangered species—just as there may be a delay between a harm-causing activity and a harm manifesting itself, there may be a delay between restoration work and the dissipation of the harm. For instance, many Superfund sites that are undergoing cleanup will require decades of what EPA terms "post-construction" activity to finish the remediation process.[157] Where the clean-up involves groundwater contamination by trace hazardous waste substances, those post-construction activities may require decades of "pump and treat" remediation of the groundwater to eliminate the trace levels of contaminants.[158]

A similar time delay likely plays out in the context of endangered species recovery.[159] Government reports about the status of salmon recovery efforts, for instance, reiterate that it may

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[155] *See* NAT'L MARINE FISHERIES SERV., *supra* note 150, at 1–2 (2007) (listing range of threats and complexity of those threats for salmon populations).

[156] *See* Holly Doremus, *Lessons Learned*, *in* 1 THE ENDANGERED SPECIES ACT AT THIRTY: RENEWING THE CONSERVATION PROMISE 195, 203–04 (Dale D. Goble et al. eds., 2006) ("Despite thirty years of experience, what we don't know about dwindling species and their protection could still fill volumes.").

[157] For an overview see PROBST AND KONISKY, *supra* note 137, at 55–74.

[158] *Id.*; *see also* C.W. FETTER, *supra* note 154, at 501 (noting that pump and treat remediation for a Superfund site will require a minimum of twelve years).

[159] *See* William Burnham et al., *Hands-on Restoration*, *in* 1 THE ENDANGERED SPECIES ACT AT THIRTY: RENEWING THE CONSERVATION PROMISE 237, 241 (Dale D. Goble et al. eds., 2006) ("Hands-on restoration [of endangered species] can also require long-term action.").

take many years for salmon populations to increase in response to habitat improvements, as it may take multiple salmon generations (each of 3–5 years) for the habitat improvements to trigger improved breeding and survival.[160] Part of the problem is that small populations can only expand so fast—if the maximum population growth rate is, for instance, 25 percent, a population at the level of 100 that reproduces every three years will take approximately nine years to double to 200 even if it reproduces at the maximal growth rate.[161] Indeed, this reality of long generation times and slow death and reproduction rates for many endangered species is at the heart of both why those species take so long to recover and why they are an example of delayed harm in the first place.

Thus, while restoration may be helpful to address the political weaknesses of regulation in addressing delayed harms, it is hardly a silver bullet. It will often be extremely costly. Policymakers seeking to use regulation to tackle the problem of delayed harms will be faced with a choice—to spend less money upfront on restoration efforts and avoid a political fight now, but take the risk that in the long-run the regulatory program will lose political support because of the ongoing nature of the delayed harm.

But even if the political obstacles to funding restoration can be overcome, there will be uncertainty about whether restoration

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[160] *See* NAT'L MARINE FISHERIES SERV., *supra* note 150, at ii, 2, 5 (2007) ("The intricate and variable life cycle of salmon and the nature of habitat requirements and restoration work mean that end results from projects often require several years to become evident.").

[161] Growth of populations is usually modeled by ecologists using the logistic growth equation, which describes population growth in a resource-limited environment. The equation is expressed as $dN/dt = rN(1-(N/K))$ where N is the size of the population, r is the rate of population increase, and K is the carrying capacity of the environment or the maximum population size that can be supported. NICHOLAS J. GOTELLI, A PRIMER OF ECOLOGY 28 (2d ed. 1998). The population grows at its highest rate when N=K/2. *Id.* Thus, populations starting well below the carrying capacity of the environment will usually begin growing quite solely (because of the small size of N), but over time the population size will begin to increase rapidly. Vertebrate species with a mean adult body mass of more than 1 kg generally have a maximum growth rate of less than 10 percent. R. Lande et al., *Estimating Density Dependence in Time-Series of Age-Structured Populations*, *in* WILDLIFE POPULATION GROWTH RATES 56 (R. M. Sibly et al. eds., 2003). *See also* Frank W. Davis et al., *Renewing the Conservation Commitment*, *in* 1 THE ENDANGERED SPECIES ACT AT THIRTY (Dale D. Goble et al. eds., 2006) ("There are biological limits to the rate at which species with small populations and limited habitat can be recovered.").

will achieve its goals in any case, even with funding. As the example of salmon in the Pacific Northwest shows, all the funding in the world will not assure the success of restoration, if only because of the lack of knowledge that we have about how so many environmental harms occur and how they can be remediated.

And finally even if we do have funding and knowledge to help overcome the problems of restoration, it may still take a long time for the restoration to be successful, as is the case for hazardous waste site remediation. Delayed harms may frequently be persistent ones, where remediation requires a minimum amount of time, often for the exact same reasons—as in the context of endangered species protection and restoration. Thus, restoration may itself require patience—but patience in the context of a backlash against a regulatory system that appears to be "broken" and failing may be in short supply. Thus, restoration may only sometimes be effective in addressing the political failures of regulation of delayed harm.

D. *Restoration and Climate Change*

How successful will restoration be in addressing the possibility of a future backlash against a carbon regulatory system? To answer that question, we have to try and understand what it means to speak of "restoration" in the context of climate change.

The significance of what it means to conduct restoration in the context of climate change depends in large part on what we think the "harm" is of climate change.[162] If we think that the harm of climate change is the direct impacts on human and natural systems from increases in temperature, then we would want to take steps to alleviate or offset those direct impacts. If we think the harm is the overall change in the planetary climate, then we would want to

[162] Other scholars have noted that a fundamental challenge for environmental restoration work is answering the questions of what is the harm that the restoration seeks to undo, and what is the goal that the restoration project seeks to achieve. *See* Craig, *supra* note 98, at 687–90; Alyson C. Fluornoy, *Restoration Rx: An Evaluation and Prescription*, 42 ARIZ. L. REV. 187, 189–92 (2000); Catherine A. O'Neill, *Restoration Affecting Native Resources: The Place of Native Ecological Science*, 42 ARIZ. L. REV. 343, 343–44 (2000) ("Restoration, of the environment or anything else: to what state or process or vision do restorative efforts aspire?"); Dan Flores, *Making the West Whole Again: Historical Perspective on Restoration*, 18 J. LAND RESOURCES & ENVTL. L. 17, 20 (1998) (question of restoration work in the American West depends on understanding what the original condition was and what changes have occurred).

take steps to "reset" the planetary thermostat. And if we think the harm is the increase in carbon dioxide levels in the atmosphere (and related greenhouse gasses), then we would want to take steps to reduce those levels in the atmosphere.

The first category—the idea that the harm is the direct impacts on the human and natural systems on the planet—aligns with the concept of "adaptation" in current climate policy discussions.[163] Adaptation is defined by the IPCC as "the adjustment in human or natural systems in response to actual or expected climatic stimuli or effects, which moderates harm or exploits beneficial opportunities."[164] In short, adaptation refers to efforts to reduce the harm from climate change in ways that respond directly to the particular harm at issue. For instance, if the harm is sea level rise, the response may be to construct bigger coastal barriers, the evacuation of populations and economic activity from threatened areas, or a mix of the two.

Adaptation is a topic that has received increasing attention in the climate policy literature, and it is not my goal here to provide a survey of that literature. But given the wide range of harms that may result from climate change, it is no surprise that there are a wide range of adaptation measures that might be pursued.[165] The

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[163] *See* WILLIAM E. EASTERLING ET AL., PEW CENTER FOR GLOBAL CLIMATE CHANGE, COPING WITH GLOBAL CLIMATE CHANGE: THE ROLE OF ADAPTATION IN THE UNITED STATES 6 (2004) (defining a successful adaptation as one that "can completely offset the loss from climate change").

[164] *See* Martin Parry et al., *Technical Summary*, *in* CLIMATE CHANGE 2007: IMPACTS, ADAPTATION AND VULNERABILITY: CONTRIBUTION OF WORKING GROUP II TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 27 (Martin Parry et al., eds., Cambridge Univ. Press) [hereinafter IPCC 4th Report]; *see also* PRADEEP KURUKULASURIYA & SHANE ROSENTHAL, CLIMATE CHANGE AND AGRICULTURE: A REVIEW OF IMPACTS AND ADAPTATIONS 1 (2003) ("[A]daptation to climate change and variability (including extreme events) at the national and local levels is regarded as a pragmatic strategy to strengthen capacity to lessen the magnitude of impacts that are already occurring, could increase gradually (or suddenly), and may be irreversible."); NICHOLAS STERN, THE ECONOMICS OF CLIMATE CHANGE 405 ("The objective of adaptation is to reduce vulnerability to climatic change and variability, thereby reducing their negative impacts") [hereinafter STERN REVIEW].

[165] *See* W. Neil Adger, et al., *Assessment of Adaptation Practices, Options, Constraints and Capacity*, *in* IPCC 4th Report, 721–24 (2007) (providing examples of a wide range of adaptation practices, including heat-wave alert systems in urban areas, artificial snow making at ski resorts, reduction of water levels in glacial moraine lakes that pose a risk of catastrophic flooding, and use of creative financial mechanisms to spread losses).

options for responding to climate change in agriculture, for instance, include changes to the time of planting of crops, changes in the crops that are planted, changes to planting methods and intensity, changes to irrigation methods, implementation of crop insurance schemes, improved food storage and reserve systems, increased investment in mechanization, and migration.[166] Undoubtedly, this wide range of adaptation measures will vary greatly on the scales of cost, certainty of success, and time to implement.[167]

However, there seems little doubt that adaptation by human and natural systems will be extremely costly in general,[168] that many adaptations will take extensive periods of time to implement, and that the success of many adaptation efforts will be highly uncertain because of our very limited knowledge of the harms caused by climate change and how to undo them.

Take, for instance, responses to sea level rise. Humans have made efforts to protect and reclaim land from the oceans for millennia, and we accordingly have a fair amount of knowledge and expertise about how this process works.[169] Nonetheless, the estimates for cost are substantial, ranging up to one trillion dollars total on a global scale.[170] Moreover, construction of most sea

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[166] *See* KURUKULASURIYA & ROSENTHAL, *supra* note 164, at 59–65 (providing an overview of the adaptations possible).

[167] *See* STERN REVIEW, *supra* note 164, at 406 (noting the distinction between short-run and long-run adaptation responses between climate change, with changing crop planting dates as an example of the former and changing irrigation systems as an example of the latter); *id.* at 408 Box 18.1 (noting that short-run and long-run distinction depends on the ability to change capital investments). *See also, e.g.*, *id.* at xxi (estimating "additional costs of making new infrastructure and buildings resilient to climate change in OECD countries could be $15–50 billion each year (0.05–0.5 percent of GDP)"); *id.* at 442 (noting cost of adaptation in developing countries is hard to estimate, but will likely be $3–37 billion per year); Gary W. Yohe & Michael E. Schlesinger, *Sea-Level Change: The Expected Economic Cost of Protection or Abandonment in the United States*, 38 CLIMATIC CHANGE 447, 468 tbl.IV (1998) (estimating cost of sea-level rise on developed U.S. coastline in 1990 dollars as ranging from $75 million to $4.6 billion, provided that abandonment of low-value lands is allowed).

[169] This is not to underestimate the complexities involved in coastal protection efforts and the unforeseen consequences of those efforts. *See generally* CORNELIA DEAN, AGAINST THE TIDE: THE BATTLE FOR AMERICA'S BEACHES (1999). However, the complexity is nonetheless much less than that involved with biodiversity protection and restoration, for instance.

[170] Robert J. Nicholls et al., *Coastal Systems and Low-lying Areas*, *in* IPCC 4th Report, 343 tbl.6.11 (2007) (estimate is for one meter sea level rise); *see also, e.g.*, STERN REVIEW, *supra* note 164, at 410 (noting that the cost of

defenses will take considerable amounts of time.

In contrast, we have much less information and understanding about how to respond to the harm to species and ecosystems from climate change. The most recent estimates are that climate change will have a devastating impact on biodiversity: perhaps 20–30 percent of all species will be at high risk of extinction as a result of climate change that results in a 2–3 degree Celsius temperature increase, with far higher levels of endangerments at higher temperatures.[171] However, our understanding of the specifics of those impacts, including the mechanisms by which ecosystems and species will be affected by climate change, is much less than it is for sea-level change.[172] Accordingly, our ability to understand how to respond to those threats and restore the harms is much more limited as well. Moreover, efforts to respond to the impacts of climate change on biodiversity are likely to be extremely costly and slow. Many of the proposals are the same as for addressing threats to biodiversity in general—restoration of ecosystems, expansion of reserves, etc.[173] But as noted above, those efforts are both expensive and likely time consuming. Other efforts, such as assisting species in their migration to suitable new habitat, appear even more fraught with uncertainty about the likelihood for success, and equally or more costly.[174]

The second major category—trying to manage the overall global temperature in order to offset the impacts caused by greenhouse gases—generally falls within the category known as "geoengineering" in the climate policy literature, and it has been highly controversial.[175] The main "geoengineering" method that

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adaptation to a sea-level rise of 0.5-m is between 0.1 percent to 1 percent of GDP depending on the vulnerability of a country, but could be much higher for a sea-level rise of 1 meter); *id.* at 417 (cost of adapting infrastructure investment in developed countries could be $15–50 billion per year); EASTERLING ET AL., *supra* note 163, at 3 (2004) (estimating "cost of adapting to 0.5-meter sea-level rise" in the United States at $20–138 billion).

[171] *See* Andreas Fischlin et al., *Ecosystems, Their Properties, Goods and Services*, *in* IPCC 4th Report, at 242 (predicting 40–70 percent extinction rates for species if warming exceeds four degrees Celsius).

[172] *Id.* at 249 (listing the substantial uncertainties and long list of research priorities for understanding the impacts of climate change on ecosystems and biodiversity).

[173] *Id.* at 246–47.

[174] *Id.*

[175] *See* David W. Keith, *Geoengineering the Climate: History and Prospect*, 25 ANN. REV. ENERGY ENV'T 245, 247 (2000) (defining geoengineering as

has been explored is the artificial reduction of the amount of sunlight reaching the Earth's surface in order to offset the increased heat retention as a result of increasing greenhouse gas emissions ("albedo modification"). The reduction in sunlight could be achieved by the injection of particles (usually sulfur particles) into the atmosphere, or the more exotic option of placing mirrors or other reflective objects in orbit around the Earth or the Sun.[176]

Geoengineering through albedo modification may be able to address the backlash that might result from the delayed harm of climate change, because it would allow the (temporary or long-term) reduction of global temperatures during the gap between the institution of regulatory measures and the eventual reduction of temperatures in response to reduced greenhouse gas levels. Unlike efforts to reduce or eliminate climate change through management of greenhouse gas emissions, albedo modification allows control of climate with much less lag time.[177] The thermal inertia of the

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"intentional large-scale manipulation of the environment" in order to respond to climate change); *id.* at 248 fig.1 (distinguishing geoenginnering as direct manipulation of the climate system to prevent climate change, versus "mitigation" which covers efforts to reduce the human activities that change climate (such as greenhouse gas emissions) and "adaptation" which covers efforts to reduce the impacts of climate change on human welfare). For examples of the controversial nature of geoengineering, *see id.* at 258–59 (noting that the IPCC reports have regularly dismissed geoengineering as "ineffective, expensive" and associated with serious negative side effects); Oliver Morton, *Is This What It Takes to Save the World?*, 447 NATURE 132, 133 (2007) (noting that an article by a leading environmental scientist urging consideration of geoengineering caused a strong negative reaction among other scientists).

[176] *See* Morton, *supra* note 175; *see also* Keith, *supra* note 175, at 261–64 (calling this concept "albedo modification"); Paul J. Crutzen, *Albedo Enhancement by Stratospheric Sulfur Injections: A Contribution to Resolve a Policy Dilemma?*, 77 CLIMATIC CHANGE 211 (2006); B. Govindasamy et al., *Geoengineering Earth's radiation balance to mitigate climate change from a quadrupling of CO_2*, 37 GLOBAL & PLANETARY CHANGE 157 (2003); Alan Carlin, *Global Climate Change Control: Is There a Better Strategy than Reducing Greenhouse Gas Emissions*?, 155 U. PA. L. REV. 1401, 1447–50 (2007).

[177] *See* Crutzen, *supra* note 176, at 216 ("In contrast to the slowly developing effects of greenhouse warming associated with anthropogenic CO2 emissions, the climatic response of the albedo enhancement experiment would start taking effect within about half a year."); Scott Barrett, *The Incredible Economics of Geoengineering*, 39 ENVTL. RESOURCE ECON. 45, 47 (2008) (stating that the "climate response of albedo enhancement would take hold in a matter of months"); Jay Michaelson, *Geoengineering: A Climate Change Manhattan Project*, 17 STAN. ENVTL. L.J. 73, 109–10 (1998); Carlin, *supra* note 176, at 1460 (noting ability of albedo modification to respond quickly to abrupt climate

oceans can be offset by adjusting the level of sunlight that is reflected. Moreover, albedo management potentially could be done at quite low cost, at least according to some estimates, relative to the costs of adaptation or reduction of greenhouse gas emissions.[178]

However, there are serious questions about whether albedo modification would truly address the problems of climate change—there are significant uncertainties about the amount of sunlight that would need to be reflected to offset the temperature impacts of various atmospheric levels of carbon dioxide and whether albedo management may still result in significant regional levels of climate change.[179] If those uncertainties mean that albedo modification is ineffective, significant time and resources may be wasted.[180]

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change).

[178] *See* Crutzen, *supra* note 176, at 213 (total cost of albedo modification to offset warming from greenhouse gases would cost $25–50 billion per year); Victor Brovkin et al., *Geoengineering Climate By Stratospheric Sulfur Injections: Earth System Vulnerability to Technological Failure*, 92 CLIMATE CHANGE 243, 255 (2008) (noting costs of program in low hundreds of billions of dollars); William D. Nordhaus, *An Optimal Transition Path for Controlling Greenhouse Gases*, 258 SCI. 1315, 1317, 1319 (1992) (arguing that geoengineering is the lowest cost option to address climate change); Keith, *supra* note 175, at 262–63; Carlin, *supra* note 176, at 1447–50 (presenting claims about low cost of albedo management); Barrett, *supra* note 177, at 49 (stating that the "economics of geoengineering are . . . incredible"). *But see* Govindasamy et al., *supra* note 176, at 167 (noting that some geoengineering options are potentially very expensive).

[179] *See* Brovkin et al., *supra* note 178, at 255–56 (noting significant regional variations in impacts of albedo modification); Lennart Bengtsson, *Geo-engineering to Confine Climate Change: Is It All Feasible?* 77 CLIMATIC CHANGE 229, 229–30 (2006) (noting uncertainty about level of climate change that will need to be offset by albedo modification); Keith, *supra* note 175, at 272, 274–75 (noting uncertainty about level of climate change and success of albedo management); Boucher et al., *supra* note 543, at 262 (noting uncertainty about success of albedo management); Morton, *supra* note 175, at 134 (same); Govindasamy et al., *supra* note 176, at 159, 163, 166 (highlighting uncertainties).

[180] There are of course other concerns about albedo management that are separate from the ability of this tool to address a possible backlash against climate change regulation, including side effects on other environmental resources, the inability to prevent the acidification of oceans from increased carbon dioxide levels, concerns about whether geoengineering will undermine efforts to reduce greenhouse gas emissions, and uncertainties about whether albedo management can be sustained for the centuries and millennia that will be required to fully address long-term climate change. *See* Brovkin et al., *supra* note 178, at 255 (noting concerns about side effects and whether geoengineering

The third category is another type of "geoengineering" that has not been well-developed in the climate policy literature, at least in the form that I use it here. It would require the development of techniques to extract carbon dioxide from the atmosphere and resequester it in terrestrial or marine systems in a form in which it is unlikely to be released in the future. Carbon sequestration has been much explored, of course, but in the context of attempting to capture and store carbon emissions from large-scale stationary fossil fuel carbon sources, such as coal-fired power plants.[181] For carbon sequestration to function as a restoration tool, it would need to be able to extract carbon from the general atmosphere and sequester it underground. This is a much more aggressive form of carbon sequestration then has generally been considered—I call it "carbon capture". There are a range of possibilities: the burning of biofuels for energy, with the capture and sequestration of the emitted carbon dioxide;[182] the management of natural and agricultural landscapes to maximize the absorption and retention of carbon;[183] the burning of organic biomass in a manner that would fix carbon in a relatively permanent way ("biochar");[184] the fertilization of areas of the

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can be maintained for extended periods of time); Keith, *supra* note 175, at 262, 276 (noting concerns about side effects and risk of undermining mitigation efforts); Simone Tilmes et al., *The Sensitivity of Polar Ozone Depletion to Proposed Geoengineering Schemes*, 320 SCI. 1201 (2008) (noting risks to stratospheric ozone from use of sulfur particles to change albedo).

[181] For an overview, *see* INTERGOVERNMENT PANEL ON CLIMATE CHANGE, SPECIAL REPORT ON CARBON DIOXIDE CAPTURE AND STORAGE (2005), *available at* http://www.ipcc.ch/ipccreports/srccs.htm.

[182] *See, e.g.*, Christian Azar et al., *Carbon Capture and Storage from Fossil Fuels and Biomass—Costs and Potential Role in Stabilizing the Atmosphere*, 74 CLIMATIC CHANGE 47 (2006); Detlef P. van Vuuren, *Stabilizing Greenhouse Gas Concentrations at Low Levels: An Assessment of Reduction Strategies and Costs*, 81 CLIMATIC CHANGE 119, 147-48 (2007).

[183] *See, e.g.*, P. Smith et al., *Agriculture*, *in* IPCC 4th Report, 497, 506–507 and tbl. 8.3 (2007) (noting that a wide-range of agricultural management practices might increase the ability of the soil to absorb carbon dioxide); G.J. Nabuurs, *Forestry*, *in* IPCC 4th Report at 541, 550–51 (2007) (noting potential for afforestation and forest management efforts to increase carbon sequestration); John T. Litynski et al., *An Overview of Terrestrial Sequestration of Carbon Dioxide: The United States Department of Energy's Fossil Energy R&D Program*, 74 CLIMATIC CHANGE 81 (2006) (describing the use of reclamation of abandoned mine areas to promote sequestration through reforestation); Ning Zeng, *Carbon Sequestration Via Wood Burial*, 3 CARBON BALANCE & MGMT. (2008) *available at* http://www.cbmjournal.com/content/3/1/1 (describing the use of the burial of trees to sequester carbon).

[184] *See* Johannes Lehmann, *A Handful of Carbon*, 447 NATURE 143 (2007).

ocean with iron to increase photosynthesis by plankton that would capture carbon dioxide;[185] the introduction of minerals to the oceans that would increase the ability of the oceans to absorb and sequester carbon dioxide;[186] and the development of systems to absorb carbon dioxide directly from the atmosphere and fix it in solid form.[187]

All of these various proposals, however, are relatively untested and uncertain as to their effectiveness. Some—such as the fixation of carbon directly from the atmosphere or the combustion of biomass and capture of the emitted carbon dioxide—are relatively direct and so would likely effectively address the problem, but may be expensive.[188] Others—such as

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[185] *See, e.g.*, Stephane Blain et al., *Effect of Natural Iron Fertilization on Carbon Sequestration in the Southern Ocean*, 446 NATURE 1070 (2007); Sallie W. Chisholm et al., *Dis-Crediting Ocean Fertilization*, 294 SCI. 309 (2001); Ken O. Buesseler, *Ocean Iron Fertilization—Moving Forward in a Sea of Uncertainty*, 319 SCI. 162 (2008); Michaelson, *supra* note 177, at 77 (calling this the "Geritol cure"); Keith, *supra* note 175, at 266–67.

[186] *See, e.g.*, Jennie C. Stephens and David W. Keith, *Assessing Geochemical Carbon Management*, 90 CLIMATIC CHANGE 217, 228–33 (2008); Carlin, *supra* note 176, at 1446; Martin I. Hoffert et al., *Advanced Technology Paths to Global Climate Stability: Energy for a Greenhouse Planet*, 298 SCIENCE 981, 983 (2002).

[187] *See* David W. Keith et al., *Climate Strategy with CO2 Capture from the Air*, 74 CLIMATIC CHANGE 17 (2006) (providing an overview of the methods for direct capture and assessment of feasibility); Carlin, *supra* note 176, at 1447. For a related system that involves the removal of carbon dioxide from power plants and sequesters it as cement, *see* David Biello, *Cement from CO2: A Concrete Cure for Global Warming?*, SCI. AM., Aug. 7, 2008.

[188] Keith et al., *supra* note 187, at 18 (noting costs of carbon fixation ranging around $500/ton of carbon, a relatively high level, though the cost is about half for the use of carbon capture from the combustion of biomass); Azar et al., *supra* note 182, at 50 tbl.1, 56 (cost of carbon capture for biomass may somewhat more than for carbon capture and sequestration from fossil fuels, probably around $300/ton of carbon). Note, however, that the use of carbon capture with the combustion of biomass depends on the long-term effectiveness of carbon sequestration methods, which is open to considerable uncertainty as well. *See id.* at 59.

One option that appears to be relatively low cost, beneficial on a wide range of public health measures, and relatively effective relatively quickly in its impact on global climate would be efforts to reduce the production of "black carbon," or the soot produced by inefficient burning of biomass. Black carbon is a non-trivial contributor to global climate change; a significant part of black carbon is produced by biomass burning by the poorest of the world's population for heat and cooking; it is a major public health threat to that population; because of its very short residence time in the atmosphere, curbing black carbon would have a very rapid impact on global warming. *See* Elisabeth Rosenthal, *Soot From Third-World Stoves is New Target in Climate Fight*, N.Y. TIMES, Apr. 16,

the use of iron fertilization or biochar—are controversial because it is unknown whether they would be effective at all.[189] There is tremendous uncertainty about the ability of terrestrial ecosystems (whether actively managed by humans for carbon sequestration or not) to sequester carbon.[190] And still others are both potentially high cost and uncertain.[191] Finally, all of these methods work by managing the levels of carbon dioxide in the atmosphere—as a result, they may still face the same inherent lag time problems that the regulatory solutions face (albeit possibly at a reduced extent).[192]

2009, at A1; V. Ramanathan & G. Carmichael, *Global and Regional Climate Changes Due to Black Carbon*, 1 NATURE GEOSCIENCE 221 (2008). Accordingly, addressing black carbon appears to be very low-hanging fruit in efforts to prevent backlash. The tentative draft of the Waxman-Markey bill in Congress includes a provision to address black carbon. *See* American Clean Energy & Security Act, *supra* note 47, at § 333.

[189] *See* Sallie W. Chisholm et al., *supra* note 185 (questioning the effectiveness of iron fertilization); Ken O. Buesseler, *supra* note 185 (same); Rachel Courtland, *Charcoal's green image blackened*, NATURE NEWS, May 2008, *available at* http://www.nature.com/news/2008/080501/full/news.2008.791.html (questioning the effectiveness of biochar).

[190] *See, e.g.*, P. Smith et al., *supra* note 183, at 506–507 and tbl. 8.3 (2007) (noting limited evidence for many forms of agricultural sequestration methods).

[191] *See* Stephens and Keith, *supra* note 186, at 230–31 (noting possible high cost and uncertainty around the feasibility and effectiveness of mineralization of the oceans to increase absorption of carbon dioxide). *See generally* David G. Victor, *On the Regulation of Geoengineering*, 24 OXFORD REV. OF ECON. POL'Y 322, 325 (2008) (arguing that the actual implementation of feasible geoengineering schemes will likely be highly costly and involve significant uncertainties).

[192] Azar et al., *supra* note 182, at 74 (noting that carbon removal through the capture of carbon released from the burning of biomass would take "at least half a century before carbon removals could have a substantial impact on the atmosphere CO2 concentration and there is additional inertia in the climate system"); Keith et al., *supra* note 187, at 34 (same). The reason that carbon capture might move quicker than reduction of carbon emissions is that, in theory at least, one could remove carbon from the atmosphere before it heats up the oceans and at least reduce the long-term persistence of higher temperatures, if not also reduce the peak of temperatures as well. *See* Boucher et al., *supra* note 54, at 265, fig. 1c (2008) (model estimating that if emissions are peaked above stabilization goals and then offset by carbon removal in the future, the absolute peak of temperature is lower than if there is no carbon removal and the long-term harm is reduced significantly, although there is still a peak of temperature above levels that would exist if stabilization goals are reached); *see also* IPCC Climate Projections, *supra* note 21, at 827–28 & fig. 10.36b and 10.36c (studying an "overshoot" example where carbon levels peak above the stabilization goal but are gradually reduced because of natural absorption of carbon combined with drastic reductions in emissions, and finding that the peak temperature would be the same as for the higher carbon levels, but that temperatures long-term would

The take-away lesson is that using the restoration method to address climate change will not be easy. There is significant uncertainty about the effectiveness of not just the more exotic geoengineering options, but also about even more mundane efforts to encourage adaptation, such as efforts to help species and ecosystems adapt. Many of these options will be very costly. And many of them will require significant time, with only a few (such as, perhaps, albedo enhancement, or the improvement of coastal defenses to address moderate amounts of sea-level rise) having an impact within a time frame of months or years as opposed to decades.

CONCLUSION: LESSONS FOR CLIMATE CHANGE POLICY

Delayed harm environmental problems present difficult challenges to policymakers. Liability systems may be difficult and costly to implement because of causation problems. Regulatory systems that reduce causation problems will face the risk of backlash. Education and norm-shifting may be difficult and unreliable tools to prevent backlash. Restoration efforts can help reduce the obstacles for regulatory systems on an ongoing basis, but their feasibility may be doubtful because of high cost, high uncertainty, or long-term time frames.

All of these problems exist in the context of climate change, especially for regulatory solutions and restoration efforts. It is certain that the planet will continue to warm, with serious implications for human and natural systems, even if draconian carbon regulation is implemented. Thus, there is a distinct risk that, even if the serious obstacles to creating a carbon regulatory system are overcome, there may be a backlash against that regulatory system. Restoration efforts to ameliorate the backlash problem are fraught with difficulties. Adaptation may be costly, time-consuming, and uncertain of success, depending on the particular strategies adopted. The uncertainty is even higher, however, for geo-engineering proposals to directly address climate change either through offsetting the impacts of carbon on the climate system or through direct elimination of carbon from the atmosphere. The alternatives to restoration—changing norms or education—are limited as well.

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be significantly reduced).

I began this piece by noting that my object was to note an additional obstacle to the efforts by environmental policymakers to address climate change. The analysis above indicates that there are no easy solutions to this additional obstacle, but I do not want to leave the reader with a purely pessimistic conclusion. I believe there are some important lessons that can be drawn from the implications of delayed harm for climate change policymaking—lessons which, if learned, might help avoid some serious mistakes in the future.

One clear lesson is the *political* importance of the climate change regulatory system in encouraging investment in new energy systems, such as renewable wind, solar, and geothermal sources. That investment will have not only a direct payoff in reducing our reliance on carbon-based sources of energy, it will also have a political payoff by creating a new base of support for the regulatory system, support that might be able to resist or at least moderate calls for backlash.

Even more importantly, the analysis makes clear the necessity of seriously considering addressing the harm that climate change is causing before our efforts to address the harm-causing activities kick in. There is already general recognition that adaptation will be needed to address the impacts from climate change that will occur either because of prior historical emissions or because of emissions that will be released in the future before mitigation[193] efforts to reduce climate change emissions can take effect.[194] That is because at least some forms of adaptation can be implemented quickly enough that they can have an impact in the short-term.[195] In contrast, the benefits of mitigation will be delayed not only because of the time delay of climatic response to carbon levels, but also because of the inertia of human economic and social systems

[193] Efforts to address carbon emissions are generally called "mitigation" efforts in the climate policy literature.

[194] *See* STERN REVIEW, *supra* note 164, at xxi (Executive Summary) ("Adaptation is the only response available for the impacts that will occur over the next several decades before mitigation measures can have an effect."); WILLIAM E. EASTERLING ET AL., *supra* note 163, at ii ("[G]iven that additional future climate change is now inevitable regardless of mitigation efforts, adaptation is an essential strategy for reducing the severity and cost of climate change.").

[195] *See* STERN REVIEW, *supra* note 164, at 459 ("Adaptation is different from mitigation because: (i) it will in most cases provide local benefits, and (ii) these benefits will typically be realized without long lag times.").

and the challenge of changing those systems to no longer emit carbon.[196] Thus, adaptation to climate change can—at least in part—fulfill the potential role of restoration efforts in addressing the built-up delayed harms.[197] As one of the early reports on adaptation put it:

> [R]ecognition that the climate system has a great deal of inertia is increasing, and that mitigation efforts alone are insufficient to protect the Earth from some degree of climate change. Even if extreme measures could be taken instantly to curtail global emissions, the momentum of the Earth's climate is such that additional warming would still happen. Although essential for limiting the extent of rapid and severe climate change, mitigation is not—and this report argues, should not be—the only protective action in society's arsenal of responses.[198]

This point has been reiterated in the most recent IPCC report.[199] And as the most recent IPCC report also emphasizes, there are likely trade-offs between allocating limited resources to adaptation versus allocating limited resources to mitigation. Adaptation efforts may also either interfere with or assist mitigation efforts (and vice versa).[200] Accordingly, there will need to be an increasing emphasis on the importance of connecting adaptation and mitigation decisionmaking.[201]

This paper adds a political reason to why adaptation is an essential component of climate change policy. The possibility of a

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[196] *See* Richard J.T. Klein et al., *Inter-relationships Between Adaptation and Mitigation*, *in* IPCC 4th Report at 745, 750 (2007) ("The benefits of mitigation carried out today will be evidenced in several decades because of the long residence time of greenhouse gases in the atmosphere . . . whereas many adaptation measures would be effective immediately and yield benefits by reducing vulnerability to climate variability.").

[197] Adaptation, of course, has its own problems. Many types of adaptation efforts will have their own significant environmental impacts, and the complexity of understanding the changing climate system and its impacts on human and natural systems may make the design and implementation of optimal adaptation efforts that minimize environmental costs incredibly difficult. *See* Zinn, *supra* note 93, at 66–90.

[198] William E. Easterling et al., *supra* note 163, at 2.

[199] *See* Richard J.T. Klein et al., *supra* note 196, at 748 ("[O]wing to lag times in the global climate system, no mitigation effort, no matter how rigorous and relentless, will prevent climate change from happening in the next few decades. . . . Adaptation is therefore unavoidable.").

[200] *See id.* at 752–63.

[201] *See id.* at 753, 766–70 (noting how mitigation and adaptation can be seen as substitutes).

backlash against future carbon regulatory systems emphasizes the importance of adaptation as a complement for mitigation not just as a tool to reduce the harm from climate change, but also to ensure that mitigation and other regulatory systems are politically sustainable in the long term. In other words, for mitigation to have a chance to succeed, we likely will have to undertake adaptation efforts in the near term. Coordination between mitigation and adaptation efforts are therefore all the more important. Unfortunately, the current political and policy infrastructure makes those kinds of coordination efforts difficult.[202]

The analysis also indicates that we may want to diversify our portfolio of potential policy responses to climate change beyond mitigation and adaptation to include geoengineering. This is not to minimize the tremendous uncertainty as to whether various geoengineering options will be effective, their significant cost, the fact that some may nonetheless take substantial amounts of time to address the harm of climate change, and their enormous potential side effects (environmental, social, and political). Moreover, there is the risk that geoengineering efforts may distract us from the mitigation and adaptation efforts that we must also pursue if we are to have a successful long-term climate change policy. One of the main reasons why the most prominent example of geoengineering—albedo enhancement—cannot be the sole or probably even primary response to climate change is that absent mitigation and adaptation efforts, we would be forced to maintain albedo enhancement as an ongoing intervention in the global climate system for centuries or millennia. Otherwise, the breakdown of albedo enhancement would lead to catastrophic warming in the future. Policy analysts are properly skeptical of the ability of human institutions to maintain such an intervention for such a long period of time.[203]

Despite all of these risks and limitations to geoengineering, however, it may be an important element of hedging against the risk of a "backlash." If we want to achieve the mitigation goals that we need to stabilize temperatures for the long-term, we may

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[202] *See id.* at 753 ("Relatively few public or corporate decision-makers have direct responsibility for both adaptation and mitigation. For example adaptation might reside in a Ministry of Environment while mitigation policy is led by a Trade, Energy or Economic Ministry.") (citation omitted).

[203] *See, e.g.*, Bengtsson, *supra* note 179, at 231; Brovkin et al., *supra* note 178, at 255.

need to reduce the short- and medium-term impacts of climate change until our mitigation efforts have translated into the amelioration of the risk of climate change. And it may well be that modest geoengineering efforts are the only way to achieve that short- and medium-term impact reduction. At the very least, it seems sensible to invest in research and development in geoengineering as a complement to our mitigation and adaptation efforts so that we can hedge not just against the risk of catastrophic climate change impacts that might occur despite our mitigation efforts (as some have proposed)[204] but also against the risk of political backlash against our mitigation efforts as well.[205] In doing so, we should be well aware of the risk that the apparently "safe answer" of geoengineering might undermine our ability to mobilize for the mitigation that must be done.[206]

There is a final lesson, a lesson that builds on the ambiguity of what the meaning of harm is in the context of climate change. Is the harm change in climate or is it the change in carbon dioxide levels in the atmosphere? Policymakers might be able to exploit an aspect of that ambiguity of harm to try and alter some of the political dynamic that might lead to backlash. The delay in climate change is much greater on the climate side than on the carbon dioxide side—that is, as mitigation efforts succeed in reducing carbon dioxide emissions, that will translate relatively quickly into at least a flattening of carbon dioxide levels in the atmosphere, even as the climate continues to warm and sea levels rise because of thermal inertia.[207] If policymakers can convince the public that the relevant metric that we should focus on in evaluating the success or failure of our climate change mitigation policy is carbon dioxide levels, and not climate phenomenon, then the backlash may be less likely to occur, as results are likely to occur more

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[204] *See, e.g.*, Crutzen, *supra* note 176, at 216–17. For another discussion of a combined geoengineering/mitigation strategy for climate change, see T.M.L. Wigley, *A Combined Mitigation/Geoengineering Approach to Climate Stabilization*, 314 SCI. 452 (2006).

[205] *But see* David G. Victor, *supra* note 191, at 328 (arguing that exploratory research about geoengineering will necessarily require field testing and trial implementation, and that large social investment in geoengineering research is unlikely unless there is a non-trivial possibility that geoengineering might actually be implemented).

[206] *See, e.g.*, Keith, *supra* note 175, at 276 (noting this "moral hazard" risk of undermining mitigation efforts).

[207] *See supra* notes 21–24 and accompanying text.

quickly. In other words, the potential for backlash depends greatly on the metric that is used to measure success or failure of environmental policy.[208]

There are obvious limits to this strategy of dealing with the delayed harm nature of climate change. Foremost among those limits is the fact that the reason why we care about climate change as a society is overwhelmingly because of the impacts that changed climate will have on human and natural systems—not because of an abstract concern about carbon dioxide levels in the atmosphere.[209] If millions are losing their homes, and tens of thousands are dying because of storm surges associated with tropical storms interacting with sea level rise despite climate change mitigation efforts, the public may be quite skeptical of explanations from political leaders that climate change mitigation policy is working because carbon dioxide levels are decreasing. In other words, changing the metric by which we measure success in managing climate change will only work as a supplement to our adaptation efforts to reduce the harm to human and natural systems from changing climate. If we are able to use adaptation efforts to greatly reduce storm surge impacts on vulnerable populations, then the metric argument may well have more traction. The metric argument might also have more traction if it is combined with a public education campaign alerting the public to the necessarily slow process of ending and undoing the harm that greenhouse gasses have caused, and the inevitable gap between environmental regulation and performance that will exist.[210]

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[208] Holly Doremus makes this point in the context of endangered species management, arguing that our measurement and our goal should not be the delisting of endangered and threatened species under the Endangered Species Act—a goal that is likely implausible for many species—but instead should be successful management to avoid extinction and restore population levels, even if regulatory protection under the ESA is an ongoing necessity. *See* Doremus, Delisting Endangered Species, *supra* note 120; Doremus & Pagel, *supra* note 113.

[209] The most significant exception is the connection between atmospheric carbon dioxide levels and acidification of the oceans, which will have significant negative effects on marine ecosystems, particularly coral reefs. *See supra* n.180.

[210] Professor Holly Doremus and Joel Pagel make a similar call in the context of the implementation of the U.S. Endangered Species Act, arguing that the proper response to critiques of the apparent lack of success of the Act in recovering listed species is not accelerating the delisting process, but instead educating the public about the need for long-term conservation. Doremus & Pagel, *supra* note 113, at 1267.

There are many, many political and legal challenges that we face as we seek to address the looming threat of climate change. But in the process of seeking to address those challenges that have received the great majority of academic and policymaker attention to this point, we must not forget the problems that the delayed nature of climate change also presents. Otherwise, we may find that after successfully struggling to establish a workable regulatory system, a global public backlash might wipe it away. The efforts to better integrate adaptation into our overall policy decisionmaking and to conduct research into the feasibility and desirability of geoengineering appear to be small investments that are well worth it to help manage that risk of a future backlash.