ARTICLE

LEGISLATING TO ADDRESS CLIMATE CHANGE: SOME LESSONS FROM THE FIELD

Christopher H. Schroeder[*]

I. INTRODUCTION

Only a few years ago, any discussion in the United States of *how* to address the problem of global warming and climate change would have been preceded by a debate over *whether* there was a problem worth addressing. Our international friends thought we were being amazingly retrograde; they had crossed the threshold from the whether-world to the how-world years ago, and were frankly unable to understand why we had not done

[*] Christopher H. Schroeder is Charles S. Murphy of Law and Professor of Public Policy Studies and director of the Program in Public Law at Duke University. Much of his interest in climate change issues has developed as a result of conversations with fellow members of the Center for Progressive Reform, a non-profit organization dedicated to constructive approaches to pressing environmental problems.

so as well.[1] That gap has now substantially narrowed.[2] After a longer-than-necessary period in which the intellectual and scientific groundwork had been laid, a series of dramatic, high-visibility events seemed to tip the balance. Hurricane Katrina's extension of droughts in the western and southeastern parts of the country; Al Gore's tremendously successful movie; strong language from the Intergovernmental Panel on Climate Change ("IPCC") Fourth Assessment; and the unusual choice of both the IPCC and Vice President Gore as the 2007 recipients of the Nobel Peace Prize have helped fuel the transition.[3] When Florida insurance companies are justifying rate increases under revised liability models by publicly claiming ocean temperature *rise* leads to unexpectedly severe hurricanes, we have turned a corner.[4]

So the issue of reducing greenhouse gas ("GHG") emissions has begun to move forward in the United States, taking the first indispensable step in the journey that policy problems must survive before constructive action is taken to address them. The difficulties in gaining this initial step have proved so frustrating that there may be a tendency for many people to breathe a sigh of relief that this first step has finally been accomplished. That would be a mistake: the hard work has only just begun, because the journey from policy problem to policy solution is arduous, multi-layered, and complex. In fact, most policy problems never complete the entire journey. In modern times, it is hard to think of many policy problems that we consider solved.

Even though it is hard to vanquish a policy problem completely, there can still be enormous variation in the relative success of different strategies, both in terms of their ability to

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1. *See*, *e.g.*, Jim Giles, *From Words to Action*, 445 NATURE 578, 578 (2007) (discussing an inconclusive 2001 report).

2. *See, e.g.*, *id.*

3. To be sure, skeptics can still be found. Senator James Inhofe (R-OK), for instance, continues to consider global warming "the greatest hoax ever perpetrated on the American people." Senator James Inhofe, Address on the Senate floor (July 28, 2003). Such skeptics, however, are increasingly fewer and their voices no longer seem likely to be sufficient to prevent the United States Congress from taking action to reduce greenhouse gas emissions. The argument of the skeptics, furthermore, has shifted noticeably from contesting the science to economics. *See* Michael Hopkin, *Climate Skeptics Switch Focus to Economics*, 445 Nature 582, 583 (2007) ("With less to argue about on the scientific front, climate skeptics have been turning their attention to the economics of adapting to a changing climate."); Joel Achenbach, *The Tempest*, WASH. POST, May 28, 2006 at W08.

4. Joe Follick & Kirk Semple, *Florida Insurers Defend Increases in Home Rates*, N.Y. TIMES, February 5, 2008 at B1 ("[A spokesman for Allstate] said the company was bracing for an increase in destructive hurricane activity because of rising ocean temperatures, a possibility that the state's hurricane loss projection models do not take into account. 'Prudent business judgment dictates that this increased risk of hurricane formation should be taken into consideration in determining the appropriate rate for the risk being insured,' he said.").

deal with a problem constructively by reducing adverse impacts and in terms of controlling unintended consequences that can offset positive achievements. Effective policy has the best chance of development if we can keep our focus clearly on the goal to be achieved, while at the same time not ignoring or naively underestimating the many obstacles that always stand in the way of implementing programs with difficult goals. As we embark on a national and international effort to halt the increase in atmospheric levels of GHGs, we can learn some lessons about how to do this from our nearly forty years of experience designing national programs to address other hard environmental problems.

II. LESSONS

A. The Devil is in the Details: Pay Attention to Implementation

One point that stands out from past experience is the general neglect of systematic, programmatic oversight and evaluation of the implementation of our policies. We know that there are enormous differences between the aspirations of programs as stated in the enabling legislation and the concrete results that the enacted programs achieve. Years ago, Aaron Wildavsky and Jeffrey Pressman laid out the importance of the distinction in their little book entitled *Implementation*.[5] The much longer subtitle to the book says it all. The subtitle reads: "How Great Expectations in Washington are Dashed in Oakland; Or, Why it's Amazing that Federal Programs Work at All, This Being a Saga of the Economic Development Administration as Told by Two Sympathetic Observers Who Seek to Build Morals on a Foundation."[6] Programs are often flawed in their design, which was one of Wildavsky and Pressman's points; but another point was that even the best conceived program will fail to gain achievable results if it is not well implemented.[7]

Yet in the environmental field as in many others, we often fail to evaluate the implementation of legislation on an on-going basis. Instead, our assessment of implementation is sporadic and often woefully inadequate. As a result, policies may deviate

5. JEFFREY PRESSMAN & AARON WILDAVSKY, IMPLEMENTATION: HOW GREAT EXPECTATIONS IN WASHINGTON ARE DASHED IN OAKLAND; OR, WHY IT'S AMAZING THAT FEDERAL PROGRAMS WORK AT ALL, THIS BEING A SAGA OF THE ECONOMIC DEVELOPMENT ADMINISTRATION AS TOLD BY TWO SYMPATHETIC OBSERVERS WHO SEEK TO BUILD MORALS ON A FOUNDATION 1, 35 (U. Cal. Press 1979) (1973).

6. *See id.*

7. *See id.*

widely from the paper documents that describe them, failing dismally to impact the real world. In many cases, oversight by Congress is triggered only by fire alarms set off by some dramatic failure, like the levee failures in New Orleans.[8] Congress—and this holds true for state legislatures as well—seldom engages in police patrol surveillance, or systematic quality review of agency work in advance of catastrophic failures.[9] Even a cursory review of the disaster preparedness planning for New Orleans would have revealed startling gaps, such as the failure to provide evacuation transportation for the estimated 100,000 low income residents who did not own cars.[10] Prior to Katrina, if anyone focused on this glaring deficiency, they failed to take corrective action when it might have done some good. Other chronic problems arise in program design because we do not learn enough from past implementation efforts, even though that knowledge might help us get the design right the next time around. For instance, decisions about what approach to take often turn heavily on crude estimates of implementation costs that amount to little more than semi-educated guesses. Retrospective studies of actual implementation costs would allow us to use past programs as natural experiments that might improve our ability to estimate countervailing costs the next time around; yet such studies are seldom done.[11]

Any program that seeks to stabilize GHG emissions is going to take decades to implement.[12] For instance, the latest IPCC report describes some mitigation scenarios that would stabilize GHGs at approximately twice pre-Industrial Revolution levels by the year 2100.[13] It will therefore be a long time between enacting a legislative program and seeing the fruits of that program in the

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8. For a review of some of the implementations failures that contributed to the magnitude of Hurricane Katrina's destruction, see CTR. FOR PROGRESSIVE REFORM, AN UNNATURAL DISASTER: THE AFTERMATH OF HURRICANE KATRINA (Sept. 2005), *available at* http://www.progressiveregulation.org/articles/Unnatural_Disaster_512.pdf.

9. The seminal work on fire alarm and police patrol oversight is Mathew D. McCubbins & Thomas Schwartz, *Congressional Oversight Overlooked: Police Patrols Versus Fire Alarms*, 28 AM. J. POL. SCI. 165, 166 (1984) (arguing that Congress often exercises "fire-alarm" oversight that responds to specific complaints rather than initiating its own routine review of agency programs to identify on its own ways to improve implementation).

10. *See* CTR. FOR PROGRESSIVE REPORT, *supra* note 8, at 6.

11. When they are, they often show that ex ante estimated compliance costs had been estimated to be significantly higher than ex post real compliance costs. *See* Thomas O. McGarity & Ruth Ruttenberg, *Counting the Cost of Health, Safety and Environmental Regulation*, 80 Tex. L. Rev. 1997 (2002).

12. *See* Intergovernmental Panel on Climate Change ("IPCC"), *Climate Change 2007: Synthesis Report Summary for Policy Makers*, at 18 (Nov. 12, 2007).

13. *Id.*

form of stabilized GHG concentrations. Even if mitigation programs have been adequately designed to achieve stabilization at 550 ppm or some other level, we will not get there without paying better attention to monitoring and evaluating implementation than we have historically provided to our environmental programs. If we do not pay better attention to implementation, we will fail to meet interim objectives that are now within our grasp, assuming implementation had not been faulty.[14] In the case of climate change, the consequences of letting too much slippage into the implementation process will be one of two highly unattractive types. Failure to meet interim goals and faulty implementation might mean that the target stabilization level will have to be adjusted upward due to the additional GHGs that have been discharged.[15] As a consequence, global mean temperatures will rise more and the effects of climate change will be more severe.[16] Alternatively, it might mean that more expensive or disruptive mitigation strategies than originally contemplated will need to be adopted to get the glide path to stabilization back on target.[17]

There can be more than one way to build monitoring and evaluation into a climate change program. Congress needs to shoulder a part of this responsibility, but given our experience with congressional oversight of existing programs, one ought not to place complete faith in congressional committees. Instead, accounting and reporting functions ought to be expressly assigned to executive branch agencies, where regular reports that are transparent and publicly accessible can be prepared. To the greatest extent possible, care ought to be taken to write the basic reporting requirements into the legislation, although the development and good presentation of data will depend upon further elaboration by the agencies involved. Estimates of anticipated levels of GHG from different sources and sectors will need to be made at the outset because it will not be possible to use atmospheric concentrations of GHGs as a yardstick for any national program, insofar as those levels depend upon the actions of other countries as well as our own. This will require us to have reliable emissions inventories of existing levels and then to make projections concerning the likely impact of strategies to reduce those emissions. As to the first, federal legislation may be able to piggyback on state-level programs to develop reliable

14. *Id.*
15. *Id.*
16. *Id.*
17. IPPC, *supra* note 12, at 18.

GHG emissions inventories. As of December, 2007, thirty-nine states had joined the Climate Registry, "a collaboration aimed at developing a common system for entities to report GHG emissions," which will "serve as a tool to measure, track, verify and publicly report GHG emissions consistently and transparently."[18] Four other states have independent mandatory reporting requirements in place,[19] while two more have voluntary registries.[20]

B. Be Prepared to Make Mid-Course Corrections

In the past, experiences with individual environmental programs have cross-pollinated other programs. Here are two examples of such cross-pollination, the first from the water program to the air program. The national permitting system instituted by the 1972 Clean Water Act Amendments under its National Pollution Discharge Elimination System effectively made compliance monitoring straightforward in various ways, including by mandating self-reporting by individual dischargers; this directly contributed to Congress adopting an analogous program for air pollution sources when it wrote the 1990 Clean Air Act Amendments.[21] To show cross-pollination in the reverse direction, from the air program to the water program, the success of the cap-and-trade program from the 1990 Amendments to address acid rain has led to EPA experiments with effluent trading programs under the Clean Water Act.[22] Each of these innovations ought to be applied to a GHG program as well. However, even after we take advantage of learning from other programs, obstacles and unanticipated consequences will afflict any program with the necessary ambition. Accordingly, mid-course corrections will have to be made.

Anticipating the need to make mid-course corrections poses difficult problems in this or any other environmental context. While many of the foundational pieces of environmental legislation have gone through legislative mid-course corrections in the past, this sort of congressional improvement of existing

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18. PEW CTR. ON GLOBAL CLIMATE CHANGE, LEARNING FROM STATE ACTION ON CLIMATE CHANGE 1, 5 (2007).

19. Wisconsin, Maine, Connecticut and New Jersey. *See id*. at 6.

20. Texas and West Virginia. *See id*.

21. RICHARD LAZARUS, THE MAKING OF ENVTL. LAW 65-67 (U. Chi. Press 2004) [hereinafter LAZARUS, THE MAKING OF ENVTL. LAW]; Richard Lazarus, *Congressional Descent: The Demise of Deliberative Democracy in Environmental Law*, 94 GEO. L.J. 619 (2006) [hereinafter Lazarus, *Congressional Descent*].

22. LAZARUS, THE MAKING OF ENVTL. LAW, *supra* note 21, at 65-67; Lazarus, *Congressional Descent*, *supra* note 21, at 619.

programs has come to a nearly complete standstill in recent decades. For instance, the 1990 Clean Air Act Amendments were the last significant legislative revisions of that program.[23] Mid-course corrections require constructive re-engagement, but in recent years, congressional debate on significant environmental policy as been racked by sharp partisan divisions.[24] The few times that Congress has been able to re-engage constructively have been prompted by some exogenous shock to the status quo that has convinced both the regulated community and the environmental community that the existing regime is untenable, that some alternative exists giving sufficient benefits to both sides, and that the result will be politically viable.[25]

The partisan divide on environmental policy provides part of the explanation for why congressional evaluation of program implementation has been sporadic and unhelpful to a great extent in substantially improving existing programs. When a considerable portion of Congress opposes much of what federal environmental policy wants to accomplish, its oversight exposes programmatic inadequacies and mistakes largely in order to tear the programs down, not to repair them constructively. When oversight is conducted to embarrass program officials or to cast programs in a negative light, it is much less unlikely to contribute anything constructive to the better management of the program.[26] In much the same way, constructive mid-course corrections will not occur unless an effective majority of the Congress is supportive of the policy's broad missions and wants to improve their implementation. These days, this means a simple majority in the House, but a supermajority of sixty in the Senate.[27] The combination can be difficult to achieve.

Unlike the ex-post program evaluation that must contribute to the learning process under any GHG regime, mid-course

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23. 42 U.S.C.A. § 7521 (2008), Pub. L. 101-540, 104 State. 2399. *See also* LAZARUS, THE MAKING OF ENVTL. LAW, *supra* note 21, at 65-67; Lazarus, *Congressional Descent*, *supra* note 21, at 619.

24. LAZARUS, THE MAKING OF ENVTL. LAW, *supra* note 21, at 65-67; Lazarus, *Congressional Descent*, *supra* note 21, at 619.

25. For example, the Ninth Circuit's decision in *Les v. Reilly*, 968 F.2d 985 (9th Cir. 1992), *cert. denied sub nom.,* 507 U.S. 950 (1993), ordering EPA to apply Delaney Clause without any de minimis exception, encouraged the pesticide industry and growers to seek changes in the pesticide laws. Environmental groups were prepared to accept a de minimis exception in exchange for greater protections for children and expedited re-registration of existing pesticides, and so a compromise resulting in the Food Quality Protection Act of 1998 was possible. *See also* LAZARUS, THE MAKING OF ENVTL. LAW, *supra* note 21, at 65-67; and Lazarus, *Congressional Descent*, *supra* note 21, at 619.

26. *See* Joel D. Aberbach, *What's Happened to the Watchful Eye?*, 29 CONGRESS & THE PRESIDENCY 1, 14-16 (2002) (discussing the effectiveness of partisan oversight).

27. *Id.* at 19.

corrections that require legislative action cannot be outsourced to the administrative agencies.[28] Agencies can make changes within the parameters defined by their delegated authority, but changes beyond a certain magnitude will require congressional involvement.[29] At this juncture, one can only speculate how serious a problem this will be for the development of an effective GHG reduction strategy. There is a fairly broad consensus that the United States needs to take action.[30] The real question is whether such a consensus will exist several years down the road when the effectiveness of what is enacted and implemented begins to be assessed. All we can be confident about is that the robustness of a political consensus around taking effective action will be tested more than once as the program unfolds.

C. In the Debate between Shallow and Deep Environmentalism, Experience Shows We Need Both

Lessons from existing programs, if taken up and incorporated into program planning and implementation, will certainly help us to pursue the reductions in GHGs necessary to address the seriousness of the climate change problem. At the same time, controlling GHG emissions presents unique problems that distinguish it from any previous undertaking. Perhaps most importantly for citizens of the United States, so much do we believe in the efficacy of autonomous action, this is the first environmental challenge we have squarely confronted where the problems our country faces cannot be effectively addressed by the United States alone. With respect to global warming, we are not in nearly as much control of our own destiny as we are when dealing with most local air pollution, water pollution, or waste disposal problems.[31] This is what made President Bush's decision to repudiate the Kyoto Protocol so tragic. The Kyoto Protocol is seriously flawed and has not done much to address the global warming issue, but it does provide the forum through which international climate change policy is going to develop. Our standing on the sidelines has deprived the United States of

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28. *Id.* at 18.

29. *Id.*

30. Giles, *supra* note 1, at 578.

31. This distinction is a matter of degree. Up to thirty percent of the mercury found in the United States is believed to originate in China, for example. *See* Matt Pottinger, Steve Stecklow & John J Fialka, *Invisible Export – A Hidden Cost of China's Growth: Mercury Migration*, WALL ST. J., Dec. 20, 2004, at A1. Interestingly, reductions in mercury emissions from coal-fired power plants will be a significant co-benefit from attacking the greenhouse gas problem, because use levels of coal-fired generation of electricity will decline, reducing both carbon dioxide and mercury emissions.

its ability to lead on this issue.

Another distinctive feature of climate change has already been alluded to above, which is the aspect of time. The acknowledged length of time it will take to stabilize GHG concentrations at an acceptable level must be measured in multiple decades, not years.[32] Only a cursory understanding of the problem is necessary in order to realize that policies to bring the level of GHG concentrations in the atmosphere under control will require many decades to accomplish their objectives. In contrast, when we enacted laws like the Clean Air Act and the Clean Water Act, we were infatuated with the successes of the lunar mission, which had made good on President Kennedy's promise to put a man on the moon by the end of the 1960s. Still basking in that success, we allowed ourselves to believe that we would "solve" those problems through massive but manageable efforts within a short time span. This expectation has obviously not been borne out with respect to any of our conventional pollution problems. Optimism has its virtues, especially because it helps give us the motivation to act, but optimism needs to be coupled with programs that are scaled realistically to the demands of the task at hand. In the case of GHGs, we know that we will have to manage the GHG problem for years to come. This will demand a constancy of purpose and commitment to programmatic steps that will be regularly challenged by the pushes and pulls of other priorities.

While we need to acknowledge that these and other features make the climate change issue unique, the GHG problem also exhibits a number of important structural characteristics similar to those of other environmental problems we have faced. Importantly, addressing climate change is going to require nationwide action by thousands of participants. National goals must be translated so that understandable signals will be sent to these participants. The actions that must be taken implicate deeply embedded economic and social structures. They will require changes in the generation of electrical power; in the transportation sector; in how we build our buildings, both commercial and residential; and in the agriculture and natural resource extractive industries.[33] Close monitoring of results and compliance will be required.[34] All of these features are shared by our air and water pollution programs, as well as those designed

32. *See* IPCC, *supra* note 12, at 18.

33. *See* LAZARUS, THE MAKING OF ENVTL. LAW, *supra* note 21, at 219–28.

34. *See* MARY GRAHAM, THE MORNING AFTER EARTH DAY 47 – 50 (Brookings Inst. Press 1999).

to address solid and hazardous waste problems.[35] Overall, the situations we have faced in the past are similar enough to the one we are now confronting to permit further cross-pollination.

An additional lesson we can learn from our prior efforts to address traditional air pollution problems addresses the long-standing conflict between so-called deep and shallow perspectives on environmental problems. Throughout the environmental era, which we can mark symbolically with the signing of the National Environmental Policy Act in 1970, one can identify these two quite different schools of thought regarding our environmental problems.[36] Both acknowledge that environmental degradation poses problems of the greatest magnitude, and that we must face up to them.[37] Yet they differ markedly in their diagnoses of the causes of those problems and their approaches to fixing them.

The shallow perspective views environmental degradation as caused by our history of giving our natural resources away for free to anyone who would use them as waste receptacles.[38] The result is over-use.[39] When untreated, effluent from manufacturing plants or untreated sewage from municipal collection systems can be discharged without cost into rivers. These activities will continue far beyond the point where the health and safety costs have exceeded the cost savings of not having to treat the waste before discharging it.[40] When multiple sources engage in the same activities, the aggregation of many sources creates pollution problems that are widespread and pervasive.[41] They are also ones that can be remedied—at least in principle—through relatively minor corrective measures designed to ensure that natural resources are being put to their highest and best use.[42] Once clean water becomes more valuable for public health, consumption, fishing or a recreational purpose, its use for waste disposal ought to be reduced – but if the alternative means of disposing of waste cost more than the fish that people cannot eat or the recreation that they cannot enjoy, then from the shallow perspective using the environment as a

35. *Id.*

36. The locus classicus for the distinction is Arne Naess, *The Shallow and the Deep, Long-Range Ecology Movements: A Summary*, 16 INQUIRY 95 (1973).

37. *Id.*

38. *See generally* MAARTEN A. HAJER, THE POLITICS OF ENVIRONMENTAL DISCOURSE: ECOLOGICAL MODERNIZATION AND THE POLICY PROCESS (Oxford U. Press 1995).

39. *Id.*

40. WILLIAM J. BAUMOL & WALLACE E. OATES, THE THEORY OF ENVIRONMENTAL POLICY 178 (Cambridge U. Press 1988) (1975).

41. *See* GRAHAM, *supra* note 34, at 15.

42. *See id.* at 21-24.

disposal site represents sound policy.

On this diagnosis, there is nothing fundamentally amiss with the basic structure of our economy or our society. The shallow perspective does not raise questions about whether the business of producing, manufacturing, and marketing is deeply flawed; it only questions whether, in making business decisions, firms are being confronted with the true costs of all the raw materials, environmental resources, and other goods they consume.[43] Likewise, the shallow perspective does not question whether the human consumption patterns that drive production are deeply flawed; it only questions whether in deciding among the different ways in which people are free to spend their money, they are being confronted with prices that reflect the full costs of the goods they may decide to purchase.[44]

Under the shallow perspective, fixing environmental problems becomes an exercise in marginal adjustments, not fundamental transformation.[45] Those adjustments can be achieved in one of two ways. On the one hand, firms could be required to pay for the natural resources they consume, just as they must pay for other inputs.[46] Once they receive that price signal, they would figure out for themselves whether they could reduce pollution more cheaply than continuing to pay for the costs of their use of the environment.[47] Alternatively, firms could be directly required to reduce pollution by amounts that the government determines will properly balance the firm's use of the environment against competing uses.[48]

In the early years of the environmental era, officials and others often used deep rhetoric in describing the need for fundamental change. Nonetheless, it was the shallow perspective that generally controlled the policy-making process. One substantial reason the shallow perspective controlled was the assumption—sometimes explicit, sometimes not—that the sorts of marginal changes contemplated by the shallow perspective would achieve levels of environmental quality and public health protection that would respond fully to people's concern about environmental problems.[49] A spirit of technological optimism also pervaded the public policy

43. *See* Naess, *supra* note 36.
44. *See id.*
45. *See id.*
46. *See* BAUMOL & OATES, *supra* note 40, at 175.
47. *See id.*, at 177.
48. *See* GRAHAM, *supra* note 34, at 96-98.
49. *See* Naess, *supra* note 36.

community, further contributing to the view that many environmental stressors can be eliminated or reduced dramatically without major adjustments in the mass-produced, industrial or technological resources people expect or desire in modern society.[50] Once the inefficiencies in the marketplace that permitted under-investment in environmentally benign and environmentally protective technologies were adjusted by new laws and incentives, the implementation of technology that reduced pollution without fundamental changes in production or consumption patterns would come to pass fairly quickly.[51]

The shallow perspective on the causes and the cures of environmental problems underwrote an expectation that we could get on top of pollution problems expeditiously.[52] Industry would surely incur additional costs, but only to offset the fact that heretofore they had been getting a free ride using resources that others valued more highly.[53] The primary response to the new costs, or to new regulatory requirements, would be to install end-of-the-pipe technologies to capture pollution after it was produced and before it was vented or discharged into the environment.[54] For automobiles, this meant using a catalytic converter; for power plants, flue gas desulphurization ("FGD") devices and baghouses were used; and for manufacturing and municipalities, primary, secondary, and tertiary treatment plants were used.[55] Because adopting a shallow perspective was sufficient to get the job done, there was no need for deeper measures.

The deep perspective's view of the air pollution problem is not nearly so simple. From the deep perspective, the causes of our environmental problems are structural and firmly rooted in a basic orientation toward the environment that a shallow-perspective program fails to address.[56] So long as we view our relationship as one of resource-user to resource, our patterns of consumption and production will place ever increasing demands on the environment. Relatively available technological additions, like end-of-the-pipe controls, will be able to put band aids on the

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50. *See* John Applegate, *The Prometheus Principle: Using the Precautionary Principle to Harmonize the Regulation of Genetically Modified Organisms*, 9 IND. J. GLOBAL LEGAL STUD. 207, 223 (2001).

51. *See* GRAHAM, *supra* note 34, at 58 (discussing the public's preference for technological-based solutions over those requiring behavioral changes).

52. *See* Naess, *supra* note 36.

53. *See* GRAHAM, *supra* note 34, at 83–89.

54. *Id.*

55. *See* Naess, *supra* note 36.

56. See *id.*

problems temporarily, but the trajectory of resource use will eventually overwhelm these shallow measures. Our environmental problems may be deferred, but they will not be surmounted without a transformation of the way we relate to the environment. We need to think in terms of living in a harmonious relationship with the planet, rather than in terms of an essentially exploitative relationship, even after pollution costs have been factored into the equation. In fact, adopting shallow measures may even be destructive of our ability to take the strong measures that are required; it may drain the energy out of the social movement that might otherwise pressure for stronger measures by misleading people into thinking that the shallow strategies have successfully dealt with our problems.

The deep perspective urges transformative changes in economic and social structures.[57] When Senator Edmund Muskie (D-ME) was shepherding the Clean Air Act Amendments of 1970 through the Senate, his colleague, Senator Gaylord Nelson (D-WI), remembered as the "father of Earth Day," was proposing legislation to ban the use of the internal combustion engine.[58] Muskie's legislation, ambitious for its time but still more consistent with the shallow perspective than the deep one, passed the Senate unanimously and became law at the end of 1970.[59] Nelson's proposal, which would have subjected the transportation sector to deep restructuring, did not come up for a vote at all.[60]

The comparative fates of Muskie's and Nelson's initiatives track the broader fates of the shallow and deep perspective when they have vied to see which would supply the characterization and diagnosis of our major environmental problems that policy makers would follow. The shallow perspective has overwhelmingly prevailed, while the deep perspective has suffered from an association with two very unpopular ideas.[61] The first idea is that for the implications of the deep perspective to be faithfully followed, we would have to adopt policies that

57. *See* WALTER A ROSENBAUM, ENVIRONMENTAL POLITICS AND POLICY 25 (3rd ed. 1995) ("Many more within the movement, preferring social to political action, have adopted individual and collective lifestyles outside conventional American culture.").

58. *See* Christopher H. Schroeder, *Regulating Automobile Pollution: An Environmental Success Story for Democracy?*, 20 ST. LOUIS U. PUB. L. REV. 21, 43 (2001). *See also* Claudia Luther, *Gaylord Nelson, 89; Champion of Environment Started Earth Day*, L.A. TIMES, July 4, 2005, at B11.

59. E. Daniel Elliott et. al., *Toward a Theory of Statutory Evolution*, 1 J.L. & ECON. 313, 337-38 (1985). *See also* Edward S. Muskie, *NEPA to CERCLA The Clean Air Act: A Commitment to Public Health*, ENVTL. FORUM 3, 3 (1990).

60. Schroeder, *supra* note 58, at 43-44.

61. Rosenbaum, *supra* note 57, at 25-26.

would doom any chance of improving our general well-being, bringing prosperity to more people, or even maintaining the quality of life that many of us associate with current circumstances.[62] Deep restructuring of the sort called for by a deep diagnosis of our situation has been thought to require a regression to technologically primitive and much harder lifestyles.[63] The second idea associated with the deep perspective arises from the conviction that the general public would never endorse such restructuring once the public understood that it had these regressive implications.[64] Consequently, an authoritarian state would be required to achieve the restructuring that deep environmentalism finds necessary.[65]

Associating these two ideas with deep environmentalism has always been something of a caricature, although one can find strands within the diverse literature that seem to tilt toward them.[66] Equally available within the deep environmentalism literature, however, is a more upbeat, optimistic viewpoint; one which argues that a life lived in better harmony with the natural environment could offer lifestyles superior to those available today. Illustrative of this viewpoint is a publication of the Science Council of Canada entitled *Canada as a Conserver Society: Resource Uncertainties and the Need for New Technologies*.[67] The slogan of the *Conserver Society* report is "doing more with less."[68] It does not endorse the idea that comforts and conveniences have to be sacrificed nor is it technologically pessimistic.[69] In fact, this strand of deep

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62. *See* Rosenbaum, *supra* note 57, at 25. *See also* Christopher D. Stone, *Is Environmentalism Dead?*, 38 ENVTL. L. 19, 44 (2008) (citing *Environmentalists vs. Scientists*, AM. ENTER., May-June 1999, at 19); Karl Zinsmeister, *Indicators: Environmentalists v. Scientists*, AM. ENTERPRISE, May – Jun. 1999, at 18, 19 (drawing from a survey of leaders at sixteen environmental organizations); BRUCE YANDLE, THE POLITICAL LIMITS OF ENVIRONMENTAL REGULATION: TRACKING THE UNICORN 161-65 (Quorum Books 1989).

63. Stone, *supra* note 62, at 44.

64. *Id.* at 32.

65. *See generally* WILLIAM OPHULS, ECOLOGY AND THE POLITICS OF SCARCITY 2-3 (1977) (developing the idea that a democracy will never be able to take the drastic measures required to save the planet and that only a totalitarian state could succeed in putting them in place).

66. *Id.* at 2; E.F. SCHUMACHER, SMALL IS BEAUTIFUL: ECONOMICS AS IF PEOPLE MATTERED (Harper & Row 1973) (discussing the impacts of simpler lifestyles).

67. ROBERT PAEHLKE, ENVIRONMENTALISM AND THE FUTURE OF PROGRESSIVE POLITICS 1, 137 (1989).

68. *Id.*

69. *Id.* at 138. *See also id.* at 119 (noting that deep environmentalism also does not reject democratic politics, in fact the strand represented by the CONSERVER SOCIETY report would "like [to see] decision making … be more conscious and democratic than it has been.").

environmentalism depends upon technological development, because it is through the development and use of sustainable, green technologies that doing more with less will be achievable.[70] As Robert Paehlke has put it, "[s]cientific optimism need not now be rejected, but it does need to be guided by a more complex understanding of progress."[71]

Deep environmentalism need not be totalitarian or retrograde in its orientation, but it does believe that looking at environmental problems as marginal deficiencies in an economic system otherwise oriented toward growth in material consumption is a fundamental error.[72] In an influential essay in the 1960s, Kenneth Boulding set the problem in verse:

> One principle that is an ecological upsetter
>
> Is that if anything is good, then more of it is better,
>
> And this misunderstanding sets us very, very wrong
>
> For no relation in the world is linear for long. [73]

Deep environmentalists perceive the shallow perspective as remaining committed to the "more is better" idea, failing to see that environmental problems need to be addressed with more than band-aids.[74] For deep environmentalists, these problems require a fundamental reorientation of patterns of consumption and production in ways that will lead to sustainable patterns of living.[75]

Concerning the contest between the shallow and deep perspectives, our past experiences with conventional pollution programs send a layered message; people can disagree about the proper interpretation of that message. Without canvassing all of the possible interpretations in this space, I want to suggest the one that seems to me the most compelling: rather than showing that one perspective is superior to the other, experience demonstrates the usefulness of both. The shallow perspective has the advantage of being able to drive short-term strategies while the deep point of view has the advantage of being able to

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70. *Id.* at 136-39.

71. PAEHLKE, *supra* note 67, at 119.

72. OPHULS, *supra* note 65, at 3.

73. BILL MCKIBBEN, DEEP ECONOMY: THE WEALTH OF COMMUNITIES AND THE DURABLE FUTURE 26 (2007) (quoting verse attributed to Kenneth Boulding).

74. Kenneth Boulding, *The Economics of the Coming Spaceship Earth*, *in* ENVIRONMENTAL QUALITY IN A GROWING ECONOMY (Henry Jarrett ed. 1966), *available at* http://www.eoearth.org/article/The_Economics_of_the_Coming_Spaceship_Earth_(historical).

75. *Id.*

guide long-term transformations.[76] Either perspective without the other is less effective than the two in combination. An exclusively shallow perspective stops short of the changes that we need to make, creating a false sense that the problems have been addressed when they have only been forestalled. On the other hand, while the deep perspective can guide long-term planning, it is unsatisfactory and impractical as a basis for immediate responses because any effort to implement it over the short term will face resistance. In addition, the changes that it urges are quite difficult to implement without significant lead time.

Our history over the past forty years with traditional air pollution illustrates these points. In that time period, end-of-the-pipe controls have considerably improved environmental conditions.[77] Emissions of the six national ambient air pollutants have each fallen substantially. Lead emissions are down ninety-seven percent from 1970 levels; particulate matter (PM10) is down twenty-eight percent. The remaining four ambient air pollutants—oxides of nitrogen, volatile organic compounds, sulfur dioxide, and carbon monoxide—are each down percentages in between.[78] These gains translate into substantial health gains for the American population.[79] There is also no denying that catalytic converters have reduced emissions per mile traveled dramatically, on the order of ninety percent or greater from pre-1970 levels.[80]

At the same time, the deep critique that these ameliorative measures will not get the entire job done is also being borne out by our experience. Nearly forty years after the Clean Air Act Amendments of 1970 were passed, over half the United States population lives in counties that have unhealthy levels of ozone

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76. *Compare* ROSENBAUM, *supra* note 57, at 25 (3d ed. 1995) (noting that deep ecologists want to change fundamentally the way we live in all aspects of society including political and economic institutions), *and* Naess, *supra* note 36 (noting that the central objectives of the "shallow" ecologists are health and affluence of people).

77. ROSENBAUM, *supra* note 57, at 189 (noting that "overall, national air quality has undoubtedly improved – in a few instances, dramatically – since the Clean Air Act's enactment in 1970.").

78. EPA 2007 EMISSIONS TRENDS, SIX PRINCIPAL POLLUTANTS, FIGURE 4, http://epa.gov/airtrends/2007/report/sixprincipalpollutants.pdf.

79. *Id.* (acknowledging that "most areas had fewer unhealthy days in 2006 compared with the previous five years.").

80. The catalytic converter has been aided by adjustments to the workings of the internal combustion engine through technological improvements in fuel injectors, micro processors and other technologies. *See* ALON TAL, JERUSALEM INST. FOR ISR. STUD., INSURING THE EFFECTIVENESS OF CATALYTIC CONVERTERS TO PREVENT AIR POLLUTION FROM TRANSPORTATION IN ISRAEL 1, 4 (2005), http://www.jiis.org.il/imageBank/File/Publications/catalytic_eng.pdf.

and particulate matter, according to EPA standards.[81] End-of-the-pipe controls face engineering limits, and after these have been reached, the effectiveness of this approach begins to erode. For example, the catalytic converter can no longer be greatly improved upon, which means that in the future vehicle miles traveled are going to be the significant determinant to total auto emissions.[82] Between 1960 and 2000, average per-vehicle emissions per mile of hydrocarbons, one of the precursors of ozone and smog, fell from about sixteen grams to about one gram.[83] This improvement more than offset the increases in vehicle miles traveled during the same period, from about four billion miles per year to thirteen billion.[84] While no significant additional reductions through improved converter technology are presently anticipated, vehicle miles will continue to climb, approaching eighteen billion by 2015, with additional growth in the years to come.[85] Climbing mileage will inexorably chip away at the converter gains. Improvements in the average fuel economy of the auto fleet will offset the effects of rising miles traveled, but as Boulding wrote, "no relation in the world is linear for long," and declines in pollution due to fuel economy gains will at some point turn around again as total vehicle miles traveled continue to go up.[86]

The catalytic converter story thus illustrates the general problem when dealing with emissions from any source whose usage rates can increase: increases in units of usage can offset reductions in emissions per unit. The concentration of many sources in one area produces a similar problem. The reason that the Los Angeles Air Basin continues to exhibit some of the worst

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81. Nearly fifty-five percent of the U.S. population lives in counties that have unhealthy levels of ozone and PM. Approximately eighty-one million Americans are exposed to unhealthy levels of short-term PM and sixty-six million suffer chronic exposure to PM. AM. LUNG ASS'N, STATE OF THE AIR: 2004 INTRODUCTION, http://lungaction.org/reports/sota04_intro1.html (last visited Nov. 15, 2008). This exposure produces increased levels of asthma and heart failure, particularly to children and the elderly. COAL. FOR CLEAN AIR, POLLUTANTS AND HEALTH EFFECTS, http://www.coalitionforcleanair.org/air-pollution-pollutants.html (last visited Nov. 15, 2008).

82. TAL, *supra* note 80, at 4.

83. ENVTL. PROT. AGENCY, MOBILE SOURCE EMISSIONS – PAST, PRESENT AND FUTURE: HYDROCARBONS, http://www.epa.gov/oms/invntory/overview/pollutants/hydrocarbons.htm (last visited Nov. 15, 2008). *See also* ENVTL. PROT. AGENCY, VEHICLE MILES TRAVELED, http://www.epa.gov/otaq/invntory/overview/vmt.htm (last visited Nov. 15, 2008) [hereinafter EPA, VEHICLE].

84. EPA, VEHICLE, *supra* note 83.

85. *Id.*

86. McKibben, *supra* note 73, at 26.

air quality in the country (although improved over what it was forty years ago) is that there are too many individual sources of pollution pumping emissions into too small an area. Once again, at high enough levels of activity, reductions in pollution per unit of activity are offset by the volume of the activity itself.

Shallow solutions also suffer from the fact that they frequently solve one problem by creating another. End-of-the-pipe solutions are unable to make pollution disappear; the best they can do is move it around. For example, FGD devices and baghouses are effective in removing much pollution from the air, but those emissions have to go somewhere.[87] Typically, the emissions end up as solid waste or sludge, which then creates its own disposal problems.[88] For this reason, deep environmentalists favor pollution prevention over pollution control. This approach often requires changes in the manner in which goods and services are produced, rather than capturing the pollution generated by existing production processes.[89]

The experiences we have had with air pollution can be generalized to water, solid waste and the other pollution types generated by our modern, complex economy. As long as end-of-the-pipe solutions cannot take *all* of the pollution out of any waste stream and render it innocuous, their effectiveness is vulnerable to increasing rates of use of the processes that are producing the pollution and to the creation of new disposal problems that replace the old ones.[90]

Our experiences with conventional pollutants also include some occasional instances of taking a deeper approach to a problem, and thereby actually demonstrating the dramatic effectiveness of deep strategies that aim at pollution prevention rather than pollution control. The story of airborne lead is one such experience. Of all the ambient air pollutants, the one story that stands out as a singular success is that of lead emissions, which have fallen to nearly zero.[91] Its success comes about because instead of mandating end-of-the-pipe controls for lead, the EPA eliminated it from gasoline entirely, thereby obviating any end-of-the-pipe approaches to capture lead before it entered

87. ENVTL. PROT. AGENCY, AIR POLLUTION CONTROL TECHNOLOGY FACT SHEET, http://www.epa.gov/ttn/catc/dir1/ffdg.pdf (last visited Nov. 15, 2008) [hereinafter EPA, AIR POLLUTION CONTROL].

88. Rosenbaum, *supra* note 57, at 45-46.

89. *See* Paehlke, *supra* note 67, at 137.

90. EPA, AIR POLLUTION CONTROL, *supra* note 87.

91. ENVTL. PROT. AGENCY, LEAD IN AIR, http://www.epa.gov/air/lead (last visited Nov. 15, 2008).

the environment.[92] In the 1970s, the EPA was faced with the unfortunate chemical circumstance that lead coming through an auto's exhaust system greatly diminished the effectiveness of the catalytic converters being used to trap other auto exhaust emissions.[93] Alternative end-of-the-pipe solutions to address this incompatibility were non-existent. This incompatibility, combined with the serious adverse health effects associated with lead which were being documented in the 1970s, led the EPA simply to ban the use of lead in gasoline.[94] Gasoline manufacturers quickly found other ingredients to deal with the problem of engine knock.[95]

It may be tempting to take away from our experiences with existing air policy the conviction that we made a mistake when we adopted the Clean Air Act Amendments of 1970 and put our existing regime of essentially shallow strategies into place. In my judgment, however, that is not when the mistake occurred. That dubious distinction goes to the mid-course corrections Congress enacted in 1977. In the years between 1970 and 1977, the United States experienced an oil shortage and an oil price shock at the hands of the OPEC oil cartel.[96] We had also been trying to implement the Clean Air Act for enough years to realize that the air quality problems in the United States were more intractable than originally supposed and the original compliance dates for bringing air pollution under control were not going to be met.

The interaction between the energy crisis and the air pollution experiences produced mid-course corrections that simply extended the original compliance dates and watered down compliance provisions applied to the domestic energy industry. The legislative debate in the late 1970s thus squandered a great opportunity. The 1977 Amendments could have been the occasion to acknowledge the inherent weaknesses of shallow

92. *See* David M. Driesen, *The Economic Dynamics of Environmental Law: Cost-Benefit Analysis, Emissions Trading and Priority-Setting*, 31 B.C. ENVTL. AFF. L. REV. 501, 527-28 (2005).

93. *See* Andrew P. Morriss and Nathaniel Stewart, *Market Fragmenting Regulation: Why Gasoline Costs So Much (and Why It's Going to Cost More)*, 72 BROOK. L. REV. 939, 1022-23 (2007).

94. *Id.* at 1023.

95. The lead example, furthermore, was a relatively easy deep solution because it required only marginal adjustments in existing petroleum refining processes and in the workings of the internal combustion engine to achieve the same functionality without the use of lead. *See* ENVTL. PROT. AGENCY, U.S. TAKES FINAL STEP IN PHASEOUT OF LEADED GASOLINE, http://www.epa.gov/history/topics/lead/02.htm (last visited Nov. 15, 2008).

96. James A Duffield, et. al., *Ethanol Policy, Past, Present and Future*, 53 S.D. L. REV. 425, 427 (2008).

approaches as long-term solutions to any pollution issue when pollution is an increasing function of usage. In the case of air pollution, nearly all of the emissions of carbon monoxide, nitrogen oxides and sulfur dioxides, as well as more than half of hydrocarbon emissions, come from fossil fuel combustion in vehicles, electrical power plants or industrial facilities.[97] The decision making environment of the late 1970s was an ideal moment to acknowledge the need to reduce our use of fossil fuels over the long-term in order to reduce the pollution levels associated with the burning of those fuels. This environmental issue could have been raised hand-in-hand with the energy security issues that OPEC's actions and their dramatic impact on American markets had brought to many people's attention. Thus, the time seemed to be advantageous to promote a national program that would have moved the nation away from a fossil fuel dependent energy base. As the solution to a national security problem, this would have had the tremendous co-benefit of beginning the deep structural shift that was also necessary to address the country's air pollution problems.

Instead, the energy security debate was framed as a question of enhancing domestic *supply* rather than reducing domestic demand for fossil fuels. Bills were introduced to authorize exploratory drilling in the Alaska National Wildlife Refuge.[98] The country embarked on a publicly funded program to develop oil shale technology, whereby liquid petroleum products could be produced from the vast oil shale deposits along the western slope of the Rockies in Wyoming, Utah and Colorado.[99] This emphasis on increasing domestic supply as a response to the OPEC challenge did nothing to address air pollution. In fact, the development of oil shale as a source of petroleum would have increased emissions attributable to fossil fuel production and consumption. One reason that the linkage between the energy security issue and the air quality issue was not made more forcefully was that the air quality debate was still being framed as a question of how to achieve our air quality goals within a very

97. ENVTL. PROT. AGENCY, AIR EMISSION SOURCES, http://www.epa.gov/air/emissions/index.htm (last visited Nov. 15, 2008).

98. *See, e.g.,* James R. MacAyeal, *The Comprehensive Response, Compensation, and Liability Act: The Correct Paradigm of Strict Liability and the Problem of Individual Causation*, 18 UCLA J. ENVTL. L. & POL'Y 217, 254 (2000); Sara N. Pasquinelli, *To Drill or Not to Drill: The Arctic National Wildlife Refuge v. "the Need" for U.S. Energy Independence*, 33 GOLDEN GATE U. L. REV. 503, 506-07 (2003).

99. Our oil shale reserves have been estimated as equivalent to 1.5 trillion barrels of oil, five times larger than Saudi Arabia's oil reserves. *See* Dan Denning, *Oil Shale Reserves: Stinky Water, Sweet Oil*, *A Daily Reckoning White Paper Report*, http://www.dailyreckoning.com/rpt/OilShale.html (last visited Nov. 15, 2008).

short time frame. The full-throated optimism of the 1970 Act had not been borne out, but sufficient optimism and faith in end-of-the-pipe controls remained to foreshorten the planning horizon for success.

The energy debate of the 1970s did not entirely ignore the deep structure of the country's energy sector, but it failed to respond with programs that might have laid the groundwork for the transition to another, more sustainable structure. Under President Carter, the federal government did invest in research into renewable energy and energy conservation for a few years, but funding was minimal and even those amounts evaporated when President Reagan came into office in 1981.[100]

What was missed in 1977 was not the chance to repudiate end-of-the-pipe and other shallow responses to the problems of air pollution. At the time, we had just begun to fully implement policies that would eventually produce substantial improvements in the nation's air quality, and it would have been a mistake to abandon them. Instead, we missed recognizing that shallow approaches would inevitably be insufficient; eventually, the gains from shallow approaches to air quality would be increasingly offset by rises in energy consumption, so long as our country relied upon fossil fuel as its energy backbone. Therefore, we also missed the chance to institute a dual-track policy that could pursue both shallow and deep strategies in parallel. One can only wonder where we would be today if, in 1977, the nation had continued to implement end-of-the-pipe and other marginal adjustments to the existing fossil fuel dependent systems for energy production and transportation while simultaneously stimulating the long-term research, development, and demonstration of the transformative technologies required to shift to a non-fossil fuel backbone. Thirty years of hard work on that research and development might have seen the sorts of breakthroughs in solar and wind power, in the hydrogen fuel cycle and in energy conservation that would have enabled these technologies to have a significant impact today. Thirty years of acting on the awareness that residential and commercial development patterns contribute to energy use could also have resulted in the suburbs and exurbs being built to specifications that conserved rather than wasted energy. The missed opportunities could be stretched out into a long list.

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100. Michael J. Weiss, *Everybody Loves Solar Energy, But…*, N.Y. TIMES, October 18, 2008, *available at* http://query.nytimes.com/gst/fullpage.html?res=950DE3DD1F3DF937A1575AC0A96F948260&sec=&spon=&pagewanted=all.

In 1977, the climate change problem was not understood well enough by policy makers to play any significant role in the deliberations over the 1977 Amendments. Had it been, policy makers would have had even more urgent reasons to conclude that deeper responses to the environmental problems associated with the carbon-based fuel cycle were essential; climate change is just as closely correlated with our carbon fuel cycle as are many of the conventional air pollution problems. Sixty-one percent of GHGs and seventy-five percent of carbon dioxide come from the use of fossil fuels.[101] The climate change problem is made even more urgent by three decades of GHG loading that has occurred since 1977, compelling us to confront the deep perspective more forthrightly than we have so far.

The move away from carbon becomes even more urgent as a response to climate change because of the problem of persistence. With local air pollution, short-term, end-of-the-pipe solutions reduce atmospheric levels of air pollution in a very short period of time. Thus, improvement in air quality produces beneficial effects promptly. Accordingly, shallow solutions—that effectively grab the low-hanging fruit of readily reducible emissions—really do have a genuinely beneficial effect on human and environmental health. Furthermore, because air quality had been given away freely for decades, destroying any financial incentive for companies to innovate pollution reduction strategies, such low-hanging fruit has been fairly plentiful.[102] Once required to make reductions, industry quickly found technologies that could be rushed into production and extract a good percentage of existing pollutants from waste streams.[103] Getting those increments of readily-removable pollutants has done some real good, but there is not much of this low-hanging fruit left to be claimed. Further progress slows and can even be reversed unless deeper solutions are adopted.

The life cycle of GHGs in the atmosphere is decidedly different. Carbon dioxide is estimated to remain in the atmosphere for 100 years, and the persistence of other greenhouse contributions is measured in the thousands of

101. KEVIN BAUMERT, TIMOTHY HERZOG & JONATHAN PERSHING, NAVIGATING THE NUMBERS: GREENHOUSE GAS DATA AND INTERNATIONAL CLIMATE POLICY 41 (World Resources Inst. 2005).

102. Richard Haeuber, *Setting the Environmental Policy Agenda: The Case of Ecosystem Management*, 36 NAT. RESOURCES J. 1, 2 (1996) (identifying the "low-hanging fruit' of environmental issues . . . [as] cleaning up the most obviously polluted airsheds and waterways, for example").

103. *Id.* at 2.

years.[104] Global warming is a function of the increasing stock of GHGs already in the atmosphere, a stock that can continue to grow even after new flows and new contributions to that stock have slowed considerably.[105] For GHGs, the atmosphere is like a bathtub that has filled up nearly to the top and is draining very slowly. The drain empties the bathtub so slowly that even after the spigot has been turned way down, the water level in the bathtub continues to rise. So lowering the rate of GHG emissions, even substantially, does not reduce the adverse effects of global warming; it only slows the rate at which the world's mean temperature will rise.[106] In the case of GHGs, grabbing the low-hanging fruit does not actually prevent further global warming from occurring. For this reason, Kyoto's goal of reducing GHG emissions to seven percent less than 1990 levels by the year 2012 was never thought to be more than a tentative first step, inadequate by itself to stop climate change.[107] Kyoto just slows down the speed with which the increase in temperature occurs.[108] A more ambitious plan is needed.

The plans that have been suggested vary a great deal, and it would take considerably more expertise than I command to provide anything approaching a thorough evaluation. For discussion purposes, consider the target mentioned at the beginning of this essay: the widely discussed goal of stabilizing GHGs at no more than twice the concentration that existed prior to the Industrial Revolution, or about 550 ppm CO_2-eq., by the year 2100.[109] Many of the pieces of legislation pending in the United States Congress set domestic objectives consistent with some proposals to stabilize at 550 ppm or less; this is also a goal that has been widely used for discussion purposes in various international and national analyses. According to IPCC models, stabilizing at this level would imply a global mean temperature

104. IPCC, *supra* note 12, at 2.

105. *Id.*

106. *Id.*

107. CHARLI E. COON, HERITAGE FOUND., WHY PRESIDENT BUSH IS RIGHT TO ABANDON THE KYOTO PROTOCOL, (2001), *available at* http://www.heritage.org/Research/EnergyandEnvironment/BG1437.cfm; William K. Stevens, *Experts Doubt Rise of Greenhouse Gas Will be Curtailed*, N.Y. TIMES, Nov. 3, 1997, at A1 (stating that "it is widely agreed [among climatologists], based on proposals on the table, that any action emerging from Kyoto would be insufficient to prevent an eventual doubling of [GHGs]").

108. *Id.*

109. *See* IPCC, *supra* note 12, at 2 (stating "Modeling studies show global carbon prices rising to 20-80 US$t/CO2-eq by 2030 are consistent with stabilization at around 550 ppm CO2-eq by 2100.").

rise of 2.8 to 3.2 degrees Celsius.[110] That amount of temperature gain will cause some climate disruption, as well as sea-level rise, so that adaptation measures will still be required. Some collective international decisions will have to be made about whether this is the appropriate global goal, as opposed to something more ambitious or less ambitious.[111]

How does our current situation and GHG growth trajectory correlate with this goal? Concentrations of CO_2, the leading GHG, had already increased from a pre-Industrial Revolution level of 280 ppm to approximately 383 ppm by late 2007.[112] This concentration has actually been going up at an *accelerating* pace in recent decades.[113] Estimates are that fifty percent of the some 2.3 trillion tons of CO_2 that humans have released into the atmosphere in the past 200 years have come in the thirty year period between 1974 and 2004.[114] Current emissions rates, furthermore, continue to climb annually, influenced by expanding energy use in both the industrialized and the developing worlds.[115] Some estimates are that annual CO_2 emissions could double between now and 2050, from seven to fourteen billion tons of carbon per year; if that happened, it would then be nearly impossible to avoid a *tripling* of GHG concentrations compared to pre-Industrial Revolution levels.[116]

Given our current trajectory, there are no shallow approaches that will be adequate enough to achieve the goal of stabilization at 550 ppm by the end of the century. Robert Socolow and Stephen Pacala have usefully identified a set of currently available options that could stabilize annual emissions

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110. IPCC, *supra* note 12, at 2.

111. United Nations Framework Convention on Climate Change, Dec. 7-10, 1992, *Final Declaration*, 4 [hereinafter UNFCCC]. Article 2 of the UNFCCC provides: "The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties … As the IPCC acknowledges, settling on what level of stabilization is necessary to prevent 'dangerous anthropogenic interference with the climate system' will require value judgments to be made by the international community." *See also* IPCC, *supra* note 12, at 2.

112. As of November, 2007, NOAA reports a globally averaged marine surface monthly mean concentration of 383 ppm. DR. PIETER TANS, NAT'L OCEANIC & ATMOSPHERIC ADMIN., TRENDS IN ATMOSPHERIC CARBON DIOXIDE – MAUNA LOA (2007), http://www.esrl.noaa.gov/gmd/ccgg/trends (follow "globally averaged marine surface monthly mean data" hyperlink).

113. Lakshman Guruswamy, *Integrated Environmental Control: The Expanding Matrix*, 22 ENVTL. L. 77, 87 (1992).

114. Baumert, et al., *supra* note 101.

115. Andrew C. Revkin, *Reports: Energy Thirst Still Topping Climate Risks*, N.Y. TIMES, June 25, 2008, *available at* http://dotearth.blogs.nytimes.com/2008/06/25/reports-energy-thirst-still-topping-climate-risks/?pagemode=print.

116. Robert H. Socolow & Stephan W. Pacala, *A Plan to Keep Carbon in Check*, SCI. AM., Sept. 2006, at 50.

rates at the current level of seven billion tons per year.[117] However, stabilization at that level implies continued increases in global temperature due to the persistence of GHGs in the atmosphere. Adoption of the Socolow/Pacala recommendations would buy us valuable time to plan for the transformative changes necessary to achieve even deeper cuts in annual emissions, but cannot by itself stabilize atmospheric concentrations. In order to succeed, our climate change strategy needs to embrace a transformation away from the carbon fuel cycle entirely. Approaches like Socolow and Pacala's will give us the time to develop the means for that transformation, but only if we use the time their shallow recommendations provide to lay the groundwork for the eventual transformation.

III. CONCLUSION

Forty years ago, had we been sufficiently aware of the nature of the climate change problem, we might have taken advantage of the opening provided by the Environmental Decade of the 1970s to initiate steps that would now have us well on our way to addressing that problem. Having missed that opportunity, we now need to do the next best thing: take advantage of the lessons to be learned from our forty years of experience in addressing other environmental problems in order to craft a successful strategy today. We need to take these lessons seriously, because it is unlikely we are going to have a second chance.

117. *Id.*