Tulsa Law Review

Volume 46
Number 2 *Geoengineering*

Volume 46 | Number 2

Winter 2010

Geoengineering and Climate Management: From Marginality to Inevitability

Jay Michaelson

Follow this and additional works at: https://digitalcommons.law.utulsa.edu/tlr

 Part of the Law Commons

Recommended Citation

Jay Michaelson, *Geoengineering and Climate Management: From Marginality to Inevitability*, 46 Tulsa L. Rev. 221 (2013).

Available at: https://digitalcommons.law.utulsa.edu/tlr/vol46/iss2/1

This Article is brought to you for free and open access by TU Law Digital Commons. It has been accepted for inclusion in Tulsa Law Review by an authorized editor of TU Law Digital Commons. For more information, please contact megan-donald@utulsa.edu.

GEOENGINEERING AND CLIMATE MANAGEMENT: FROM MARGINALITY TO INEVITABILITY

Jay Michaelson*

INTRODUCTION

In 1998, I wrote the first law review article advocating geoengineering as a climate change mitigation strategy in the *Stanford Environmental Law Journal*.[1] At the time, geoengineering was both unknown and unpopular — a seemingly impossible combination, but one enabled by the curious fact that as soon as anyone heard of it, they disliked it.

Twelve years later, the political economy of geoengineering — or as I prefer to call it, for reasons described here, climate management ("CM") — has shifted, precisely because the conditions I outlined in 1998 have stayed so strikingly the same. Then, I argued that the lack of political will, absence, complexity, and sheer expense of climate change mitigation made meaningful preventive measures, i.e. cutting greenhouse gas ("GHG") emissions, extremely difficult to undertake.[2] After a decade of obfuscation and misinformation by powerful political actors, the case seems stronger than ever.

It was on the basis of this first conclusion, that meaningful GHG reduction would be extremely difficult,[3] that I then proceeded to investigate geoengineering from a political-economic point of view. The causal nexus is crucial, and one I share with most other advocates of CM. Few believe that sulfuric sunscreens and oceanic algae farms are *preferable* to traditional GHG reduction policies. Rather, my claim twelve years ago, and advocates' claim today, is that geoengineering is *necessary* because of the unfortunate political economy of GHG reduction, in which the highest costs of mitigation fall

---

* J.D., Yale; Ph.D. Candidate, Hebrew University of Jerusalem. Much of the research for this project was completed when I was a Visiting Assistant Professor at Boston University Law School. I would like to thank Andrew Novak, Jay Wexler, Gerald Leonard, Robert Sloane, and the students in my environmental ethics class for their stimulating conversations and invaluable assistance.

1. Jay Michaelson, *Geoengineering: A Climate Change Manhattan Project*, 17 STAN. ENVTL. L.J. 73 (1998) [hereinafter *Manhattan*]; James Edward Peterson, *Can Algae Save Civilization? A Look at Technology, Law, and Policy Regarding Iron Fertilization of the Ocean to Counteract the Greenhouse Effect*, 6 COLO. J. INT'L ENVTL. L. & POL'Y 61 (1995) (This was the first law review article on a type of geoengineering; as the title implies, it focused exclusively on Ocean Iron Fertilization ("OIF")).

2. *Manhattan*, *supra* note 1, at 81-103.

3. "Meaningful" here is the key modifier, of course. A commonly used CO_2 stabilization target is 450ppm; we are currently at 385ppm, 100ppm above the pre-industrial level. Thus even this target represents more CO_2, and thus more global warming potential, than is presently in the atmosphere. Additionally, this target, post COP-15, is now regarded as unachievable. I discuss these issues *infra* Part I. *See* Tom Wigley, *The Science of Geoengineering*, Presentation at American Enterprise Institute for Public Policy Research Conference (June 3, 2008), *available at* http://www.aei.org/docLib/20080606_WigleyJune3powerpoint.pdf.

precisely on some of the most powerful political actors. Likewise, geoengineering advocates usually do not claim that it should be implemented *in place of* GHG reduction. Rather, the usual claim is that it should be pursued *in addition to* GHG reduction and that at the very least, serious research into its feasibility is warranted.

Geoengineering was a marginal idea in 1998, and I had only a dozen or so legal, political, and scientific studies to rely upon. Since then, much has changed. While CM remains at the margins of our popular political discourse, there has been an explosion of scientific and policy analyses, particularly since the publication of Paul Crutzen's 2006 editorial on Solar Radiation Management (SRM), probably the most promising potential geoengineering technology.[4] Indeed, one may divide the history of this progress into B.C. — Before Crutzen — and after. This was not some recent law school graduate making a policy recommendation — this was a Nobel laureate, prophet of the atmospheric ozone crisis, and widely-respected leader in climate science. SRM, Ocean Iron Fertilization ("OIF": seeding gigantic phytoplankton carbon sinks in the oceans by fertilizing them with iron), and other technologies have since been explored and advanced by credible scientists, scholars, and even entrepreneurs. Such proposals are no longer the stuff of "giant laser space Frisbees," the phrase from *Bloom County* which I cited in 1998.[5]

At the same time as this increase in attention to CM in scientific and policy circles, there has been another, subtler trend that has accompanied it: its tentative exploration by conservative think tanks and pundits. In a sense, this is every environmentalist's worst nightmare: the same conservatives, lobbyists, and business interests who have successfully stopped climate change legislation are, just as some greens feared, coming around to support engineering the atmosphere instead of reducing our consumption. As well they should. As I noted in 1998, CM can be postponed; it can be undertaken by making more stuff, rather than less; and it can even be subcontracted out to private actors, without the need of government regulation of ordinary people. It's a Tea Partier's green dream.

Yet the mere fact that conservatives support geoengineering should not, in itself, cause liberals and greens to oppose it. Despite my unsavory bedfellows, I remain a geoengineering advocate, or, on the "blue team," in the language of Eli Kintisch's recent book.[6] Had geoengineering been the Right's idea, perhaps I would now be saying, for the sake of the planet, "If you can't beat 'em, join 'em." But it was not the Right's idea. CM has come about, and come to prominence, because of sincere environmental scientists and policy analysts struggling with how to avert massive climate catastrophe. Supporting CM should give any environmentalist pause, both because of its riskiness and because so many of our political foes support it. It i's outrageous, in a way.First, greedy oilmen block GHG reduction by saying that climate change does not exist, and then they support CM because all of a sudden it does.

---

4. Paul J. Crutzen, *Albedo Enhancement by Stratospheric Sulfur Injections: A Contribution to Resolve a Policy Dilemma?*, 77 CLIMATIC CHANGE 211–19 (2006). *See also* ELI KINTISCH, HACK THE PLANET: SCIENCE'S BEST HOPE — OR WORST NIGHTMARE — FOR AVERTING CLIMATE CATASTROPHE, 55-58 (2010).

5. *Manhattan, supra* note 1, at 130.

6. In Kintisch's lingo, the "Blue Team" is pro-geoengineering, the "Red Team" against. KINTISCH, *supra* note 4, at 8-9.

But this nauseating political dynamic is a blessing, not a curse. Yes, it is troubling that CM enriches the malefactors of great wealth. But are we environmentalists interested in punishing the bad guys, or saving the Earth? CM is a climate change strategy that, unlike regulation, might actually stand a chance of becoming reality. It is the only approach to climate change that can act as a compromise between liberals and libertarians, greens and browns. It is the delight of my political opponents, and for that reason, the planet's best hope of survival. As climate change becomes ineluctable, geoengineering becomes inevitable.

This essay explores this new political dynamic, and reaffirms my conclusion from 1998 that we environmentalists must swallow our pride and our misgivings, and support research into geongineering — no longer because it is a marginal idea in need of advocates, but because it is the inevitable fast, cheap solution to climate change that should be carefully researched before it needs to be deployed. Yes, one of our worst nightmares is slowly coming true, but that means an even worse one may be averted.

As a threshold matter, I suggest in part I (as others have before me) that it is time to retire the term "geoengineering." It's too sci-fi to be taken seriously, and it misleadingly suggests that the solution to climate change has to do with bulldozers, rocks, and dams. For reasons set forth in part I, I propose "climate management" (CM), which better describes what SRM and OIF are really about, how they differ from GHG reduction, and how they fit within an overall risk management portfolio for climate change.

Following that terminological proposal, part I explores what has stayed the same since 1998, and what has changed. What has *not* changed is chiefly our inability to do anything about global warming. Perhaps I could have predicted — back in the Clinton administration, pre-Google, pre-9/11 — that the idea of intentionally manipulating the Earth's climatic systems would remain a relatively marginal one. But what I could not have predicted is that in 2012, politicians would still be arguing over whether climate change is a real, anthropogenic phenomenon or not. This is not because the science is uncertain, but because, as former President Clinton recently observed, "We're kind of in a truth-free period right now."[7] The strategy, begun in 1998, to sow uncertainty regarding climate change is now almost as well documented as it is well funded.[8] And so, despite rises in temperatures, a high-grossing documentary film by a Nobel laureate, visible changes in glaciers and ice shelves, and widespread understanding of the climate crisis in Europe, the newly ascendant political party in Washington still has, as its official position, the view that climate change is either not happening, or is part of some natural cycle and requires further study.

I did not take these claims at their word in 1998, and I do not do so today. Yet if

7. Interview by George Stephanopoulos with Bill Clinton, *Good Morning America: Bill Clinton on Haiti, Obama, and Palin* (ABC television broadcast Sept. 21, 2010), *available at* http://blogs.abcnews.com/george/2010/09/bill-clinton-on-palin-resilient-like-me-dont-underestimate-her.html.

8. *See* JAMES HOGGAN & RICHARD LITTLEMORE, CLIMATE COVER-UP: THE CRUSADE TO DENY GLOBAL WARMING (2009); ERIC POOLEY, THE CLIMATE WAR, 31-52 (2010); Peter J. Jacques, Riley E. Dunlap, & Mark Freeman, *The Organisation of Denial: Conservative Think Tanks and Environmental Skepticism*, 17 ENVTL. POL. 349-85 (June 2008); Naomi Oreskes, *Beyond the Ivory Tower: The Scientific Consensus on Climate Change*, 306 SCI. 1686 (2004), *available at* http://www.sciencemag.org/cgi/content/full/306/5702/1686.

the pseudo-controversy regarding climate change proves anything, it is that my earlier article was correct. We should be very pessimistic about greenhouse gas (GHG) reduction as an effective climate change policy, because it would so greatly impact some of the largest and most powerful industrial, commercial, and corporate entities in the country (indeed, the world).[9] If anything, I was too optimistic in 1998. Then, I conjectured that these campaigns of deliberate misinformation would end only once glaciers melted and the evidence was obvious to everyone. Clearly, I was incorrect.

Part I next explores what has changed in the last twelve years: first, the scientific and policy discussions of CM, and second, the growing support of CM in unlikely conservative quarters. Certainly, the most obvious change in the last decade has been in the sheer volume of material. In 1998, there were fewer than half a dozen articles that engaged seriously with geoengineering; now there are hundreds. There have been multiple conferences on the scientific, political, and ethical consequences of geoengineering. And there has been at least some reasonable coverage of geoengineering in the mainstream media, scientific press, and academic sectors. Geoengineering is no longer science fiction, utopian or dystopian fantasy. Whereas it was scarcely polite conversation fifteen years ago, it is now a subject of serious scientific, academic, philosophical, and political discourse.

In part II, I turn to the normative case for CM, which I believe is stronger than ever. First, I address some of the many concerns usually levied at CM, focusing on questions of a "free pass" to polluters, unintended risks and costs, equitable considerations, the potential of cataclysm in case of cessation of CM, and institutional and legal questions regarding rogue actors (or rogue nations) pursuing CM on their own. In each of these cases, I find both reasonable and unreasonable iterations of these concerns but conclude that the concerns are answerable in every case.

Lastly, as I did in 1998, I turn to the deeper questions of CM for environmentalists. CM is appealing to conservatives not only because it protects economic interests but also because it is ideologically in sync with conservative ideas – it lets the free market be free, uses technology rather than a restraint on behavior, and avoids government regulation. This, in addition to practical concerns, is doubtless why CM appeals to so few environmentalists. It capitulates to precisely those scoundrels who have scuttled our best efforts at a sensible climate strategy, and in so doing, creates an unsensible one . Yet not to pursue it, I argue, is to condemn coastal areas, temperate forests, and thousands of species to extinction. What, exactly, is the price of our pride? CM does indeed challenge some of the core assumptions of the contemporary environmental movement. But that may not be a bad thing. CM forces greens to confront our tendency toward utopian thinking and dystopian apocalypticism and productively moves us away from each. The climate crisis, and the possibility of CM as a solution to it, forces us to reexamine our utopian dreams of greening all of society, our unreflective attachment to "nature" as a social construction, and our ill-advised sense (propaganda, really) that "one man can make a difference." This last trend in environmental advocacy regarding climate change

9. For a political account of the back room deals and betrayals involved, see Ryan Lizza, *As the World Burns: How the Senate and the White House Missed Their Best Chance to Deal with Climate Change*, NEW YORKER, Oct. 11, 2010, at 70.

— educating well-meaning consumers to reduce their carbon footprints, change their light bulbs, and so on — is actually counterproductive. The supposedly empowering rhetoric that all of us are responsible for climate change, and each of us has the power to make a change, is factually false and politically misleading. Let's be honest: without coordinated political action, consumers' personal choices are ineffectual. Each of us does *not* have the power to make a dent in climate change, at least not through our individual actions. What is needed is collective political action, and that action is being halted by a long-term campaign of pseudo-science, misinformation, and lobbying of extractive industries and pro-business conservative groups. The more we focus on individual actions and personal responsibility, the worse off we are. Every calorie of energy an individual devotes to calculating her own carbon footprint is a misdirected one; it should instead be targeted at the actual reasons for our collective inaction on climate change.

Twelve years ago, I asked whether melting icebergs and record-hot summers would be sufficient to create the political will to act on climate change. Now, we know that they are not. Yet just as CM has become ever more critical, it has also become inevitable. I was a lone voice in 1998, but not today. Whether we like it or not, whether we prepare for it or not, whether this is good news or bad news, the inevitability of CM is as much a reality as climate change itself.

I. GEOENGINEERING: TWELVE YEARS LATER

The modern theory of anthropogenic climate change dates back to the nineteenth century,[10] and its measurable, visible effects have been with us for at least two decades now. Yet American political discourse remains as if in suspended animation; as in 1998, the two major political parties still differ as to whether climate change is even happening at all. How is this possible? How is it that nothing has changed, despite melting glaciers and record-hot summers?

After a proposal regarding nomenclature, this part explores what has not changed, and what has changed, in the past twelve years of public discourse on climate change and geoengineering. Essentially, because so much has *not* changed in terms of climate change regulation, a great deal has changed in terms of CM. I was a pessimistic prophet of doom in 1998, when I predicted that GHG reduction would not happen soon. In 2010, I am merely reporting the facts.

A. Nomenclature: Let's Get Rid of "Geoengineering"

The term "geoengineering" is overbroad, unhelpful, and misleading, and should be set aside. I propose "climate management" or "CM" instead.

The Royal Society defines geoengineering as "the deliberate large-scale intervention in the Earth's climate system, in order to moderate global warming."[11] The

10. *See* Hans von Storch & Nico Stehr, *Towards a History of Ideas on Anthropogenic Climate Change*, *in* CLIMATE DEVELOPMENT AND HISTORY OF THE NORTH ATLANTIC REALM, 17 (Gerold Wefer et al. eds., 2010), *available at* http:// coast.gkss.de/staff/storch/pdf/delmenhorst.2002.pdf.

11. ROYAL SOC'Y, GEOENGINEERING THE CLIMATE: SCIENCE, GOVERNANCE, AND UNCERTAINTY, ix (2009). This is roughly identical to the definition of "climate engineering" used in the 2010 House Science & Technology Committee report: "the deliberate large-scale modification of the earth's climate systems for the purposes of counteracting and mitigating climate change." REP. BART GORDON, COMM. ON SCI. AND TECH.,

coinage of the term is attributed to Cesare Marchetti, who used it in a 1977 article, *On Geoengineering and the CO2 Problem.*[12] Although it has gained wide usage, "wide" is a relative term. It may seem to insiders that "geoengineering" is now a well-established term of art, but it still fails the cocktail party test every time, as long as there are laypeople at the party, who generally ask whether it has to do with open-top coal mining, or carving new canals in Panama. There are at least three reasons why the term "geoengineering" is negatively impacting the effort to research CM.

First, the category of "geoengineering" has perhaps become too broad, and occludes many differences. For example, is OIF more like SRM, or more like afforestation? Yes, OIF involves technological tinkering with areas of ocean, and, like SRM, it could make matters worse rather than better. But the differences are perhaps even greater. The expected oceanic pollution from OIF is relatively limited in spatial and temporal scope; OIF, unlike SRM, could be conducted in a limited area with limited impact on uncooperative nations, and for a limited period of time, at least at first. While SRM would have secondary effects potentially all around the globe, most people would never even notice OIF. Indeed, I find the concerns of OIF's oceanic pollution to be greatly overstated. With the latest reports that the so-called "Great Pacific Garbage Patch" has now exceeded the size of Texas, the emphasis on pollution from OIF seems like a highly selective form of criticism.

While SRM would represent a radically new form of human intervention with the climate, OIF is scarcely different from planting trees. Trees, too, grow more productively with fertilizers, forest management, and other forms of human intervention. Yet we do not regard tree farms as "geoengineering." Is planting "'trees"' in the ocean really so different? Perhaps we do not yet know the precise efficacy of phytoplankton carbon sequestration, b ut there are complexities regarding afforestation, as well. Remember President Reagan's statement that "trees cause pollution"?[13] This absurd claim was not entirely fictional; it was based on data that rotting trees may release the carbon dioxide they once absorbed. The point is that while OIF is afforestation in a new context, it is still quite similar to afforestation in familiar ones.

Second, the term "geoengineering" is bad PR. It connotes science fiction — giant laser space frisbees again — and, to my ears, has a somewhat musty, Arthur C. Clarke air to it. (Arthur C. Clarke was my favorite writer when I was a teenager. But this is 2011.) The word itself is wearing a pocket protector. It highlights the worst aspects of the policy: the arrogance, the 1960s-era Space Age fantasy, and a sort of "can-do" spirit that is inappropriate in the context of monkeying with the Earth's climatic systems. Indeed, it evokes the spirit of one of geoengineering's earliest proponents, Dr. Edward Teller, the

ENGINEERING THE CLIMATE: RESEARCH NEEDS AND STRATEGIES FOR INTERNATIONAL COORDINATION, H.R. DOC. NO. 111-A, at III (2d Sess. 2010) [hereinafter HOUSE REPORT].

12. Cesare Marchetti, *On Geoengineering and the CO2 Problem*, 1 CLIMATIC CHANGE 59–68 (1977) (Marchetti's specific proposal was to inject CO2 into the deep ocean). *See also* H. Damon Mathews & Sarah E. Turner, *Of Mongooses and Mitigation: Ecological Analogues to Geoengineering*, 4 ENVTL. RES. LETTER 045105, 2 (Oct.-Dec. 2009), *available at* http://iopscience.iop.org/1748-9326/4/4/045105/fulltext#erl319524bib35.

13. *See* Tim Radford, *Do Trees Pollute the Atmosphere?*, THE GUARDIAN, May 13, 2004, http://www.guardian.co.uk/science/2004/may/13/thisweeksscience questions3.

notorious, arch-conservative nuclear scientist who was a model for Dr. Strangelove.[14] It was Teller who said things like "we will change the earth's surface to suit us,"[15] and who championed geoengineering at the same time as the "'Star Wars"' missile defense system.[16] This scientific arrogance is encoded in the term "geoengineering," a connotation borne out by history.

Third, "geongineering" is misleading. Given that the two leading geoengineering proposals have to do with water and air, the "geo" prefix is itself a bit confusing. It connotes bulldozers, dikes, and dams. SRM is not first and foremost an engineering project (although of course it requires sophisticated engineering to accomplish), and neither is OIF. We are not buildingdams; we are using our limited knowledge of atmospheric science to either increase the albedo and opacity of the stratosphere, or create new carbon sinks in the oceans. Geoengineering is neither geo- nor engineering.

My proposed alternative is "climate management" or "CM." Climate management is what SRM and OIF are really about. Unlike "prevention" or "mitigation" which generally refers to GHG reduction and other ways to prevent the change in the composition of the atmosphere, and "adaptation," which generally refers to adapting to the effects of climate change (sea walls, dikes, etc.), "management" may be used to refer to attempting to manage the climate directly by means other than reducing GHGs. This range of policy options should seem appealingly familiar. (In his recent Technology, Entertainment, Design ("TED") talk, CM advocate David Keith presented a simple continuum of mitigation-geoengineering-adaptation;[17] surely mitigation-management-adaptation is even clearer.) Everyone knows that "an ounce of prevention is worth a pound of cure," and that it is better prevent disease than simply manage it or mitigate its effects. Understanding geoengineering as climate management renders comprehensible its positive and negative attributes. We are not talking about a fanciful dream of "hacking the Earth." We are talking about Plan B, because Plan A seems so expensive that a few key players remain intent on blocking it. Plan A is best; Plan B may be the best we can do. And of course, as we have said many times, the two are not mutually exclusive.

A shift of nomenclature from the technological mechanisms of a climate change strategy to the policy nature of that strategy helps clarify the issue in place, and properly shift attention from means to ends — or at least from proximate means (technological intervention) to meaningful means (regulation, management, or mitigation).

At the same time, "climate management" preserves the hubris involved in such a policy, as well it should. But it places that arrogance in the context of a long history of similar endeavors — forest management, for example, or wildlife management. We humans have, for centuries, attempted to manage the ecosystems of our planet, and we have a mixed record of doing so. Artificially managing the inputs into the global climatic system is just another, grander form of ecosystem management. This is not to minimize

---

14. *See* JEFF GOODELL, HOW TO COOL THE PLANET: GEOENGINEERING AND THE AUDACIOUS QUEST TO FIX EARTH'S CLIMATE 70-87 (2010) (for a raucous profile of Teller in the context of geoengineering).

15. *Id.* at 71.

16. *Id.* at 85.

17. David Keith, *David Keith's Unusual Climate Change Idea*, TED, (Sept. 2007) http://www.ted.com/talks/david_keith_s_surprising_ideas_on_climate_change.html. [hereinafter *David Keith's Unusual Climate Change Idea*].

its potential danger, or potential for folly; indeed, placing CM in the context of other human "management" schemes is meant to capture just that. It is simply to see CM for what it is: a technological effort to manage the scope of climate change. It also situates CM within a clear policy menu, ranging from climate change prevention (best), to climate change management (medium), to climate change mitigation (worst).

This change in nomenclature is non-trivial and should be familiar to climate change activists. Remember when climate change was called the "greenhouse effect"? And then "global warming"? The first was too theoretical and strange; the second, remarkably, was, according to some surveys, interpreted by many laypeople as sounding comfortable and pleasant. "Global warming," of course, is still in colloquial use. "Climate change" is actually the preferred locution of climate skeptics, since it sounds less threatening. However, White House Science Advisor, John Holdren, has urged people to use the term "global climate disruption" instead, a more accurate term, and one which yields less cognitive dissonance as Americans dig themselves out of blizzards (which may well increase because of climate change).[18] (On this count, I personally still prefer "climate change," which is commonly used and addresses the same concerns.)

I also prefer "climate management" over the other alternatives that have been proposed of late. Jeff Goodell and Congressman Bart Gordon have lately suggested "climate engineering,"[19] which I admit is better than "geoengineering" but still has an odd, well, "engineering" ring to it. SRM is not really "engineering" any more than is using fertilizer to change the molecular composition of soil. While it does involve building some devices to deliver sulfur dioxide, the engineering of these devices is secondary to the management of the atmosphere which they are intended to accomplish. To me, "climate engineering" still misses the mark.

Mathews and Turner have suggested "direct climate intervention,"[20] which is descriptive but perhaps too long, and not clear enough. Eli Kintisch seems fond of "planet hacking,"[21] which to me seems to heighten the absurdity of CM and make it seem like a kind of wonky computer fantasy. One of the earliest proposed nomenclatures was "climate control," although that term has been co-opted by air conditioning systems.[22] Stephen Dubner and Steven Levitt, of *Freakonomics* fame, dub SRM "Budyko's Blanket," after Belarusian climate scientist Mikhail Budyko, to whom the idea was attributed in the 1992 NAS report,[23] while climatologist Alan Robock playfully

18. John P. Holdren, U.S. Presidential Sci. Advisor, Climate-Change Science and Policy: What Do We Know? What Should We Do, Keynote Address at Kavli Prize Symposium: International Cooperation in Science (Sept. 6, 2010), *available at* http://www.whitehouse.gov/sites/default/files/microsites/ostp/jph-kavli-9-2010.pdf.

19. The suggestion was made at a 2010 conference hosted by the New America Foundation. Rep. Bart Gordon, Chairman, H. Comm. on Sci. and Tech., Address at New America Foundation, Future Tense Event: Geoengineering: The Horrifying Idea Whose Time Has Come? (Sept. 27, 2010), *available at* http://www.newamerica.net/events/2010/geoengineering.

20. Mathews & Turner, *supra* note 12, at 1.

21. KINTISCH, *supra* note 4 (though Kintisch generally supports CM, the term has been used in a derogatory fashion by opponents). *See, e.g.*, CLIMATE CONNECTIONS, *infra* note 98.

22. *See* W.W. Kellogg & Stephen Schneider, *Climate Stabilization: For Better or for Worse?*, 186 SCI. 1163–72 (1974).

23. STEVEN D. LEVITT & STEPHEN J. DUBNER, SUPERFREAKONOMICS: GLOBAL COOLING, PATRIOTIC PROSTITUTES, AND WHY SUICIDE BOMBERS SHOULD BUY LIFE INSURANCE 193 (2009).

calls it the "yarmulke solution."[24] Indeed, it is striking how many playful and derogatory terms there are for geoengineering proposals. Back in 1998, OIF was still being called the "geritol cure."[25] Perhaps the humor reflects our deep anxiety regarding CM as a climate change methodology. Or maybe it's just a way to ridicule it.

"Climate management" is less scary than "geoengineering," while still sinister enough to temper our enthusiasm; it is more accurate; and it fits within existing matrices of risk management and risk calculation. For the remainder of this essay, I will use the terms "geoengineering," "climate management," and "CM" interchangeably, and will in all cases attempt to specify whether OIF, SRM, or another particular proposal is the subject of discussion.

B. What Has Not Changed, Or: 500 Wrongs Do Make a Right

What has not changed since 1998? The theory of climate change remains surprisingly intact, with more and more evidence supporting it. Yet as we have learned more about the campaign of misinformation surrounding climate change, the cause for pessimism has increased. It is now clear that private interests will spend enormous sums on climate change denial, and that such denial will continue to be effective even when the effects of climate change are visible to all. Now, unlike in 1998, we have detailed studies of the precise ways in which science was manipulated for private gain.[26] The way these campaigns have been prosecuted lead me to be more pessimistic than ever that meaningful GHG reduction will ever be addressed.

Nor is this simply a matter of disseminating information. Several popular books, endless articles in liberal magazines, and two high-end documentary films (*An Inconvenient Truth* and Leonardo DiCaprio's *The 11th Hour*) have failed to sufficiently mobilize popular opinion. Although many people profess to care about global warming, the issue came in dead last in a 2010 Pew Research Center poll of issues that matter to Americans.[27] No surprise that the administration decided to give up on the issue and focus its attention on health care and financial reform.[28] This is a result not of ignorance but of campaigns of misinformation. Since this campaign of misinformation has been so thoroughly covered already, I will merely set out some of the highlights of the last twelve years of climate change obfuscation:

> ·Scientists from the Global Climate Coalition ("GCC"), which throughout the 1990s was among the leading public deniers of climate change, and which

24. GOODELL, *supra* note 14, at 115.

25. *See* Patrick Huyghe, *Undoing the Damage: Geoengineering Our Way Out of Trouble*, 21STC, http://www.columbia.edu/cu/21stC/issue-2.1/huyghe.htm (quoting environmental scientist Wallace Broecker's tentative support for "insurance against a bad climate trip" in the form of geoengineering).

26. *See, e.g.*, HOGGAN & LITTLEMORE, *supra* note 8; NAOMI ORESKES & ERIK M. CONWAY, MERCHANTS OF DOUBT: HOW A HANDFUL OF SCIENTISTS OBSCURED THE TRUTH ON ISSUES FROM TOBACCO SMOKE TO GLOBAL WARMING 169-215 (2010); POOLEY, *supra* note 8; Jacques, et al., *supra* note 8; Lucia Graves, *Republican Global Warming Deniers Funded by Energy Industry*, HUFFINGTON POST (Oct. 15, 2010), http://www.huffingtonpost.com/2010/10/14/pat-toomey-climate-change-republicans_n_763545.html. *See also* Naomi Oreskes, *You CAN Argue with the Facts*, SMART ENERGY (Aug. 9, 2008) http://smartenergyshow.com/node/67 [hereinafter *You CAN Argue*].

27. Lizza, *supra* note 9, at 82.

28. *See id.* One lobbyist called Obama "the James Buchanan of climate change." *Id.*

was made up of companies which are heavy producers of GHGs,[29] stated in their own internal documents in 1995 that "the scientific basis for the Greenhouse Effect and the potential impact of human emissions of greenhouse gases such as CO2 on climate is well established and cannot be denied."[30]

·From 1998 to 2002, while the scientific press featured 928 articles supporting or showing evidence for anthropogenic climate change and zero opposing it, 53% of newspaper stories in the New York Times, Washington Post, Los Angeles Times, and Wall Street Journal during the same period offered spokespeople on "both sides" of the "scientific debate."[31]

·The Information Council on the Environment ("ICE") was formed in 1991 by Western Fuels, the National Coal Association, and the Edison Electric Institute "to reposition global warming as a theory (not fact)" and "supply alternative facts to support the suggestion that global warming will be good,"[32] was particularly targeted at "older, less-educated males" and "younger, lower-income women" in congressional districts who get their electricity from coal.[33] ICE was disbanded when these strategy documents were leaked.

·As described at length on exxonsecrets.org, the same cadre of paid climate deniers work for "CTTs" (Conservative Think Tanks) that promote the same industry agenda. Since 1998, ExxonMobil has funded the Competitive Enterprise Institute ($2m), Center for Strategic and International Studies ($2.4m), Annapolis Center for Science-Based Public Policy ($1.0m), American Enterprise Institute ($2.8m), Heritage Foundation ($630k), Heartland Institute ($676k) and many others. This vast pile of CTT "junk science" is paid for by energy companies[34] — $22 million by ExxonMobil alone since 1998.[35]

·Of the 141 books published between 1972 and 2005 denying the seriousness of environmental problems, 130 (92%) were published by CTTs, written by authors affiliated with CTTs, or both.[36] These CTTs "are 'advocacy'

29. GCC's leading funders were ExxonMobil, Royal Dutch Shell, British Petroleum, Texaco, General Motors, Ford, DaimlerChrysler, the Aluminum Association, the National Association of Manufacturers, and the American Petroleum Institute. HOGGAN & LITTLEMORE, *supra* note 8, at 13.

30. Andrew Revkin, *Industry Ignored Its Scientists on Climate*, N.Y. TIMES, Apr. 20, 2009, at A1. A subsequent GCC document showed that, as of 1998, its official position had shifted to the view that some climate change was happening, but not at a severe rate. *Id.* In 1997, the year of the Kyoto Protocol, the GCC had an annual budget of $1.68 million. *Id.*

31. Maxwell T. Boykoff & Jules M. Boykoff, *Balance as Bias: Global Warming and the U.S. Prestige Press*, 14 GLOBAL ENVTL. CHANGE 125 (2004). *See also* HOGGAN & LITTLEMORE, *supra* note 8, at 21-22 (this astonishing disparity reveals the extent to which industry-led disinformation campaigns have distorted the public's view of climate science).

32. *You CAN Argue*, *supra* note 26.

33. Pooley, *supra* note 8, at 41.

34. HOGGAN & LITTLEMORE, *supra* note 8, at 73-85.

35. *How Exxonmobil Funds the Climate Change Skeptics*, EXXONSECRETS.ORG, http://www.exxonsecrets.org/maps.php.

36. Jacques et al., *supra* note 8, at 360.

Robock has asked, "Whose hand would be on the thermostat? What if India wants it cooler and Russia wants it warmer?"[131] There is no question that SRM is powerful technology, and whose hand is on the levers controlling it, given the differing incentives among nations, will doubtless be among the most contentious of questions as CM becomes discussed internationally.

As with the many practical concerns regarding SRM, this policy concern should not be a reason not to invest in research. On the contrary, it is a reason to do so. We do not yet know the non-local effects of localized bursts of sulfur dioxide, but this may perhaps be tested in limited trials of SRM technology. In addition, if such effects do take place — and one could envision a presumption of causality if unusual climatic shifts follow directly upon a geoengineering effort, even if the precise causal nexus has not been established — then the process can be halted with minimal further disruption. In addition, if possible climatic side effects are predicted, CM deployment efforts may be carried out in ways that minimize such effects — higher dispersal of SRM particulate matter, for example, or dispersal over the ocean. Most importantly, the very existence of potentially harmful climatic side effects should cause CM efforts to proceed with a healthy dose of humility and caution. Part of the rationale for the term "climate management" is precisely that it highlights not only the nature of the proposed activity, but its potential for hubris as well.

4. Future Costs: In the Art of Stopping[132]

One of the most alarming risks that has become better known over the last decade is that of sudden, cataclysmic costs that would accompany a sudden stoppage of an SRM project. In 2007, Ken Caldeira and Damon Matthews showed that, while SRM could return global GHG levels to pre-industrial revolution levels in as little as five years, a sudden stoppage could lead to warming rates skyrocketing to twenty times current rates.[133] SRM is like an addiction that cannot be kicked because the withdrawal would kill the addict.

Some have presented scenarios of this stoppage in the context of war or other calamity. In this regard, however, SRM would not be different in kind from nuclear power plants, hazardous waste facilities, and other ultra-hazardous sites which require constant monitoring. It may be different in degree, of course, but there are thousands of catastrophes that would ensue around the globe if societal infrastructure were severely and suddenly interrupted. Indeed, as in the case of nuclear facilities, the consequences are often far more immediate than those of SRM cessation; at least with a geoengineering stoppage, the timeframe is a few years, rather than a few minutes.

That being said, the costs of stoppage must be taken into account in any SRM deployment — and provide yet another reason why such deployment must be undertaken

131. Svoboda, *supra* note 73.

132. *See* WIRE, *The Art of Stopping*, *on* SEND (Pinkflag 2003).

133. H. Damon Matthews & Ken Caldeira, *Transient Climate-Carbon Simulations of Planetary Geoengineering*, 104 PROC. NAT'L ACAD. SCI., 9949-54 (2007). *See also* Eric Smalley, *Climate Engineering Is Doable, as Long as We Never Stop*, WIRED (July 25, 2007), http://www.wired.com/science/planetearth/news/2007/07/geoengineering#ixzz13aH4Q2G4.

collectively, rather than by independent actors. Fail-safe systems, multiple redundancies, and secure international locations for SRM facilities are a few of the precautions that must be taken; there are doubtless hundreds more.

Surely what the cataclysmic consequences of a sudden cessation of SRM teach us is that, contrary to the emerging conservative arguments, CM cannot be the singular policy of climate change mitigation. A more truly conservative use of CM would be to use it as a stopgap, to allow India and China to develop green technologies, and to convince Western governments to implement costly and difficult GHG reduction programs.[134] Perhaps this stopgap lasts twenty years, or perhaps two hundred — but only ideologically motivated partisans would regard CM as a permanent solution to anthropogenic interference with the world's climatic systems.

5. Monitoring and Institutions: Going Rogue

As we have already seen, geoengineering is particularly susceptible to rogue actors taking matters into their own hands. Now, in one sense, the capacity of geoengineering to be implemented by private actors is an advantage: it resonates with the free-marketeer ideologies of conservatives, circumvents the need for costly public action, and, at the very least, would allow for small-scale testing by private entities. Yet as the episode with would-be OIF pioneer Planktos showed, precisely those mavericks who might be most interested in geoengineering are the sort of private actors none of us would want to trust with the wellbeing of an ecosystem, let alone the planet.[135] As some critics have noted, SRM is like a scheme cooked up by a James Bond villain.[136]

But what did we really learn from the 2007 debacle with the for-profit corporation Planktos, which attempted, on its own initiative, to conduct limited testing of OIF on the high seas?[137] On the one hand, we learned that OIF is so easy and inexpensive that individual actors might experiment with it, perhaps even with profit in mind. On the other hand, we learned (or relearned) that international law is sufficiently plastic to allow concerned nation-states to nip any unwanted experimentation in the bud, using existing international law frameworks such as the Biodiversity Convention; while, as noted above, these were not binding law, they provided sufficient pretext for nations seeking to threaten force against rogue CM actors.[138] Indeed, while since 1998, there has been a profusion of law review articles proposing legal frameworks for geoengineering,[139] the

134. *See* David Keith, *Engineering the Planet*, *in* CLIMATE CHANGE SCIENCE AND POLICY, 494-502 (Stephen H. Schneider et al., eds., 2009); Tom Wigley, *A Combined Mitigation/Geoengineering Approach to Climate Stabilization*, 314 SCI. 452, 452–54 (2006).

135. For a profile of Planktos' Russ George, see GOODELL, *supra* note 14, at 144-58.

136. SRM in particular resembles the "Icarus" project conceived by the villain Gustav Graves. DIE ANOTHER DAY (20th Century Fox, 2002). *See* Eli Kintisch, *Climate Hacking for Profit: A Good Way to Go Broke*, FORTUNE (May 21, 2010), http://money.cnn.com/2010/05/21/news/economy/geoengineering.climos.planktos.fortune/index.htm.

137. GOODELL, *supra* note 14, at 146-47.

138. *See id.* at 157-61.

139. *See, e.g.*, William Daniel Davis, Note, *What Does "Green" Mean?: Anthropogenic Climate Change, Geoengineering, and International Environmental Law*, 43 GA. L. REV. 901 (2009); Alan Carlin, *Global Climate Change Control: Is There a Better Strategy Than Reducing Greenhouse Gas Emissions?*, 155 U. PA. L. REV. 1401 (2007) (advocating injections of sulfur into stratosphere to scatter incoming solar radiation in lieu of GHG mitigation); Alan Carlin, *Why a Different Approach is Required If Global Climate Change Is to Be*

Planktos incident showed that nation states are already quite capable of stopping unwanted CM experimentation or deployment using existing legal forms.

More generally, what we have learned is that even the relatively modest OIF ambitions of private actors such as Planktos, which was perceived to be profiteering, and its saner cousin, Climos, will raise the hackles of environmentalists and public officials. While this is inconvenient, and infuriating when relatively benign research is prevented while far more intrusive oceanic pollution goes unchecked, it is ultimately for the best. We do not want to empower Richard Branson, Hugo Chavez, Vladimir Putin, or even Al Gore to take the world's climate into their own hands — and if optimistic assessments of SRM are accurate, it is well within reach of individual entrepreneurs and leaders to do so. Thus, some form of coordinated international action is surely in the best interests of all of us.

This is how it must be, of course. Suppose a Branson/Gates/Gustav Graves rogue effort went horribly wrong; would the culpable parties not be liable for thousands of deaths and billions of dollars? What if a Bill Gates-funded project (Gates has given "a few million dollars" to climate scientists Myhrvold, Wood, Keith, and Caldeira)[140] causes crops to fail in Africa? Apart from incursions on national sovereignty and the need for international controls, geoengineering scientists and their backers require a coordinated international framework to avoid liability for failure.

Models for such coordinated international action abound. With respect to CM specifically, the United States and United Kingdom have recently collaborated on their pair of reports on climate engineering, released in 2009 and 2010. And while Red Team critics have lately attempted to hijack unrelated U.N. meetings in order to fight CM,[141] it is not difficult to imagine international meetings to coordinate an effective CM response to climate change, on the model of the Montreal meeting on ozone depletion and many others. It is clear that, while there is a certain appeal to a Climos or Planktos using the market to finance CM, the externalities and risks are such that governmental coordination, including across national lines, remains essential.

In each of these cases, there are well-founded objections to CM in principle, but each objection is answerable and generally calls for more research and study, which is what CM proponents are advocating. With the exception that even talking about CM subverts efforts at regulation, efforts which have been spectacularly unsuccessful on their own, what these Red Team concerns really argue for is the same thing the Blue Team is arguing for: more research and more international discussion.

As in 1998, however, my sense is that these concerns, while significant, are not really what bothers the Red Team. Red Teamers are afraid because, well, they are afraid. Geoengineering is frightening to contemplate, and like genetically modified foods or nuclear energy, they represent humankind tampering with nature in an instinctually dangerous way. Congressman Bart Gordon is clearly right in calling for maximal

---

Controlled Efficiently or Even at All, 32 WM. & MARY ENVTL. L. & POL'Y REV. 685 (2008) (advocating solar radiation management as alternative to "exclusive regulatory de-carbonization"). *See also* J. Virgoe, *International Governance of a Possible Geoengineering Intervention to Combat Climate Change*, 95 CLIMATIC CHANGE 103-19 (2009).

140. GOODELL, *supra* note 14, at 114.

141. *See supra* Section I.D.

transparency and communication with the public in order to allay such fears.[142] But let us recognize that generalized "concern" is not the same as specific "concerns." The former is at once more fundamental and less articulate: that this is simply the wrong way to go about things, that the bad guys want it, and that it is an indulgence of the same human vices that got us into this mess in the first place. I am sympathetic to this sentiment, but it is, after all, in the mind, not the atmosphere. As I said in 1998,

> What a Climate Change Manhattan Project asks on a philosophical level is whether the sorts of strategies and norms that have guided thoughtful environmentalism are always applicable, all the time. Many times in writing this Article, I have been struck by the ways in which my own proposal flies in the face of what I believe to be the right thing to do environmentally. But the right thing exists in the mind. Climate change is in the atmosphere.[143]

As we confront this fact, the ineluctable reality of climate change forces environmentalists to reevaluate our assumptions about what environmentalism should look like. It is to these deeper questions that I now turn.

B. The Vicissitudes of Inevitability

I believe CM to be inevitable, first because it is the lowest cost option that appeals to the widest range of political actors, and second, because it actually makes deep sense to those historically most opposed to climate change mitigation efforts. In many ways, the worst fears of environmentalists have come to pass: the most zealous advocates of geoengineering are now no longer climate scientists, but conservative voices such as the Wall Street Journal editorial page. Indeed, if we take the current discourse as a rehearsal for a larger, future one, it is clear that the professed fear of environmental groups will indeed come to pass: conservative voices will espouse CM as a replacement for GHG mitigation and as a blanket pass to pollute.

Indeed, it is one such conservative voice who I believe has made the clearest case for why CM is inevitable:

> When I talk with people who object to Geoengineering, I often say "You don't have to argue with me, and I don't have to argue with you . . . because I'm going to win." It's just written in the stars. Geoengineering is going to win, because the politicians, when they finally come down to the crunch, are going to ask: What is the cheapest thing that might possibly do the job? They don't care what it is; if it consists of Las Vegas dancers performing in the rotunda of the capital, they'll choose that if it's the cheapest solution. That's the way things work in a democracy. People never pay more than they have to.[144]

Unpleasant as it is for this onetime youthful anti-Reagan activist to admit it, this conservative, none other than Lowell Hood, the father of "Star Wars" (though, at $60 billion, hardly the "cheapest solution" to anything), is right. When the chips go down, as they will, politicians will search for the fastest, cheapest solution to a problem they failed to solve in advance. And CM is just that. It costs nothing to important constituencies; it has a short lead time; and as ugly as it is, it will become the only tenable option. The

142. *Plan B for the Climate*, *supra* note 74.
143. *Manhattan*, *supra* note 1, at 139.
144. E-mail from Lowell Wood to Jeff Goodell, *quoted in* GOODELL, *supra* note 14, at 125.

organisations that unabashedly promote conservative goals."[37]

·Many such CTTs are not limited to climate denial. The Heartland Institute, for example, likewise promoted "research" on behalf of the tobacco industry, claiming that smoking was not unhealthy — and then later, that even if it is, it is a personal right.[38]

·Heartland also promoted the bogus "'Oregon Petition" of "tens of thousands of scientists" doubting climate change, sponsored by Arthur Robinson, who said, "One of these days, people will start to see global warming for what it is — a thinly disguised scam by corporations, the United Nations, and big environmental groups to reduce the world's population."[39] Many signatories appeared to be fictional. None of the 200 climate researchers listed as signatories had published any refereed research that supported their skepticism.[40]

·The leading "climate skeptics" are not climate scientists. For example, Dr. Timothy Ball published just four peer-reviewed journal articles, none of which addressed atmospheric science.[41] Frederick Singer is a non-climatologist who has been a paid consultant for over a dozen think tanks who once disputed the linkage between CFCs and ozone depletion, and denied the existence of global warming only to later reverse course and later blame it on sun spots.[42] Climate-denial seminars routinely pay "scientists" for participation, which does not take place at actual scientific conferences.[43] (As Upton Sinclair said, "It is difficult to get a man to understand a thing when his salary depends upon his not understanding it."[44]) Steven Milloy, who regularly appears on Fox News, is a former lobbyist for Exxon, Philip Morris, the Edison Electric Institute, and Monsanto, and was "one of the authors of the American Petroleum Institute's plan to sow doubt and confusion about climate change."[45]

·In 2010, not a single Republican candidate for Senate supported any action on climate change.[46] Many of these candidates were heavily supported by the energy industry. Pat Toomey's victorious bid was financed by the Koch brothers ($15,000) and Murray Energy ($16,555), who have also contributed $45,000 and

37. *Id.* at 355 (citing Kent R. Weaver, *The Changing World of Think Tanks*, 22 PS: POL. SCI. AND POL. 563 (1988); Frank Fischer, *American Think Tanks: Policy Elites and the Politicization of Expertise*, 4 GOVERNANCE 332 (1991)).

38. HOGGAN & LITTLEMORE, *supra* note 8, at 85-87.

39. *Id.* at 89.

40. *Id.* at 91.

41. *Id.* at 49-50.

42. Pooley, *supra* note 8, at 33-37.

43. *Id.* at 33.

44. UPTON SINCLAIR, I, CANDIDATE FOR GOVERNOR: AND HOW I GOT LICKED 109 (Univ. Cal. Press 1994) (1935).

45. HOGGAN & LITTLEMORE, *supra* note 8, at 156.

46. Brad Johnson, *GOP Senate Candidates on Climate Science and Policy*, THE WONK ROOM (Oct. 7, 2010), http://wonkroom.thinkprogress.org/gop-senate-deniers/.

$30,600 to climate-denier James Inhofe, and $16,750 and $17,378 to David Vitter (Vitter called climate change evidence "ridiculous pseudo-science garbage").[47] Similarly, the largest donors to Newt Gingrich's PAC, American Solutions, are coal and electric-utility interests.[48]

· The Wall Street Journal editorial page has consistently denied the existence of anthropogenic climate change, calling the famous graph of temperature and CO2 concentrations "hockey stick hokum."[49] In fact, a retired minerals consultant, Stephen McIntyre, had found minor errors in climatologist Michael Mann's famous graph, and in fact Mann's "hockey stick" graph has been borne out by dozens of other scientific studies, including by the National Academy of Sciences.[50] This has not stopped the anti-hockey-stick meme from proliferating. Sen. James Inhofe said in 2006, "[t]he 'hockey stick' was completely and thoroughly broken for all in 2006."[51] In fact, the hockey stick is quite real.

Indeed, as journalists, activists, and muckrakers have uncovered more and more about the climate debates of the last two decades, it has become increasingly clear that "science" has been used as a pawn in these debates, and huge campaigns of deliberate misinformation have created a false sense of uncertainty that flies in the face both of scientific theory and firsthand evidence.

The other fact that has not changed at all since 1998 is that adequate GHG reduction will not be achievable. Current CO_2 levels, for example, are 385ppm, 100ppm above the pre-industrial level. Yet even the most hopeful CO_2 reduction target is 450ppm, *i.e.*, significantly higher than current levels, and it would require GHG emissions to be reduced 11% from current levels by 2030, a reduction which would likely require all new power plants to have zero CO_2 emissions,[52] a wildly uneconomical proposal that would burden the developing world the most. Likewise, the European Union's target of limiting total warming to 3.6 degrees Fahrenheit above preindustrial times would still represent a warmer average temperature than Earth has seen in millions of years. Twenty million years ago, the planet was four degrees warmer, and sea levels were twenty meters higher than today.[53] Of course, even these targets are based on relatively optimistic projections; if doomsayers like Richard Lovelock or James Hansen

47. Graves, *supra* note 26.

48. Jason Easly, *Sarah Palin Tweets Gingrich's Big Oil 527 to Blame Obama for Gas Prices*, POLITICUSUSA (Jan. 4, 2011), http://www.politicususa.com/en/palin-american-solutions.

49. Editorial, *Hockey Stick Hokum*, WALL ST. J., July 14, 2006, at A12. *See also* Antonio Regalado, *In Climate Debate, the "Hockey Stick" Leads to a Face-Off*, WALL ST. J., Feb. 14, 2005, at A1.

50. Geoff Brumfiel, *Academy Affirms Hockey-Stick Graph*, 441 NATURE 1032 (2006). For a thorough debunking of the "hockey-stick hokum" myth, see Jeffrey D. Sachs, *Fiddling While the Planet Burns*, SCI. AM., Sept. 14, 2006, *available at* http://www.scientificamerican.com/article.cfm?id=fiddling-while-the-planet; HOGGAN & LITTLEMORE, *supra* note 8, at 109-12.

51. HOGGAN & LITTLEMORE, *supra* note 8, at 110.

52. Tom Wigley, Geoengineering: A Revolutionary Approach to Climate Change, Presentation at Am. Enter. Inst. for Pub. Policy Research Conference (June 3, 2008), *available at* http://www.aei.org/docLib/20080606_WigleyJune3powerpoint.pdf.

53. KINTISCH, *supra* note 4, at 30.

are right, the situation could be far, far worse.[54]

Strikingly, what has "not changed" the most is the theory of global warming itself. We now have much more evidence, but it is remarkable that there has been no significant change in the basic understanding that carbon dioxide and other gases have the capacity to trap heat in the atmosphere. Joseph Fourier was right about it in 1824, and John Tyndall was right in 1858.[55] Svante Arrhenius was right back in the 1890s,[56] the Intergovernmental Panel on Climate Change ("IPCC") was right in its estimates of global warming being between 3.6 and 8.1 degrees Fahrenheit,[57] and our best climate models, though they have become more pessimistic of late, were right in the 1990s.[58] The U.N. Framework Convention on Climate Change was right when it was signed by the United States in 1992, and the IPCC was right when it said that imminent action was needed. There has never been any credible data to contradict either the theory or reality of anthropogenic climate change. Within the echo chambers of the American right-wing, the same few "scientific" studies casting doubt on this or that aspect of climate change bounce around and make resounding, clanging noises. But the reality is that the scientific consensus about climate change is settled[59] — 928 peer-reviewed articles to 0 does not a controversy make.

C. *What Has Changed*

1. Geoengineering Comes Out

Particularly since 2006, there has been an explosion in scientific, legal, and policy discussions of CM. Although proposals for CM to address climate change date back to the 1960s, SRM was first mentioned in a 1965 report.[60] The first major study of

54. *See* GOODELL, *supra* note 14, at 101-04; KINTISCH, *supra* note 4, at 27-29; *David Keith's Unusual Climate Change Idea*, *supra* note 17.

55. HOGGAN & LITTLEMORE, *supra* note 8, at 17.

56. See GOODELL, *supra* note 14, at 47; HOGGAN & LITTLEMORE, *supra* note 8, at 17.

57. HOGGAN & LITTLEMORE, *supra* note 8, at 18.

58. *See, e.g.*, WILLIAM R. CLINE, THE ECONOMICS OF GLOBAL WARMING 13-35 (1992) (discussing in detail the scientific data available and charting increases of mean temperature over last hundred years); COMM. ON SCI., ENG'G AND PUB. POL'Y, POLICY IMPLICATIONS OF GREENHOUSE WARMING 20 (1991) (estimating 3.4 to 9.4 degrees Fahrenheit range of warming); NAT'L ACAD. OF SCIENCES, POLICY IMPLICATIONS OF GREENHOUSE WARMING: MITIGATION, ADAPTATION, AND THE SCIENCE BASE (1992); Wilfred Beckerman, *Global Warming and Economic Action*, *in* THE INTERNATIONAL POLITICS OF THE ENVIRONMENT 258 (Andrew Hurrell & Benedict Kingsbury eds., 1992) (noting "general consensus" among scientists that rise in world temperature in twenty-first century will be between 1.5 and 4 degrees Celsius); M. Granger Morgan & David W. Keith, *Subjective Judgments by Climate Experts*, 29 ENVTL. SCI. & TECH. 468, 470-71, 473 (1995) (displaying charts of prominent atmospheric scientists' predictions on global climate change). *See generally Policy Options for Stabilizing Global Climate: S. Hrg. 101-31 Before the S. Comm. on Environment and Public Works*, 101st Cong. 10 (1989) (statement of William K. Reilly, Administrator, Environmental Protection Agency); JOHN FIROR, THE CHANGING ATMOSPHERE 57 (1990) (surveying estimates varying from 2.5 to 4.5 degrees Celsius warming over next century); AL GORE, EARTH IN THE BALANCE 5 (1992) (for layperson's surveys of scientific consensus on climate change, and political battles surrounding it; displaying graph of increased carbon dioxide concentrations in the atmosphere from 1958 to the present); ELIZABETH KOLBERT, FIELD NOTES FROM A CATASTROPHE: MAN, NATURE, AND CLIMATE CHANGE (2006); BILL MCKIBBEN, THE END OF NATURE 18-31 (1989); CHRISTOPHER D. STONE, THE GNAT IS OLDER THAN MAN: GLOBAL ENVIRONMENT AND HUMAN AGENDA 13-25 (1993).

59. Oreskes, *supra* note 8.

60. *See* Environmental Pollution Panel of the President's Science Advisory Council (PSAC), quoted in NAT'L. RESEARCH COUNCIL, ADVANCING THE SCIENCE OF CLIMATE CHANGE 293 (2010) (interestingly, the

geoengineering was published in 1992 by the National Academy of Sciences,[61] which included a chapter on geongineering in its assessment of climate change policy, discussing reforestation, OIF, cloud albedo modification, SRM, and the use of space-based reflectors.[62] All of these ideas are still around today, although SRM and OIF have emerged as the most prominent, with albedo enhancement[63] and other methods of CDR (Carbon Dioxide Removal)[64] close behind. SRM in particular has been the subject of numerous scientific studies,[65] legal and policy analyses,[66] philosophical discussions,[67] and prestigious conferences such as the 2007 gathering at the American Academy of Arts and Sciences[68] and workshops hosted by the Council on Foreign Relations in 2008[69] and 2010.[70]

1965 PSAC report focused more on albedo enhancement than on GHG reductions).

61. NAT'L ACAD. OF SCIENCES, *supra* note 58.

62. *See* James T. Early, *Space-Based Solar Shield to Offset Greenhouse Effect*, 42 J. BRIT. INTERPLANETARY SOC. 567, 567-69 (1989) (this colorful idea has faded from scientific discourse, though it remains a favorite of CM mockers; however, this is the original (short) proposal); HOUSE REPORT, *supra* note 11, at 43 (remarkably, this proposal still made it into the U.S. House report on geoengineering, although it was dismissed).

63. *See* Keith Bower et al., *Computational Assessment of a Proposed Technique for Global Warming Mitigation via Albedo-Enhancement of Marine Stratocumulus Clouds*, 82 ATMOSPHERIC RESEARCH 328, 328-36 (2006); J.J. Latham, *Amelioration of Global Warming by Controlled Enhancement of the Albedo and Longevity of Low-Level Maritime Clouds*, ATMOSPHERIC SCI. LETTERS (2002). *See generally*, Hashem Akbari, Surabi Menon, & Arthur Rosenfeld, *Global Cooling: Increasing World-Wide Urban Albedos to Offset CO_2*, 94 CLIM. CHANGE 275, 275-86 (2009) (some have proposed that albedo enhancement may even be accomplished by painting roofs white and other changes to urban environments). *See* GOODELL, *supra* note 14, at 163-89 (a lay discussion of these proposals).

64. *See* HOUSE REPORT, *supra* note 11, at 1; GOODELL, *supra* note 14, at 25-30 (discussing David Keith's "CO2 Scrubbers"); KINTISCH, *supra* note 4, at 103-25.

65. *See generally* Ken Caldeira & Lowell Wood, *Global and Arctic Climate Engineering: Numerical Model Studies*, 366 PHIL. TRANSACTIONS OF THE ROYAL SOC'Y A 4039, 4039-56 (2008); David Keith, *Geoengineering the Climate: History and Prospect*, 25 ANN. REV. OF ENERGY & ENV'T 245, 245-84 (2000) [hereinafter *Geoengineering the Climate: History and Prospect*]; Crutzen, *supra* note 4. *See also* Alan Robock et al., *The Benefits, Risks, and Costs of Stratospheric Geoengineering*, GEOPHYSICAL RESEARCH LETTERS (2009); Kevin Bullis, *The Geoengineering Gambit*, MIT TECH. REV., Jan./Feb. 2010, available at http://www.technologyreview.com/energy/24157/; William J. Broad, *How to Cool a Planet (Maybe)*, N.Y. TIMES, June 27, 2006, *available at* http://query.nytimes.com/gst/fullpage.html?res=9F0DEFDD1730F934A15755C0A9609C8B63.

66. *See, e.g.*, Alan Carlin, *Global Climate Change Control: Is There a Better Strategy than Reducing Greenhouse Gas Emissions?*, 155 U. PA. L. REV. 1401, 1485-90 (2007) (advocating injections of sulfur into stratosphere to scatter incoming solar radiation in lieu of GHG mitigation); William Daniel Davis, *What Does "Green" Mean?: Anthropogenic Climate Change, Geoengineering, and International Environmental Law*, 43 GA. L. REV. 901 (2009); J. Virgoe, *International Governance of a Possible Geoengineering Intervention to Combat Climate Change*, 95 CLIMATIC CHANGE 103, 103-19 (2009).

67. *See* Rebecca Bendick et al., *Choosing Carbon Mitigation Strategies Using Ethical Deliberation*, 2 WEATHER, CLIMATE, & SOC., 140, 140–47, *available at* http://journals.ametsoc.org/doi/abs/10.1175/2010WCAS1036.1; The University of Montana, *The Ethics of Geoengineering: Investigating the Moral Challenges of Solar Radiation Management*, *available at* http://www.umt.edu/ethics/EthicsGeoengineering/default.aspx (the research grew out of a two-year National Science Foundation grant to study the ethics of SRM). *See also* Alyson Kenward, *Scientists Consider Whether to Cause Global Cooling, Climate Central*, CLIMATE CENTRAL, Oct. 19, 2010, *available at* .http://www.climatecentral.org/breaking/news/causing_global__cooling.

68. *See* GOODELL, *supra* note 14, at 190-91. *See also* KINTISCH, supra note 4, at 3-12 (Kintisch credits the Harvard meeting as being a turning point in mainstream acceptance of geoengineering).

69. *Geoengineering: Workshop on Unilateral Planetary Scale Geoengineering*, COUNCIL ON FOREIGN RELATIONS GEOENGINEERING BLOG (May 5, 2008), http://www.cfr.org/project/1364/geoengineering.html.

70. *Developing an International Framework for Geoengineering*, COUNCIL ON FOREIGN RELATIONS (March 10, 2010), http://www.cfr.org/publication/21636/developing_an_international_framework_for_geoengineering_video.html (the panel featured M. Granger Morgan, Head, Department of Engineering and Public Policy, Carnegie Mellon University; John D. Steinbruner, Director, Center for International and Security

In addition, the policy conversation has lately spread beyond academic journals such as the present one. CM has, of late, been the subject of generally positive magazine articles in *Foreign Affairs*,[71] *The Atlantic*,[72] *Salon*,[73] *Slate*,[74] and *Wired*,[75] and has been covered on network news.[76] It received a chapter in the new best-selling sequel book *Superfreakonomics*,[77] and is the subject of at least two mass-market books.[78] CM advocate David Keith has even made it onto the TED Talks.[79]

CM has also begun to be taken seriously at the national policy level. Director of the White House Office of Science and Technology, John Holdren, has included it as a "possibility" in his presentations on climate change policy, though he later backtracked somewhat after a brief media frenzy.[80] Indeed, as this article was in final preparation, three major reports from U.S. government agencies were released. Together, these three reports represent the most sustained and important governmental inquiries into CM in history.

First, SRM was thoroughly discussed in a ten-page chapter of the June 2010, report by the National Research Council.[81] Reviewing the current state of SRM research (it included within SRM not only the usual stratospheric sulfate aerosol proposals but also placing reflective mirrors in space, cloud whitening, and albedo enhancement[82]), the NRC report focused on five questions: whether SRM could reduce climate change, how to reduce undesirable/unintended consequences (the NRC identified four: failure to reduce ocean acidification, uneven regional shifts, possible reduction of stratospheric ozone, and risk of sudden stoppages; these are discussed in part II[83]), who should decide

---

Studies, University of Maryland; and Ruth Greenspan Bell, Acting U.S. Climate Policy Director, World Resources Institute).

71. David G. Victor et al., *The Geoengineering Option*, FOREIGN AFF., Mar./Apr. 2009, *available at* http://www.foreignaffairs.com/articles/64829/david-g-victor-m-granger-morgan-jay-apt-john-steinbruner-and-kat/the-geoengineering-option.

72. Graeme Wood, *Re-Engineering the Earth*, ATLANTIC, July/Aug., 2009, *available at.* http://www.theatlantic.com/magazine/archive/2009/07/re-engineering-the-earth/7552/.

73. Elizabeth Svoboda, *The Sun Blotted Out from the Sky*, SALON, Apr. 2, 2008, *available at* http://www.salon.com/news/feature/2008/04/02/geoengineering; Thomas Rogers, *Can Technology Cool the Planet?*, SALON, Apr. 22, 2010, *available at* http://www.salon.com/books/feature/2010/04/22/how_to_cool_the_planet (reviewing GOODELL, *supra* note 14). The two *Salon* article titles themselves tell the story of how perceptions of CM have evolved in the last two years.

74. James Rodger Fleming, *Weather as a Weapon*, SLATE, Sept. 23, 2010, *available at* http://www.slate.com/id/2268232/ (providing a skeptical reading of geoengineering history); Eli Kintisch, *The Politics of Climate Control*, SLATE, Sept. 24, 2010, *available at* http://www.slate.com/id/2268477/; Rep. Bart Gordon, *Plan B for the Climate*, SLATE, Sept. 24, 2010, *available at* http://www.slate.com/id/2268478/ [hereinafter *Plan B for the Climate*] (interestingly, *Slate* turned down a proposal of mine to write on geoengineering in 2003, saying that it was "too fringey").

75. Chris Mooney, *Can a Million Tons of Sulfur Dioxide Combat Climate Change?*, WIRED, June 23, 2008, *available at* http://www.wired.com/science/planetearth/magazine/16-07/ff_geoengineering.

76. *Geo-engineering a Last Resort Climate Fix?*. NBC NIGHTLY NEWS, Dec. 27, 2009, *available at* http://www.msnbc.msn.com/id/3032619#34596069.

77. LEVITT & DUBNER, *supra* note 23, at 165-203.

78. GOODELL, *supra* note 14; KINTISCH, *supra* note 4.

79. *David Keith's Unusual Climate Change Idea*, *supra* note 17.

80. *See* Holdren, *supra* note 18; Andrew Revkin, "*Science Adviser Lays Out Climate and Energy Plans*," NY TIMES, Apr. 9, 2009, *available at* http://dotearth.blogs.nytimes.com/2009/04/09/science-adviser-lists-goals-on-climate-energy/,.

81. NAT'L. RESEARCH COUNCIL, *supra* note 60, at 291-99.

82. *Id.* at 294.

83. *Id.* at 295-96.

whether to use SRM (including both practical/legal and ethical considerations[84]), what institutional mechanisms are necessary for monitoring and follow-up, and what kinds of evaluation methods are appropriate.

Second, the House of Representatives' Committee on Science and Technology released, in October 2010, its report on "*Engineering the Climate: Research and Strategies for International Coordination.*"[85] The report draws on an eighteen-month inquiry, including three public hearings,[86] and was prepared in concert with the U.K. Royal Society, which released its report, *Geoengineering the Climate: Science, Governance and Uncertainty,* in September 2009.[87] The report, while repeatedly going out of its way not to endorse CM and to recommend GHG mitigation first (I discuss the usefulness of this strategy in section II.B below), is nonetheless the most significant U.S. government document ever produced on the subject of geoengineering — or as it calls it, climate engineering — and includes the testimony of nearly every significant client scientist who has worked on it (with the notable exception of Lowell Wood).

The report focuses on SRM and CDR,[88] and proposes no fewer than twenty-six discrete research areas that should be investigated.[89] This research, according to the report, should not be undertaken by a new CM office but rather "should leverage existing facilities, instruments, skills, and partnerships within federal agencies."[90] The report next calls on the National Science Foundation to lead the research effort and "should support merit-reviewed proposals for climate engineering research,"[91] while also opining that the National Oceanic and Atmospheric Association, Department of Energy, NASA, and EPA also conduct research, in each case providing detailed research questions to each agency.[92] In sum, the report expressed the view that "broad consideration of comprehensive and multi-disciplinary climate engineering research at the federal level begin as soon as possible in order to ensure scientific preparedness for future climate events."[93]

Unfortunately, this clarion call was released right before the transfer of power in the House to the Republican party, the leadership of which not only ignored the report but promptly disbanded the House Select Committee on Energy Independence and Global Warming.

Third, the Government Accountability Office ("GAO") released, also in October2010, its first ever technology assessment on geoengineering.[94] The report offers both an evaluation of the social, political, and environmental implications of

84. *Id.* at 296-97.

85. HOUSE REPORT, *supra* note 11.

86. *Chairman Gordon Releases Report on Climate Engineering,* COMM. ON SCI, SPACE. & TECH (Oct. 29, 2010), http://sciencedems.house.gov/press/PRArticle.aspx?NewsID=2945.

87. HOUSE REPORT, *supra* note 11.

88. *See id.* at 40.

89. *Id.* at 7-8.

90. *Id.* at 8 (One suspects that this insistence reflects the political mood and budgetary realities of 2010).

91. *Id.* at 9.

92. HOUSE REPORT, *supra* note 11, at 10-26.

93. *Id.* at 38.

94. U.S. GOV'T ACCOUNTABILITY OFFICE, GAO 10-903, A COORDINATED STRATEGY COULD FOCUS FEDERAL GEOENGINEERING RESEARCH AND INFORM GOVERNANCE EFFORTS (2010).

geoengineering, as well as a survey of the state of the science underlying the various CM methodologies.

Together, these three reports, along with the 2009 report of the Royal Society, represent a sea change in the official acknowledgment of CM as a climate change strategy. Of course, I am wary of the typically liberal confusion of hortatory documents with practical actions, and it may be that, following the 2010 election, denial will again become the dominant discourse on climate change. Then again, the more denial, the more delay — and the more delay, the more CM becomes inevitable.

2. The (U.N.) Empire Strikes Back

The quick rise of geoengineering has not gone unnoticed by critics of CM, who have struck back at CM with a series of international declarations. The Convention on Biological Diversity ("CBD") has been a central locus for this attempt to curtail CM, not because it is the appropriate international body to do so (biodiversity being only one of many issues impacted by CM, and not necessarily the most important)[95] but because it is in this venue that CM opponents have the most ability to enable non-binding rhetorical statements to be made. First, in 2008, the COP 9 ("Conference of the Parties") meeting decided, in the context of an "integration of climate-change activities within the programmes of work of the Convention,"[96] to focus on OIF. COP 9:

> (i) endorsed the June 2007 "Statement of Concern regarding iron fertilization of the oceans to sequester CO2" of their Scientific Groups, (ii) urged States to use the utmost caution when considering proposals for large-scale ocean fertilization operations and (iii) took the view that, given the present state of knowledge regarding ocean fertilization, large-scale operations were currently not justified.[97]

Contrary to the claims of some CM opponents, COP 9 did not ban OIF,[98] but it did express a non-binding opinion of one U.N. Convention that it should not be pursued.

In October 2010, COP 10 picked up where COP 9 left off. Amid utopian language (I discuss green utopianism in part II, infra) such as "[a] new era of living in harmony with Nature is born at the Nagoya Biodiversity Summit,"[99] COP 10 issued a second, broader non-binding declaration regarding CM. The decision was submitted by the chair

---

95. *See* Karen N. Scott, *Conflation of, and Conflict Between, Regulatory Mandates: Managing the Fragmentation of International Environmental Law in a Globalised World*, THIRD FOUR SOC'YS CONFERENCE: INT'L LAW IN THE NEW ERA OF GLOBALIZATION (Aug. 26-28, 2010). *See also* Neil MacFarquhar, *Trying to Lace Together a Consensus on Biodiversity Across a Global Landscape*, N.Y. TIMES, Sept. 30, 2010, at A11 (most nations agree that the climate change challenge must be addressed, but how to exactly address it — both practically and financially presents an even bigger obstacle).

96. Convention on Biological Diversity Decision IX/16, U.N. Doc. UNEP/CBD/COP/DEC/IX/16, (Oct. 9, 2008), sec. A, *available at* http://www.cbd.int/decision/cop/?id=11659 [hereinafter CBD Decision IX/16].

97. *Id.* at section C.

98. *See, e.g.*, *Geoengineering Moratorium at UN Ministerial in Japan: Risky Climate Techno-fixes Blocked*, CLIMATE CONNECTIONS (Oct. 28, 2010, 7:01 PM), http://climatevoices.wordpress.com/2010/10/28/geoeng ineering-moratorium-at-un-ministerial-in-japan-risky-climate-techno-fixes-blocked/ (calling the 2008 decision a "moratorium"); Wayne Hall, *Chemtrail Secrets: Strategies Against Climate Change?*, SPECTRE MAGAZINE (Jan. 2004), *available at* http://www.rense.com/general49/change.htm (calling my article "a masterful attempt to defend the indefensible," a characterization that I do not entirely dispute).

99. Press Release, Convention on Biological Diversity, A New Era of Living in Harmony with Nature Is Born at the Nagoya Biodiversity Summit, (Oct. 29, 2010), *available at* http://www.cbd.int/doc/press/2010/pr-2010-10-29-cop-10-en.pdf.

of a COP 10 working group:

> *Invites* Parties and other Governments, according to national circumstance and priorities, as well as relevant organizations and processes, to consider the guidance below on ways to conserve, sustainably use and restore biodiversity and ecosystem services while contributing to climate-change mitigation and adaptation:
>
> . . . .
>
> (w) Ensure, in line and consistent with decision IX/16 C, on ocean fertilization and biodiversity and climate change, in the absence of science based, global, transparent and effective control and regulatory mechanisms for geo-engineering, and in accordance with the precautionary approach and Article 14 of the Convention, that no climate-related geo-engineering activities* that may affect biodiversity take place, until there is an adequate scientific basis on which to justify such activities and appropriate consideration of the associated risks for the environment and biodiversity and associated social, economic and cultural impacts, with the exception of small scale scientific research studies that would be conducted in a controlled setting in accordance with Article 3 of the Convention, and only if they are justified by the need to gather specific scientific data and are subject to a thorough prior assessment of the potential impacts on the environment;
>
> (x) Make sure that ocean-fertilization activities are addressed in accordance with decision IX/16 C, acknowledging the work of the London Convention/London Protocol;
>
> . . . .
>
> * Without prejudice to future deliberations on the definition of geo-engineering activities, understanding that any technologies that deliberately reduce solar insolation [sic] or increase carbon sequestration from the atmosphere on a large scale that may affect biodiversity (excluding carbon capture and storage from fossil fuels when it captures carbon dioxide before it is released into the atmosphere) should be considered as forms of geo-engineering which are relevant to the Convention on Biological Diversity until a more precise definition can be developed. Noting that solar insolation [sic] is defined as a measure of solar radiation energy received on a given surface area in a given hour and that carbon sequestration is defined as the process of increasing the carbon content of a reservoir/pool other than the atmosphere.[100]

As with the COP 9 declaration, it bears repeating that this language is only an "invitation" and bears no enforceable legal weight. As Kintisch notes, "It's unclear how the statement might be enforced, as nations have not considered CBD decisions '"legally binding"' in the past. One hundred sixty-eight countries are signatories to the CBD treaty; the treaty has not been ratified by the U.S."[101] Indeed, the United States and other nations regularly ignore these sorts of hortatory statements to invite consideration of policy matters. Practically speaking, the COP 10 language is an effort by a small number of liberal greens to exercise rhetorical power in the grown-up equivalent of a college debate society. Moreover, as Ken Caldeira noted in an interview with Kintisch, the language is so expansive (using language like "may affect") as to make "no sense."[102] It is incorrect, as a factual matter, that, in the words of one environmental activist, "any

100. *See* Draft Decision for the Tenth Meeting of the Conference of the Parties to the Convention on Biological Diversity, U.N. DOC. UNEP/CBD/COP/10/1/Add.2/Rev.1 (Oct. 1, 2010).

101. Eli Kintisch, *Proposed Biodiversity Pact Bars "Climate-Related Geoengineering,"* SCI. (Oct. 26, 2010 5:55 PM), http://news.sciencemag.org/scienceinsider/2010/10/proposed-biodiversity-pact-bars-.html.

102. *Id.*

private or public experimentation or adventurism intended to manipulate the planetary thermostat will be in violation of this carefully-crafted UN consensus."[103] This is legal wishful thinking. Geoengineering would no more violate this "consensus" than would a country not "consider[ing] gender as a core cross-cutting issue in the implementation of biodiversity-related activities," an "invitation" contained in another COP 10 document.[104]

However, in the context of governmental and conservative embraces of CM, the COP 10 declaration is a clear sign that some "dark greens" have begun to take geoengineering seriously and slam the door in response. It is hoped that after the initial shock of CM wears off, that parties from a wide range of ideological backgrounds may appreciate the nature of nuanced CM proposals.

Finally, it is interesting to note that geoengineering has also been noticed by conspiracy theorists of a variety of stripes. The first of these, to my knowledge, were believers in the "chemtrails" conspiracy, which holds that the U.S. government is secretly spraying chemicals on the population by means of jet contrails. Indeed, I am sorry to report this author was one of the earliest sources for this conspiracy meme. Chemtrails activists discovered my 1998 article and linked its discussion of SRM to their pre-existing suspicions about government chemical trails.[105] However, the chemtrails theorists have come a long way since 1998. There is now an entire website, geoengineeringwatch.org, which provides exceptionally detailed descriptions of CM science and policy debates, as well as deeply troubling information, such as directions to the offices of leading CM advocates. Of course, such wing nuts remain on the fringes of public discourse — but then again, the same was said of the Tea Party just two years ago.

3. What can Brown Do for the Earth?

Geoengineering "scrambles old political alliances and carves out new ideological fault lines."[106] Indeed, one of the most intriguing, and telling, phenomena of recent CM discourse is that it is beginning to be taken up, albeit tentatively, by some conservative voices. In some ways, this should be regarded as a welcome turn of events, as it represents some evolution from a position of total denial. But "dark greens" may have good reason to worry.

As we have seen, the predominant conservative strategy regarding climate change has been to replicate bogus stories of "controversy" and disagreement among scientists. When I wrote in 1998, deniers were still claiming that no global warming was even taking place. Now, with abundant visual evidence, they have shifted to stating that if global warming is happening, it is a natural phenomenon and that anyway, we can adapt

103. Press Release, ETC Group, *News Release: Geoengineering Moratorium at UN Ministerial in Japan,* (Oct. 29, 2010), *available at* http://www.etcgroup.org/en/node/5227.

104. Draft Decision for the Tenth Meeting of the Conference of the Parties to the Convention on Biological Diversity, *supra* note 100, at 5.

105. *See* Bruce Conway, *The Chemtrail Smoking Gun*, LIGHTWATCHER (June 20, 2003), http://www.lightwatcher.com/chemtrails/smoking_gun.html (citing *Manhattan*, *supra* note 1, stating that "[i]t is evident to anyone who cares to look up, that this mitigation is now being conducted worldwide and on a daily basis" and that "[i]t is certain that our leaders have already embarked on an immense geoengineering project; one in which they expect millions of human fatalities, and consider these to be acceptable losses").

106. GOODELL, *supra* note 14, at 15.

to whatever changes it brings, some of which may be beneficial. To even entertain the possibility of geoengineering represents at least some evolution in view.

Now-presidential-candidate, Newt Gingrich, succinctly laid out the conservative case for geoengineering in a blog post which I shall reproduce in its entirety:[107]

> *Can Geoengineering Address Concerns About Global Warming?*
>
> One of the most intriguing and promising areas of scientific innovation today are methodologies to address concerns about global warming by something called geoengineering.
>
> We need to know more about it, but the idea behind geoengineering is to release fine particles in or above the stratosphere that would then block a small fraction of the sunlight and thus reduce atmospheric temperature.
>
> In other words, this is one method that holds the promise of addressing any threat from global warming at a fraction of the cost. Instead of imposing an estimated $1 trillion cost on the economy by Boxer-Warner-Lieberman, geoengineering holds forth the promise of addressing global warming concerns for just a few billion dollars a year. Instead of penalizing ordinary Americans, we would have an option to address global warming by rewarding scientific innovation.
>
> My colleagues at the American Enterprise Institute are taking a closer look at geoengineering, and we should too.
>
> With gas prices already at record highs, the last thing America needs is government regulation that will make gas prices higher, make Americans poorer, and make special interests even richer.
>
> We need innovation, not regulation. We need motivating incentives, not punishing pain. Our message should be: Bring on the American Ingenuity. Stop the green pig.

Gingrich's analysis deserves attention, as it neatly sets forth why CM is so attractive to conservatives. First, Gingrich's somewhat conditional language that leaves open the possibility that climate change is not really taking place, such as "addressing any threat from global warming" and "address concerns about global warming." There is no admission here that the threats are real and the concerns are justified — only the claim that geoengineering would help address them. This "cover" is important, and reminiscent of Guido Calabresi's analysis of the role of subterfuge in creating effective public policy:[108] by allowing conservatives to continue to claim that anthropogenic climate change is not really happening, this kind of conditional language allows research to proceed that would allow action if someday climate change really is seen to be real. In contrast, regulation forces cuts now for hoped-for benefits later. As I noted in 1998, that geoengineering may be postponed is one of its greatest strengths; SRM in particular requires so little time to be effective, it is almost like a remedial solution.[109]

Second, the ideological appeal of CM to a conservative is clearly stated: "the last thing America needs is government regulation that will make gas prices higher, make

---

107. Newt Gingrich, *Stop the Green Pig: Defeat the Boxer-Warner-Lieberman Green Pork Bill Capping American Jobs and Trading America's Future*, NEWT DIRECT BLOG, (June 3, 2008 12:00 AM), http://www.newt.org/newt-direct/stop-green-pig-defeat-boxer-warner-lieberman-green-pork-bill-capping-american-jobs-and-t .

108. *See* Jay Michaelson, *Rethinking Regulatory Reform: Toxics, Politics, and Ethics*, 105 YALE L.J. 1891, 1923 (1996) (discussing GUIDO CALABRESI & PHILIP BOBBITT, TRAGIC CHOICES 26 (1978)).

109. *Manhattan*, *supra* note 1, at 109.

Americans poorer, and make special interests even richer. We need innovation, not regulation. We need motivating incentives, not punishing pain." Setting aside the meaningless political language ("special interests"), it is striking how CM methodology does fit so squarely within existing conservative and neo-conservative thinking. Indeed, not only would CM not cost industry anything (recall from above that oil and gas utilities are Newt Gingrich's largest supporters), it would actually generate further revenue, at least for those entities responsible for research, development, and implementation of CM technology. Other than an investment by the government — which, from a conservative perspective, would presumably be in the form of grants to private sector entities doing the research and development — CM costs "Americans" nothing. It requires no new regulations, and allows Gingrich's corporate backers to continue just as they have done so far. Indeed, if past experience is any guide, some of them will probably get into the geoengineering business themselves.

Of course, Gingrich's brief blog post does not mention the many risks associated with CM, some of which are discussed below. It also presents CM as an alternative to regulation, while most CM advocates see it as a supplement to GHG reduction. And of course, Gingrich's post moves CM from a desperate last resort to a preferred policy option, which few climate scientists actually believe it to be.

Gingrich's post refers to a daylong conference held in 2008 at the American Enterprise Institute ("AEI"), entitled "Geoengineering: A Revolutionary Approach to Climate Change,"[110] and AEI's subsequent endorsement of geoengineering as a remedy for "possible" climate change. Curiously, AEI's website advertising the conference was greener than anything the CTT has put out in the past:

> For more than twenty years, policymakers have struggled to find ways to reduce greenhouse gas emissions enough to stop global climate change. Congress is likely to enact federal climate legislation in 2009, but many scientists fear that emissions reductions may not occur quickly enough to prevent significant warming. Some scientists also fear that potentially catastrophic effects, such as the melting of the polar ice caps, could happen unexpectedly quickly. If warming proves to be uncontrollable and dangerous, what could we do?
>
> A growing number of climate scientists believe that there may be only one possible answer to that question: change features of the earth's environment in ways that would offset the warming effect of greenhouse gases, a concept known as "geoengineering" (or "climate engineering"). The most plausible way of doing this would be to use very fine particles in (or above) the stratosphere to block a small fraction (roughly 2 percent) of sunlight. While geoengineering science is in its infancy, most scientists who have studied the idea believe it is likely to be feasible and cost-effective.[111]

Indeed, at least one of the presentations at the 2008 conference insisted that "[g]eoengineering cannot replace mitigation,"[112] and the conference included

110. *See Geoengineering: A Revolutionary Approach to Climate Change*, AMERICAN ENTERPRISE INSTITUTE, (June 3, 2008), http://www.aei.org/event/1728 [hereinafter *Revolutionary*]. *See also A Brief History of Geoengineering*, AMERICAN ENTERPRISE INSTITUTE, http://www.aei.org/aei-website/managed-content/site-pages/geoengineering/geoengineering-history.html (last visited Feb. 9, 2011).

111. *Revolutionary*, *supra* note 110.

112. Wigley, *supra* note 3, at 12.

respectable scientific authorities, not the same old cast of deniers.

Given AEI's longstanding opposition to any climate action — and the considerable support ExxonMobil has given to them — this may seem quite surprising. Then again, if the worst nightmares of greens are true, maybe not. Jeff Goodell reports one green activist as writing "combining dire warnings about climate action's economic costs with exaggerated claims about geoengineering's potential is the new climate denialism."[113]

Is this so? No one, of course, can read the minds of AEI's board members. Yet geoengineering is more than practically convenient for conservatives; it is ideologically consistent as well. On a simple level, of course, CM does allow polluters to continue polluting and SUV drivers to continue guzzling gas. But it is also consonant with a wider and deeper conservative view that, essentially, the market and human innovation will eventually solve whatever problems they have created. This ideological view — still in place after the global financial crisis of 2008-10 — is not based on scientific feasibility or economic data; it is an article of libertarian faith. Whatever problem the market has created, the market will solve, with no need for complex and freedom-abridging government intervention. Moreover, since, in theory at least, geoengineering could be implemented by private actors (albeit, one presumes, under the close supervision of international or at least governmental agencies), it is a libertarian dream: a market-created, privately-implemented solution that could conceivably proceed without any significant government regulation of behavior.

I will return to the conundrums this poses for environmentalists in Section II.B, below. Clearly, those of us who consider ourselves environmentalists are faced with a question. Must everything my enemy likes also be hateful to me, o r does CM represent an opportunity for an unprecedented cooperation between greens and browns, the former prevailing in ends (yes, the climate is changing, and yes, we need to act), the latter in means?

D. Summary: Plus c'est la même chose, plus ça change[114]

What has changed is a result of what has not changed. Twelve years after my initial article and eighteen years after the 1992 NAS study, at least half of the American Congress still holds the view (publicly at least) that anthropogenic climate change is not even happening. This is a result not of scientific uncertainty but of lobbying and pseudo-science by the energy industry and others with a significant financial stake in the status quo. One may, of course, deride such critiques as partisan or naïve, but they are historical, not ideological. Tracking the memes of doubt and uncertainty leads, time and time again, to publicists and occasional scientists affiliated with commercial actors. Nothing has changed, because there is great, concentrated power against change, and a collective action problem on the other side.

113. GOODELL, *supra* note 14, at 15 (quoting Alex Steffen of Worldchanging).

114. "The more things stay the same, the more they change." This is the inversion of Jean-Baptiste Alphonse Karr's famous aphorism "plus ça change, plus c'est la même chose," the more things change, the more they stay the same.

Yet precisely because so little has changed in the politics of climate change regulation, much has changed in the science and policy of climate management. The question now is: has it changed for the better, or the worse?

II. THE CASE FOR PLAN B

As we have seen, there are numerous arguments for investigating the possibility of CM as a climate change strategy. If nothing else, it is not GHG reduction, which has had such a sorry history that it begs for an alternative. Of course, CM is not a panacea, and so I begin the normative case for "Plan B" by addressing the policy objections that have been raised against CM by critics. Some of these I first addressed in 1998; others have become known more recently. All, I believe, are answerable. I then conclude this essay in the following section with a reflection on the deeper meaning of CM for environmental advocates: why it is a good idea to surrender to the villains, and the lessons all of us can learn precisely from our resistance to CM.

A. Are We Still Afraid of Giant Laser Space Frisbees?

In 1998, I identified four primary policy concerns regarding geoengineering: that it simply would not work, that it costs too much, that it is "unnatural," and that it subverts other efforts at regulation. Three of these four concerns remain active today. First, CM technologies remain largely untested, and "common sense" as well as humility cause most people to react with skepticism of their efficacy. Of course, many past efforts to correct one human intervention in natural processes by introducing another have led to unintended negative side-effects. Second, CM continues to offend the deep sensibilities of environmentalists because it is unnatural, a concern discussed in Section B. And third, there is no question that as CM grows in legitimacy, it has the potential to undermine efforts at preventive regulation — though my claim is that that potential is not needed, as regulatory efforts are failing well enough on their own.

One policy concern that has faded in importance is that of cost. Indeed, as we have learned more about the true costs of GHG reduction, and the possibilities of relatively low-cost CM, the issue of cost now seems to cut in favor of CM rather than against it.[115] Perhaps the metaphor of the "Manhattan Project" which I and others have used for a proposed CM R&D effort is misleading; it is possible that after research, CM may be among the least expensive climate change strategies in a policy portfolio. For example, Caldeira, Wood, and Myrhvold estimate the costs of an Arctic-focused SRM process to be only $20 million in startup costs and $10 million in annual operating costs.[116]

In addition to these older concerns, there are three additional ones that were not well known in 1998 but present serious challenges today. In each case, I find the concerns valid, but addressable. I now turn to these critiques.

---

115. *See* Scott Barrett, *The Incredible Economics of Geoengineering*, 39 ENVTL. & RES. ECON. 45, 45 (2008).

116. LEVITT & DUBNER, *supra* note 23, at 195. A larger, planetary-focused effort is estimated to cost $150m to begin and $100m annually to operate. *Id.* at 196. Levitt and Dubner note that the $250m figure is less than Al Gore's climate foundation is paying on increasing public awareness about global warming.

1. Moral Hazard: Don't Worry, Be Happy?

Some critics charge that geoengineering gives a "free pass" to polluters and will undermine efforts to attain meaningful GHG reduction. This is the familiar "moral hazard" argument: that, in David Keith's elegantly simple presentation, "knowledge that geoengineering is possible → climate impacts look less fearsome → a weaker commitment to cutting emissions today."[117]

This argument is quite cogent, but my response is simple: Big Oil doesn't need this moral hazard to postpone any action on climate change. It's been doing just fine for twenty years.

Even without any real awareness of CM, even with a melting Greenland and shrinking Arctic, even with drowning polar bears, American society and government has totally failed to act on climate change. We don't need this moral hazard, because we're already immoral. It's not as if we were *this close* to meaningful action in Copenhagen, or a serious climate bill in the last Congress. And as of 2010, "climate is gone," according to GOP Strategist Karl Rove.[118] In short, we are nowhere near where we need to be, and despite all the well-meaning public relations initiatives, we are moving fast in the other direction, if India and China are included. Yes, millions of people now worry about their carbon footprint. But as Gore himself well knows, all that is window dressing if we cannot shift our utilities and major industrial bases to less carbon-intensive consumption patterns, and if China and India do not come to the table.

Some have worried that geoengineering's essential political message is essentially "Don't Worry, Be Happy." But this concern, too, is answerable: as CM advocate Nathan Myrhvold has said, blaming geoengineering for complacency is like blaming a heart surgeon for saving the life of someone who doesn't exercise and eats too much.[119] Yes, the existence of heart surgery does engender a certain amount of apathy. But how much? Do overeaters really eat too much because a quadruple bypass is available someday? Obviously not — and surely none of us would ban treatements for heart disease because they do not address the "root problem." Likewise here.

2. Risks: Unk-Unks

As in 1998, one of the leading criticisms of CM today is that it there are too many unknowns and too many risks associated with human management of climate. Bad enough are the "known unknowns" — but worse are what Donald Rumsfeld called "unknown unknowns," or, as they are now called colloquially, "'unk-unks,'" which in the case of the Earth's climate are effectively infinite.[120]

We cannot answer this criticism today because we have not even begun serious research into CM. We don't know whether CM can work, and we won't know until we take it seriously as a policy option. We know that its theoretical basis is sound. But it is

117. *David Keith's Unusual Climate Change Idea*, *supra* note 17.

118. Will Bunch, *Fracking Karl Rove to Pa.: "Climate is Gone"*, THE PHILADELPHIA INQUIRER (Nov. 3, 2010), http://www.philly.com/philly/blogs/attytood/Fracking_Karl_Rove_to_Pa_Climate_is_gone.html.

119. LEVITT & DUBNER, *supra* note 23, at 103.

120. *See* KINTISCH, *supra* note 4, at 25-26.

premature to object that "we don't know if it will work" because we haven't yet even begun to investigate it.

Some of this criticism, surely, is more based in fear than in rational calculation: "Common sense" simply tells us that SRM, OIF, and albedo enhancement are crazy ideas that will not' work. So, Al Gore calls CM "nuts."[121] But what is really "nuts," as the old cliché holds, is doing the same thing as before and expecting a different result. If there is a concern about the feasibility of a particular project, then more, rather than less, research is warranted. Doubtless, the Apollo missions to the moon seemed loony at the time, yet a serious campaign of research and development yielded success. Likewise, perhaps, with climate management.

These general anxieties are not, of course, the same as specific concerns that climate scientists have raised. For example, it is possible that sulfate aerosol SRM may increase tropospheric sulfate loading and surface deposition or affect cirrus clouds, and that SRM may negatively impact atmospheric ozone levels, and allow ocean acidification to intensify.[122]

Yet all of these potential risks call for more research, rather than less. And because the economics of regulation are so unfavorable, the risks of *not* researching CM are considerable. As such, this a classic risk vs. risk dilemma. Indeed, as David Keith has noted[123] given the feasibility of CM and the temptation to use it as a quick fix, it might be more useful to compare the risk of geoengineering carefully against the risk of doing so hastily. The question is whether we want an eventual CM implementation to be a hasty fix erected amidst an emergency, or one which has been carefully planned over time.[124] The climate chickens will come home to roost eventually; will we be ready, or will our concern over risks make those risks more acute?

3. Equity: The Rain in Spain Falls Mainly. . .

As we have learned more about the science of geoengineering, questions of equity have become much sharper than they were in 1998, particularly surrounding SRM. It is already known that the effects of climate change will vary across the globe. Some regions will get hotter, others cooler, and some may even experience benefits from climate change. All of this is complicated by uncertainty, as models vary widely regarding the local effects of global climate change. Even if SRM is applied more or less uniformly across the globe, or focused in less-populated areas (such as the Arctic, where it is needed most),[125] the net effects of SRM on local climate patterns will likely vary considerably from place to place, with some areas experiencing more negative effects

121. *Id.* at 200.

122. *See* Ken Caldeira & Lowell Wood, *Global and Arctic Climate Engineering: Numerical Model Studies*, 366 PHIL. TRANSACTIONS OF THE ROYAL SOC'Y A 4039, 4051 (2008); Wigley, *supra* note 3, at 13.

123. *Geoengineering the Climate: History and Prospect*, *supra* note 65.

124. *See* Richard A. Kerr, *Climate Tipping Points Come in from the Cold*, 319 SCI. 153 (2008); KINTISCH, *supra* note 4, at 39-52 (on the possibility of a sudden climatic emergency). The recent House Science & Technology Committee report suggested that one agenda item warranting immediate attention would be to define the parameters of a "climate emergency" so that policymakers would have a benchmark on which to base a rapid deployment of SRM technology. *See* HOUSE REPORT, *supra* note 11, at 39-40.

125. According to David Keith, "Geoengineering may be the only tool we have to save certain ecosystems, like the Arctic." GOODELL, supra note 14, at 39.

than others.

For example, the effects of SRM's "cooling" may be experienced in radically different ways, far more complex than mere temperature change: since SRM only decreases temperature in the daytime, it reduces the average temperature difference between day and night, which may play havoc with local ecosystemic processes, including plant and animal populations, wind and precipitation. Some areas may have increased precipitation, others decreased precipitation. The severity of these effects likewise will vary from region to region. Some have expressed concern that SRM might lessen rainfall in Africa, Asia, and the Amazon.[126]

A second example of regional variation could arise with regard to albedo enhancement, which may have strong localized effects; if clouds are brighter in one place but unaltered in another, the differential impact could be significant. This, indeed, is one of the advantages of albedo enhancement, as it might be focused on the poles, where warming is worst.[127]

Regional variations in SRM effects are further complicated by the difficulty of measurement. While climate is essentially predictable, many of the effects of SRM may manifest more in local weather patterns, which, as we all know, are far less predictable. Even if we could imagine a scenario in which countries compensated one another for the undesirable consequences of SRM, it is difficult to imagine how those consequences would be measured, or attributed to SRM as opposed to some other source. History here may be instructive: thirty years into the acid rain crisis, northeastern states are still bickering with midwestern ones about the causes of acid rain and what might be done to compensate for them. Surely, such negotiations would be even more fraught on a global scale.

It is also possible that, if SRM takes place in the stratosphere, the sulfates involved may adversely affect atmospheric ozone layers. In response, David Keith has recently suggested that SRM focus on the mesosphere, the layer above the stratosphere, where such secondary effects would not arise and where, due to differences in atmospheric currents, SRM could be better focused on the polar regions where it is needed more.[128] I note that a number of private actors (including, yes, Richard Branson) are developing high-altitude aircraft/spacecraft that may well be able to deliver the sulfates to the mesosphere at extremely low cost, simply as part of their ordinary business.[129]

Finally, even accounting for unintended regional variations, it is also the case that not all nations have the same incentives regarding climate change. It has been suggested, for example, that Russia may actually stand to gain from global warming; would Russia insist on compensation for a successful SRM scheme (especially one focused on the Arctic), which prevented such a boon from occurring?[130] As Red Team member James

126. KINTISCH, *supra* note 4, at 71-72 (citing presentation of Tony Janetos to the National Academy of Sciences, June 2009); Alan Robock, Luke Oman, & Georgiy L. Strenchikov, *Regional Climate Responses to Geoengineering with Tropical and Arctic SO_2 Injection*, 113 J. GEOPHYSICAL RESEARCH-ATMOSPHERES 15 (2008).

127. GOODELL, supra note 14, at 114.

128. *David Keith's Unusual Climate Change Idea*, *supra* note 17.

129. *See Space Matters!*, VIRGIN GALACTIC, http://www.virgingalactic.com/overview/environment/ (last visited May 12, 2011).

130. GOODELL, *supra* note 14, at 192.

only question environmental advocates have is whether we want to implement that option in a rushed, hasty way, or whether we want to research, plan, and test CM in advance. When looked at from a pragmatic point of view, like Wood's, the game is really already over.

In this concluding section, I want to engage with what it means for an environmentalist to support a strategy that indulges precisely those villains who got us into this mess in the first place — and why we should get over ourselves and do so. In a sense, CM is a resounding defeat, a huge concession to industries that have lied so much that now only CM will save us. Yet if we can transcend the us/them, green/brown dichotomy, only the last few words of that sentence should matter: only CM will save us.

1. Utopian Dreams, Dystopian Nightmares

"The master's tools will never dismantle the master's house. They may allow us temporarily to beat him at his own game, but they will never enable us to bring about genuine change." – Audre Lorde[145]

Clearly, the motives of liberal and conservative advocates of CM differ. On the left, most CM advocates have stated that one must embrace it reluctantly, and with great hesitation. Not so on the Right, however. As described above, for libertarians and conservatives, geoengineering as a concept is to be embraced enthusiastically. It is preferable to vast and expensive regulatory regimes. Additionally, most people of a conservative or libertarian bent tend also to have fewer essentially philosophical (or even religious) qualms about "tampering with nature." After all, these are the same ideologies that tend to align with genetic engineering, pesticide use, and artificially-created "foods" in the first place — the notion of doing so on a climatic scale is not particularly uncomfortable. Indeed, it may even be regarded as exciting.

The deeper message of CM is far more alluring than the mere saving of money; it is that we can rely on human ingenuity, market forces, technological innovation, and that we have no need for government regulation and harsh preventive measures. Geoengineering resonates with conservatives in a deeper way than liberal concerns have yet articulated; it is in harmony with fundamental conservative commitments to market forces, technology, and anti-government sentiments.

For greens, this is a double conundrum. First, research into geoengineering empowers the "Don't Worry, Be Happy" crowd in their debates with sincere activists trying to fight global warming. Second, if CM actually works, the bad guys win: precisely the most heinous twisters of truth to continue profiting from their exploitation of the Earth. But we liberals should not burn the planet out of spite. Yes, CM is our worst nightmare — but it also can awaken us from the utopian dream that somehow, American capitalist consumerist society will transform itself, the "people" will rise, and the malefactors of great wealth will be defeated. This is a pipe dream. Do we really believe that Al Gore's Nobel Prize will really defeat ExxonMobil in the halls of the

145. Audre Lorde, *The Master's Tools Will Never Dismantle the Master's House*, *in* SISTER OUTSIDER: ESSAYS AND SPEECHES 112 (1984).

Congress? Even when the American public overwhelmingly supports some action on climate change, the American Congress does not. And so long as climate change mitigation can be said to require "intrusive government regulation" and "job-killing carbon taxes" and other bogeymen of the Fox News Right, it will be a very difficult sell. We need to find a way beyond the partisan battle-lines — and geoengineering, precisely because it is so distasteful and abhorrent to dark green liberals like me, is that way.

If CM gives us some new bedfellows, well, all the better, since continuing to hope against hope that everyone will "green up" is naïve. Perhaps we might take a cue from Ken Caldeira and Lowell Wood, two ideological opposites who are now close allies in CM research and development. Wood, as already mentioned, is the father of "Star Wars," the Strategic Defense Initiative, as well as a protégé of Edward Teller, and a longtime conservative Cold Warrior.[146] Caldeira is a former "quasi-socialist" whose car has a bumper sticker saying "JAIL BUSH."[147] Caldeira calls Wood a "right-wing nut," and Wood calls Caldeira "a tree-hugger of the most liberal persuasion."[148] Yet they are friends and colleagues who agree on the reality of climate change and the need for CM to address it.

Moreover, we should consider the impact of utopian, idealistic wishes for a carbon-free future might have on "Southern" developing countries and their populations. A serious shift to low-carbon energy sources would take decades, during which time the developing world would either need to receive some sort of a "pass" (thus further limiting the impact of such a shift) or would be at a severe disadvantage in terms of their own development. Put simply, there is no way to force everyone to live green without harming the developing world.[149] Of course, all this pretends that it is even "our" choice to make, which in fact it is not. India, Brazil, China, and other nations are not asking the North's permission to develop as they wish. Concealed in the utopian insistence on global lifestyle change, then, is a Eurocentrism that blinds us to the pressing needs of billions of poor people.

It is not surprising, in this vein, that environmentalists on the left, caught in utopian thinking, resort, over and over again, to nonbinding resolutions, aspirational goals, and hopeful summits in which nothing of consequence is actually achieved. En route to COP-15, for example, the United States and several European countries hammered out a meaningless "aspirational goal" for 50% GHG reductions by 2050, after (of course) intense negotiation among themselves.[150] Never mind that such targets have no prayer of being achieved in the United States, China, India, Russia or Brazil; activists pretended, as we often do, that passing a resolution constituted meaningful action on climate change. None of that, of course, saved the Copenhagen summit from disaster, and none of it will help Copenhagen the city deal with rising sea levels.

146. *See* GOODELL, *supra* note 14, at 120-24.

147. *Id.* at 111.

148. *Id.* at 126.

149. For a recent example of this dilemma, see Bob Davis, *World Bank Struggles with Coal Power*, WALL STREET J., Nov. 4, 2010.

150. Jonathan Weisman, *Climate Declaration to Get Global Boost*, WALL STREET J. (Jul. 3, 2009), http://online.wsj.com/article/SB124656785956688323.html.

Climate change is real. Perhaps geoengineering bears out the conservative view that human ingenuity can clean up the messes it creates, and perhaps it is caving into precisely the villains who created this mess in the first place. But I for one would gladly swallow my pride in exchange for being able to walk in the forest.

Such humility is a good thing. If utopian dreaming characterizes some dark green thinking about environmental policy, dystopian nightmares characterize much of the rest of it. If we look honestly, there is no question that, among progressives in particular, forms of apocalyptic thinking are commonplace. Utopians, progressives, and liberals tend to fret (or celebrate) that the end of the world as we know it is nigh — not just in terms of environmental issues, but also economic, political, scientific, and religious ones. When I wrote my original geoengineering article, fears of Y2K were already beginning to surface, particularly among left-wing doomsayers who warned that our financial system was in danger of collapse. These days, on the fringes of political and social discourse, it's 2012.

Now, it is obviously true that such predictions are occasionally correct. The global financial system did indeed melt down in 2008, and would likely have melted more had former free-marketeers suddenly (and perhaps courageously) embraced massive governmental action. Biodiversity has indeed crashed, and species do often become extinct or extirpated. The sky sometimes does fall.

But sometimes it does not. Surely the astonishing success of the Montreal Protocol to reverse the loss of stratospheric ozone — and the faster-than-expected recovery of the atmosphere — should give pause to all of us who are deeply concerned about climate change. Of course, as I also noted in 1998, ozone and climate change are very different problems, the latter far more complex than the former. But is there not *some* cause for pause? Is there not a grain of truth to the generally conservative sense that our species' collective know-how can indeed solve very serious problems, and that nature can sometimes rebound faster than we suspect?

Now, I certainly do not want to endorse, even for a moment, the pseudo-scientific prevarication that climate change is not actually happening, only to explore the cognitive orientation that mitigates against panic. Of course, it may well be that such "pause" feels good precisely because the worst-case climate scenarios are so horrifying. Perhaps climate change is so horrible that human beings find it impossible to contemplate seriously, which is why the campaigns of denial are so successful. Maybe we can't handle the truth. But the years I have spent since 1998 exploring the nexus points between religion, sexuality, and law, as well as my work outside the legal academy exploring apocalyptic and messianic religious movements, have convinced me that ideologies of fear have, as it were, minds of their own. As a factual and, for lack of a better term, spiritual matter, I am still quite persuaded that we are in the midst of an unprecedented global climate crisis. But I am also mindful that apocalypses tend to be feared excessively, and tend not to happen.

So, yes, I intended the Audre Lorde quotation to be somewhat ironic. I am indeed advocating, in this case, playing by the master's rules — by which I mean the political arithmetic determined by the power of certain corporate interests, together with the

ideology and pseudo-ideology that their lackeys fabricate. It is more than distasteful to do so; it is practically repugnant. But that's politics. If environmentalists are serious about climate change, rather than other agendas, then we must divest ourselves of our utopian dreams and dystopian nightmares, and do the messy work of political compromise. The adage holds that a compromise is a solution that pleases nobody. If nothing else, climate management is that.

2. Killing Mother Nature

"Dark greens," those deep ecologist, ecofeminists, and others of us who view nature not as a mere resource or commodity, but as something sacred in itself, obviously must loathe the very idea of "climate management." Perhaps this is the "end of nature," as Bill McKibben prophesied: a giant air conditioner in the sky, whitening the blue sky and creating fake, technicolor sunsets. No wonder the likes of Edward Teller — Dr. Strangelove himself, the man who tried to carve new fjords in Alaska with nuclear weapons[151] — was one of geoengineering's earliest proponents.

As a wind-power-using, Prius-driving, Mother-Nature-News-contributing environmentalist myself, I resonate deeply with these concerns, on both rational and sub-rational levels. CM feels deeply wrong, and the fact that Newt Gingrich likes it makes it feel even more wrong. Blue Team veteran David Keith puts it this way:

> This is why geoengineering is so dangerous, and why we need to be careful about how we pursue this . . . It's not the end of nature — but it is the end of wildness — or at least our idea of wildness. It means consciously admitting that we're living on a managed planet. It may be that geoengineering can help save the Arctic. But it won't be the same Arctic we have today. It will be a museum piece, a place for the elites to go someday and remember what the real Arctic used to be like. The fact is, whether we want to admit it or not, we're living in a zoo. And we're both the animals and the zookeepers now.[152]

Climate management *should* feel wrong; in a way, it goes against the very reasons most greens are green to begin with. But there are at least two responses to this critique.

First, let's remember that we are talking here not about intellectual, idealist, or social constructions of "nature," but about actual ice caps, polar bears, estuaries, and trees. Is it really true that the "'managed"' Arctic will be so different from the present one? Will the polar bears notice? We greens need to get real. We must grant that the human race has made a mess of its home planet. The question now is, can we clean it up? Or do we continue to delude ourselves that somehow we will reform our ways, not be messy anymore, and somehow miraculously avoid the consequences of a century of profligacy? As my intervening decade spent working on questions of law and religion may perhaps evince, I do believe that attitudes and behaviors can change, and that the deepest problems of our society are spiritual (psychological, if you prefer) at root. None of that, however, changes the current molecular composition of the stratosphere, or the inevitable results it will bring to life on Earth. We dark greens need to get over ourselves.

In so doing, we can at least take solace from nature itself. As I was writing the

151. GOODELL, *supra* note 14, at 70-87.

152. *Id.* at 45.

previous paragraph, a pileated woodpecker landed on a tree outside my window. It struck me immediately that my human conceptions of "nature," which are of course social constructions,[153] just like other intellectual concepts of the world, had very little to do with the bird's wellbeing, while the fall weather certainly did. The hemlocks in my yard will, at some point, almost certainly succumb to the hemlock tip blight slowly destroying the hemlocks of the Northeast, a blight which may (of course we will never know) be traceable to changes in climate. That affects the woodpecker much more than my sense of wonder when I go hiking in the Adirondacks. If dark greens "get real," then the reality of non-human life might show us a way forward.

Second, let's remember that the so-called "nature" we enjoy already is already geoengineered beyond recognition. As Bill McKibben put it, the sound of the chainsaw is always in the woods. The tree where the woodpecker landed was not a hemlock, but a Japanese invasive that wouldn't be in my yard but for human intervention. Likewise with the global climate. As Steven Levitt and Stephen Dubner put it, "In just a few centuries, we will have burned up most of the fossil fuel that took 300 million years of biological accumulation to make. Compared with that, injecting a bit of sulfur into the sky seems pretty mild."[154] Anthropogenic climate change is, itself, a form of unintentional CM, and while two wrongs do not make a right, they can sometimes get us back to neutral.

3. One Man Cannot Make a Difference

Stan: Who are the corporations?

Hippie: The corporations run the entire world. And now they've fooled you into working for them.[155]

We are creatures of narrative. Our sacred myths, our everyday lives, and our political minds all are built upon stories; narrative is how we organize ourselves as human beings, and it has been this way, it would seem, ever since we became human, tens of thousands of years ago. Narratives are about people — good, bad, and in between — and they imbue a sense of power and moment to our lives. If only Macbeth had chosen differently; if only Moses hadn't struck the rock. These stories, even when tragic, imbue our own decisions with a sense of importance; our decisions, they say, matter. And of course, we don't like to feel powerless in the face of tragedy.

Yet this reliance on narrative misleads us today, in a world of large-scale structures, hidden villains, and political and economic forces which are not conveyed adequately in tales. If we look for "what each of us can do to solve the climate crisis," we will be looking in the wrong place for solutions. If we really believe that our individual choices, as opposed to our collective political will, make a serious difference, we are deluding ourselves.

---

153. *See* KLAUS EDER, THE SOCIAL CONSTRUCTION OF NATURE: A SOCIOLOGY OF ECOLOGICAL ENLIGHTENMENT (1996) (on the social construction of "nature"); I.G. SIMMONS, INTERPRETING NATURE: CULTURAL CONSTRUCTIONS OF THE ENVIRONMENT (1993); David Demeritt, *What Is the "Social Construction of Nature"? A Typology and Sympathetic Critique*, 26 PROG. HUM. GEOGRAPHY 767-90 (2002). *But see* Eileen Crist, *Against the Social Construction of Nature and Wildness*, 26 ENV. ETHICS, 5-24 (2004).

154. LEVITT & DUBNER, *supra* note 23, at 197.

155. *South Park: Die, Hippie, Die!* (Lionsgate Television Mar. 16, 2005).

Yes, in some sense, the causes of our climate crisis are carbon emissions. But individual emissions are ecologically insignificant compared with the emissions from utilities, and the functional difference between my Prius and my neighbor's Hummer SUV, even multiplied across society, is statistically zero. We need collective action to solve this collective problem, with the largest sources of GHG emissions addressed in a systematic, top-down way that prevents free riders and ensures that all of our individual actions actually add up to a meaningful abatement in global GHG emissions. Not only has this not occurred, but even the fitful starts toward such a policy have not even been attempted. Kyoto, Geneva, Copenhagen — at some point the international community will run out of cities in which to fail to address climate change. Europe's actions are insufficient, yet they are not even close to being met by India, China, the United States, and Brazil. Domestically, the United States has gone from bad to worse, and internationally, the prospects of a meaningful (*i.e.*, India- and China-inclusive) treaty seem dim indeed. And every time popular momentum seems to gather behind meaningful GHG reduction, Exxon or the Koch brothers pour another $20 million into spin and electioneering.[156]

The real reason for the climate crisis is not individual behavior but the lack of collective action. The problem here is that our popular legal culture still sees these problems as essentially narrative ones, and narratives have heroes and villains. Our wrong characterization of political motivation helps enable the con.

Likewise, who are the "villains" in climate change? Bashing corporations is, as the *South Park* quote suggests, something of a cliché. But the reason it is a cliché is precisely because of our inability to see clearly, and to extend moral, ethical, and religious reasoning to the post-nineteenth century capitalist world. The problem of corporations is not that they are sinister, dastardly conspiracies led by Montgomery-Burns-like villains. Nor is the problem about a CEO who cheated or a manager who cut corners. All of us who have worked in business (including this writer), know that most people who work at corporations are simply trying to do their jobs and make some money.

No, the problem isn't when corporations go wrong. The problem is when they go *right*. By law, public corporations are required to maximize profit for shareholders. Even if they give money to charity, or choose an ethical way of doing business, they are required to justify the decision by saying it will ultimately pay off, in the form of increased sales or goodwill, for example. Enshrined in law at 1 U.S.C. § 1, the word "person" when used in a statute includes corporations and other companies. Corporations can be sued, like people can be; they, not shareholders, hold responsibility for their actions; and they, too, have certain constitutional rights, including the right to contribute heavily to political campaigns. But imagine if these corporate entities really were people, what kind of people they would be. Enormously powerful, and richer than the wealthiest billionaire. Nearly omnipresent, with outposts of information gathering and product dissemination around the globe. And yet, totally, animalistically greedy, with only the single focus of maximizing profits. If corporations were people, they would be massively

156. For a succinct retelling of how two oilmen created a pseudo-populist movement, see Jane Mayer, *Covert Operations: The Billionaire Brothers Who Are Waging a War with Obama*, NEW YORKER, August 30, 2010, *available at* http://www.newyorker.com/reporting/2010/08/30/100830fa_fact_mayer.

powerful ogres, direly in need of religious or moral instruction.

The villains are not individual "black hats," although those certainly exist. The villain is the system itself. The pleasant falsehood that "each of us can make a difference" prevents us from making a difference. It miscasts the nature of the problem and of the solution. The problem, domestically, is that our Congress is being bought and our population being brainwashed, not because of evildoers or ignoramuses but because of the regular functioning of the system of incentives that enable our market economy to work. The system is the problem, and the system isn't going anywhere.

We may cherish our dreams of individuals being able to make a difference, but individuals cannot make a meaningful difference when public utilities, huge industries, and vast economic patterns matter so much more. As someone who has spent much of the last decade as an activist as well as academic, I know this is Not What We're Supposed To Say. We're supposed to empower people. A well-meaning voice in Leonardo DiCaprio's film, *The 11th Hour*, puts it well: "People need to realize there are things they can do in their everyday lives. Everybody making a change adds up to something meaningful."[157] But this sentiment, however pleasant, is demonstrably false.

I recognize that this argument, like CM itself, flies in the face of some time-honored American values. As one reporter said, "Geoengineering, in some ways, runs counter to a deeper American philosophy — it's not about self-betterment through individual action, it's about big-picture thinking."[158] But GHG concentrations in the atmosphere are numerical values, not ideological ones, and the facts are the facts.

Indeed, the only place where individual action might well make a difference is if that action is focused on political communication, rather than ever-more-puritanical curbs on one's own wasteful behavior. No amount of bike riding will stop climate change so long as James Inhofe can affect policy in Washington. The myth that climate change is somehow a non-partisan political issue plays into the right-wing strategy of delay and debate, and its concomitant falsity that the science of climate change is somehow controversial. In the 2010 Senate debate on climate change, only a single Republican, Lindsey Graham, initially supported GHG reduction, and he abandoned the bill due to political pressure and conflicts with Democratic leadership.[159] Every other one was opposed. Once again, this is not to suggest that G.O.P. politicians are wearing black hats; rather, they are responding to the political influence of their extremely high-capacity donors in a way that is consonant with overall conservative ideologies The point is that this is a political, not personal, problem. Citizens who know their carbon footprint but not Sen. Inhofe's name are wasting their time.

Of course, it is better to have fluorescent bulbs than not to have them. But doing so confuses ethical responsibility with political efficacy. Ethically, it may well be that, as Kant insisted, each of us is required to act in a universalizable way; it is ethically wrong, in this view, to have an unreasonably positive carbon footprint. But ethics is not the same as politics. Now, if ever we have real climate change regulation, changes in personal behavior will perforce be required, and so maybe it makes sense to start training now.

157. THE 11TH HOUR (Leonardo DiCaprio 2007).

158. Rogers, *supra* note 73.

159. Lizza, *supra* note 9.

But the notion that such behavior change will make a difference absent such regulation — absent massive changes from factories, utilities, fleets of trucks, factory farms, power grids, and automobile manufacture techniques — is a fallacy which tends to diminish the importance of collective, pragmatic political action. The idealism of personal purity coupled with non- or un-pragmatic voting (remember Ralph Nader?) is a form of willful blindness that costs all of us.

The climate change narrative is an almost faceless one, in which the structures of our economy and politics are aligned in an almost perfect array against meaningful action against GHGs. Activists may still rail about "corporate greed," but perhaps miss the true meaning of the term. Yes, the problem is *corporate* greed, the depersonalized "greed" built into corporate law itself. One wonders if it would be a breach of fiduciary duty for Exxon's executives *not* to oppose every effort at averting climate change. Surely their legal responsibility must be to ensure Exxon's long-term sustainability — not the sustainability of the planet. If these individuals wear black hats, it is because the costumes are required by law.

I am convinced that working toward meaningful emissions reduction is a fight we will lose. In an era of record oil-industry profits, newly unlimited corporate contributions to political campaigns, and the exigencies of mass media and expertise regarding spin and science, scientists concerned about climate change are at an insurmountable disadvantage to those whose legal responsibility it is to maximize profits. It would be nice if we could maintain our ideological purity, and pretend that if each of us acts ethically, the forests will not burn. But given the factual inaccuracy of that view, is it not, in fact, unethical to maintain it?

C. *Conclusion, or, How I Learned to Keep Worrying and Still Love Climate Management*

Am I still a geoengineering believer? Yes, more than ever. The last twelve years have shown that the vested interests in doing nothing about climate change are stronger than I predicted in 1998, and give rise to a deep pessimism that the United States — and a fortiori China and India — will ever make the GHG reductions necessary to avert dangerous climate change. So what are the next steps?

First, we need an immediate commitment to government subsidized research, on the basis of the October 2010 House Science & Technology Committee Report and the September, 2010 GAO Report, and the 2010 NRC report, each of which listed specific areas for further research.[160] The 2010 NRC report suggested seven research areas: the physical potential and feasibility of different SRM approaches, potential consequences of SRM on other Earth systems, methods for decision making in "climate emergencies," systems of governance, improved 'baseline' measurements of climate change, public attitudes and potential communication approaches, and an integrated research effort into the physical, ecological, technical, social, and ethical issues.[161] CM has languished as a policy without a constituency: too brown for the greens, too green (insofar as it

160. U.S. GOV'T ACCOUNTABILITY OFFICE, *supra* note 94.

161. NAT. RESEARCH COUNCIL, *supra* note 60, at 297-99.

acknowledges that climate change is real) for the browns. But we are clearly at a tipping point, with more momentum and movement in the last six months than in the six years after I wrote my first article. I argued in 1998 that the time for a geoengineering "Manhattan Project" was now. After twelve years, it seems as though "now" has finally come.

Second, we need a shift in the policy and legal discourse surrounding climate management. How we talk matters. Along with the term "geoengineering," I would like to remove the whiff of whimsy that still lingers around many popular, legal, and even scientific discussions of CM. The more this strategy is depicted as being something out of Jules Verne, the less seriously it, and climate change, will be taken. If human management of the global climate scares us, good — it should scare us. But it should not scare us into jokes.

Third, we need a shift in mindset among environmentalists, and a healthy dose of ideological humble pie. CM has long been too brown for the greens and too green for the browns. But we are clearly at a tipping point. I have suggested that CM, for all its flaws, is our best bet for climate sustainability. This does not mean, however, that every environmentalist must support it. On the contrary, environmentalists can think tactically about the breadth of policy options presented to policymakers. Yes, CM may make the "both-and" argument somewhat harder to make. But we have not exactly succeeded with "either/or," have we? Just as moderates need liberals to define the parameters of public conversation, so too CM advocates need dark greens to prevent neo-cons from running away with geoengineering as a panacea. Tactically, and ultimately practically, geoengineers and dark greens are playing on the same team, even if we play different positions as we do so.

I argued in 1998 that the time for a geoengineering "Manhattan Project" was now. After twelve years, it seems as though geoengineering is, as the New America Foundation dubbed it, "a horrifying idea whose time has come."[162] As Scott Barrett said, geoengineering's "future application seems more likely than not."[163] It is a matter of simple economics: "The incentives for countries to experiment with geoengineering, especially should climate change prove abrupt or catastrophic, are very strong. It is also because the incentives for countries to reduce their emissions are weaker."[164] In this light, it is as irresponsible to postpone serious research into CM as it is to postpone serious research into green technologies. Hoping that we can avoid the need for CM is like hoping we can avoid the need for cars and air conditioners, envisioning some utopian future in which everyone will have the personal tastes of a "dark green" and the lack of personal property to match. Not only is this vision hopelessly unrealistic and potentially fascistic, it sacrifices to its ideal eschatological vision the very survival of the biosphere as we know it today.

I return, then, to my concluding paragraph from 1998, which I think still holds true, twelve years on:

---

162. *Future Tense Event: Geoengineering: The Horrifying Idea Whose Time Has Come?*, NEW AMERICA FOUNDATION (Sept. 27, 2010), http://www.newamerica.net/events/2010/geoengineering.

163. Barrett, *supra* note 115, at 45.

164. *Id.*

> In the end, the debate about geoengineering is largely a debate about what sorts of environmental policies to pursue in an imperfect world. It seems almost preposterous to buck the trends of holistic systems management and suggest running like the Sorcerer's Apprentice from symptom to symptom. It may also seem as though driving less or cutting fewer trees is simpler than scattering dust particles in the stratosphere. It is certainly more elegant. But when the Damocles' sword of massive biotic disruption is hanging over our heads, we should choose what works.[165]

165. *Manhattan*, *supra* note 1, at 139.