Political Effectiveness in Science and Technology

Daniel Sarewitz
Workshop on Science and Social Values
Center for Interdisciplinary Research
Bielefeld University
Bielefeld, German
April 16, 2007

Thank you for invitation.

I'd like to begin by asking you to imagine yourself living three hundred years ago. At that time, which of the following predictions might seem plausible?

- That all people would learn how to read with fluency.
- That the world would be inhabited by six billion people, and that enough food would be produced to feed all of them.
- That floods and hurricanes would be predictable days in advance.
- That 95% of all children in Europe and North America would survive through their fifth year, driving life expectancy into the 70s.
- That smallpox would be wiped out in the world.

Four hundred years ago, only one of these predictions was less than crazy. Literacy expectations were high: In the mid-17th century, for example, Massachusetts colony was sufficiently confident in the feasibility of achieving widespread literacy that a law was enacted requiring that reading be taught in the home. In contrast, even a century later there were no general expectations for reducing childhood mortality, or smallpox. "A dead child is a sign no more surprising than a broken pitcher or a blasted flower," said one of Massachusetts' most famous citizens, Cotton Mather, in 1721 (quoted in Allen, 2007, p. 28). He knew this well: only two of his 15 children survived to adulthood. Yet when Mather sought to implement smallpox variolation in Boston, he was repudiated by the medical profession and his house was firebombed.

Now, of course, the situation is reversed. In the U.S., decades of efforts to improve the reading skills of our secondary school students have proved remarkably ineffective. In contrast, we have reduced childhood mortality to a tiny fraction of what it once was, and eliminated smallpox from everywhere except a few weapons laboratories.

Today I want to explore the question of why humans make considerable gains in their efforts to solve some problems, whereas even persistent and significant effort on other problems yields little advance. What are the sources of effective human action? And in exploring this question I want to say something about the political meaning of technology, and of science, and their inherent differences. And then I'll make some unabashedly normative observations about what this might mean for progressive politics.

I began with this very brief historical perspective in an effort to tutor our intuitions. In areas of human problem-solving where progress has been significant, the reasons may seem patently obvious in retrospect, but they did not necessarily seem so before-the-fact. So today it might seem ridiculous to compare, say, the teaching of reading to the prevention of childhood infectious diseases. Of course the reading problem is more difficult: the context for applying know-how is deeply complex, and includes a mélange of behavioral, political, and biochemical factors, such as the conditions in the home, in the school, and in the student's brain. Childhood diseases, in contrast, are contextually simple, their prevention depending only on a simple intervention in the human immune system. But this obviousness was once obscure—who knew what an immune system was in 1700?—and even just a century ago the prospect of reducing childhood mortality to a few percent would have seemed a utopian delusion, especially in contrast to our ability to achieve widespread literacy.

The political perspective is not dissimilar: The best methods for protecting children from measles and other childhood infectious diseases are pretty generally accepted, whereas the benefits of competing teaching techniques are often bitterly contested. But when someone hurled a firebomb into Cotton Mather's house in 1721, the problem of smallpox prevention was every bit as politically laden as the vitriolic debates that go on today in the U.S. over the proper way to teach reading.

So I want to begin by claiming that the sources of the human ability to make progress on solving particular problems are non-obvious. In particularly, I'm going to argue that when we do end up making progress on a seemingly difficult problem, the progress is typically not easily explained by the level of resources or effort that we throw at the problem. Rather, significant progress depends on the existence of a core element of know-how—of the ability to reliably achieve a desired consequence—that acts as a fulcrum for, and a magnifier of, effective action. This core element of know-how embodies several attributes:

- Condensed cause-and-effect linkages
- Observable and thus demonstrable cause-and-effect linkages
- Context-independence
- Reliability
- Transferability
- Subject to incremental improvement

I'm further going to make the argument that in cases where significant progress on solving a problem occurs, political convergence around a solution typically is a consequence of that progress, not a cause of it. This is important because it says that "political will" to solve a problem is catalyzed by know-how relevant to solving the problem, not vice versa. And if this is sometimes, or often, the case, then it perhaps can tell us something about the types of problems that are most amenable to making progress on, and equally important it might help us see when our efforts are misplaced, misdirected, or likely to be frustrated.

My interest in this set of issues and questions arose in part from years of great frustration about the problem of climate change. Now I understand that here in Europe, and among political progressives in the U.S., the major obstacle to making progress on climate change is seen as the

political intransigence of the U.S. But I think this is incorrect—tragically and profoundly incorrect. It is of course true that the U.S. has been intransigent, but it is equally true that Europe has made no significant progress in dealing with the climate problem, and I believe this reflects confusion about where, and how, we ought to expect progress to occur.

Now the mental model surrounding the formal approach to climate change—represented by the UN Framework Convention on Climate Change and the Kyoto protocol—treats scientific research as the engine of necessary political change. First, we develop a comprehensive understanding of the fundamental behavior of the coupled ocean-atmosphere system, including the impacts of human activity on that system, and prediction of future evolution of the system, as reported every several years by the Intergovernmental Panel on Climate Change. This knowledge then compels action, because it proves that there is a problem, and demonstrates the need for action. This mental model has motivated the expenditure of enormous sums on climate science research, and on setting up an international governance regime aimed at mobilizing the nations of the world to cooperate in reducing emissions of gases that contribute to greenhouse warming.

Keep in mind that action is to be motivated by prediction of the bad things that will happen in the future as a result of our actions today—bad things like more floods and bigger hurricanes, longer droughts, stressed ecosystems and agricultural systems, and resurgent infectious diseases—amplification, that is, of major problems that we already face, and that we have confronted with highly variable attention and success absent the motivating fear of climate change. So the chain of logic here is that science will motivate nations to cooperatively establish policies that will force them to reduce their emissions by changing their behavior and incentivize them to invest in more efficient technologies. The result of these actions will be a reduction of the future magnification of bad things, a reduction that cannot, for a variety of reasons, begin for at least fifty years.

Let me probe this logic. Problems like natural disasters, biodiversity loss, declining availability of clean water, and infectious diseases are already very serious challenges to human well-being, challenges that have been growing worse by the decade, for reasons mostly of human development patterns such as urban and coastal population growth. Climate change will make many of the problems even worse, however. Scientific research on climate will motivate people and nations to take actions aimed at slowing this “even worse” part of the problem, reducing its effects some time in the distant future. In other words, climate science will make more compelling the reasons for addressing a range of climate-related issues that already greatly challenge society, and which we have yet to address effectively. Yet, to be clear, when thinking about such challenges as natural disasters, biodiversity loss, or infectious diseases, the approaches to reducing vulnerability depend little, if at all, on scientific knowledge about climate change. Apparently, then, climate change knowledge points to the need to reduce emissions of greenhouse gases so that these problems won’t become even worse in the future, but it does not seem to advance action through other means.

So climate change discussions implicate, and confuse, two very different types of problems. The first is the problem of societal vulnerability to a variety of multi-causal but climate-related challenges—floods, droughts, and the like. The second is the problem of reducing the

greenhouse gas emissions that will make these challenges even worse. Now these problems are distinct in two key dimensions. First, as a temporal matter, the inertia in both the global energy system and in the behavior of greenhouse gases in the atmosphere means that reduction of the magnifying effect of global warming on already existing problems cannot occur for many decades. Second, as matter of effective action in the world, reducing greenhouse gases is a much more tractable problem than reducing social vulnerability to climate impacts.

Here's what's happening: The moral challenge of reducing social vulnerability to climate impacts is being exported to motivate action on the largely technical challenge of reducing carbon emissions, action supported by the scientific evidence for anthropogenic climate change. Despite the fact that solving the technical challenge will not resolve the moral one.

Why is this a problem? Isn't it all for a good cause? Indeed, some may be offended by my characterizing emissions reductions as a technical challenge, rather than a moral imperative. But now I can get back to the mainstream of my talk. I am interested in effective action. Let's compare these two problems of carbon emissions and climate impacts. I'll use natural disasters as a proxy for climate impacts.

While carbon dioxide emissions have been rising progressively since the industrial revolution, these increases have also been accompanied by a progressive decarbonization of primary energy sources, and by a progressive decarbonization of economic activities in industrialized countries. To be sure, because overall energy use and economic activity continue to rise, emissions continue to rise as well—but the history of energy technology tells us that we can continue to decarbonize the energy system, and the more recent history of technological innovation tells us that we can significantly increase the rate of decarbonization through an appropriate portfolio of investments and regulations. This is the type of problem that technologically sophisticated countries have learned how to solve. In the case of decarbonization, however, we have barely tried (though the widespread adoption of nuclear power by France perhaps puts them farther along the path). For example, G-7 nations have been *disinvesting* in energy research and development for the past 25 years or so, perhaps by as much as 65 percent—a trend that is only now beginning to reverse itself.

But the learning curves and the historical trends are in the right direction. The challenge here is to accelerate the process. And what I will argue soon is that the best way to do this is not through moral arguments, bolstered by science and intended to overcome competing interests and get people to modify their lifestyles in particular ways so that they use less energy, which would at best have a small effect on emissions, but through the potential of technological innovation to satisfy multiple, competing interests *without* demanding significant behavioral change.

The climate impacts problem is inherently different. Unlike carbon emissions, the underlying trends are mostly in the wrong direction. In the case of disasters, both the numbers and the costs continue to increase, not because of global warming but because of demographics and socioeconomics. In particular, more people are moving to coasts, more poor people are moving to cities (which are often on coasts), and more development is occurring in environmentally unsustainable ways. Disasters disproportionately harm poor people in poor countries because

those countries typically have densely populated coastal regions, shoddily constructed buildings, sparse infrastructure, and inadequate public health capabilities. Poor land use leads to widespread environmental degradation, such as deforestation and wetlands destruction, which in turn exacerbates flooding and landslides. Emergency preparation and response capabilities are often inadequate, and hazard insurance is usually unavailable, further slowing recovery, which in turn fuels vulnerability to future disasters.

In 1998, 5000 people died in Nicaragua in a matter of a few minutes from a mudflow triggered by Hurricane Mitch. Hurricanes are relatively common in Central America, but the problem was that the people were living on a deforested, and thus unstable mountain slope. When the slope became saturated with water, it collapsed into a wave of mud.

The devastation of New Orleans by Hurricane Katrina in 2005 tells a similar tale. The progressive development of the city and the environmental destruction of the surrounding wetlands rendered it increasingly vulnerable to hurricanes, while the levees that were designed to protect the city under precisely the circumstances that Katrina presented were poorly designed and maintained. While there was enough suffering and loss to ensure that most everyone living around New Orleans got a good dose, it was the poor, the disenfranchised, the infirm, and the historically discriminated-against who suffered most and were disproportionately left behind to fend for themselves. Indeed, New Orleans, with its stark juxtaposition of the affluent and the poor, provided a synoptic portrayal of the global challenge.

Now I want to emphasize two attributes of the climate impact challenge. First, the level of scientific understanding surrounding the causes and impacts of natural disasters can be very high. For example, scientists have known—and warned for years—that the location of New Orleans on a rapidly subsiding river delta in the heart of the hurricane belt made some version of Katrina entirely inevitable. Similarly, the conditions leading to the Nicaraguan mudflow had been well-modeled and accurately predicted.

Second, the natural disaster problem, and climate impacts more generally, cannot be linked to a coherent technological solution path. Many well-tested policies are available to help reduce vulnerability to natural disasters. These range from building codes that can keep structures from collapsing in a storm, to land use regulations that limit construction in flood-prone areas, to environmental laws that preserve natural features, such as wetlands and forested slopes, that act as buffers against disasters. Yet all such policies are complex to adopt and implement, typically pitting vested interests against one another and demanding reasonably functional enforcement at local levels. They are, that is, politically difficult to implement. The clearest path to reduced climate vulnerability is increased and better-distributed wealth, and in this sense the problem is simply a subset of the larger problem of addressing global poverty.

So climate change is two problems that are profoundly different in their essences. The first is the largely technological problem of reducing greenhouse gas emissions; the second is a much more difficult problem of social infrastructure and wealth creation necessary to protect people against climate impacts. And our inability, our unwillingness, to think clearly about the different essences of these two problems is, in my view, one of the reasons that we have made so little progress in addressing either of them over the past twenty years or so.

Now I want to say something further about why we should expect problems that can be solved technologically to show more progress than those that must be solved through political and policy processes. The story I want to mention tells how the nations of the world came to an agreement in the late 1980s—the Montreal Protocol—to phase out the production of chlorofluorocarbons—a technologically and economically important refrigerant and solvent that also happens to destroy the stratospheric ozone layer that protects Earth from harmful ultraviolet radiation.

The popular narrative goes something like this: The CFC-ozone problem was solved when the science proved that CFCs had caused the Antarctic ozone hole, and the world, faced with definitive knowledge of a clear, shared risk, took effective action. This is a story of science forcing right behavior, a story that provided the model upon which the response to climate change was based. But the story is bizarrely incomplete. It ignores the question of what "effective action" actually means, and how it is to be taken. Did the many nations that agreed to phase out CFC production decide to live without the benefits of keeping refrigerators cold, or keeping semiconductors clean? Of course not. The missing element here is the technological.

Neither the politics nor the science surrounding the ozone debate was settled until DuPont found a CFC substitute, hydrochlorofluorocarbons, that was shown to be less destructive of ozone. The availability of an alternative to CFCs made it possible at once to meet the goals of three distinct constituencies: those whose primary interest was to protect the ozone layer, those whose primary interest was to make money producing chemicals, and those, especially in the developing world, who were unable to give up on the benefits that CFCs alone could provide in an economically viable way. This story is perhaps less satisfying than the tale of science convincing people to make sacrifices for the good of the planet and humanity, to do the right thing regardless of worldly consequences, but it has the virtue of actually explaining, in a way that does not do damage to history, how effective action was able to come about.

So now I'm beginning to home in on a way to think about the politics of technology—or, more generally, of effectiveness—that is, perhaps, rather different from the way this issue is typically framed by those of us who study technology and society.

We're all comfortable with the idea that science is always connected to action via the values and interests of those who want to act in a particular way. When a scientific fact—say, that the earth's atmosphere is warming—becomes associated with a political agenda that supports a particular type of action—say mandated emissions reductions—the science shoulders the values and interests of those who are pushing that agenda. Science becomes a tool of political persuasion, a lens for focusing many values and interests on a single type of action. This difficult task is further compounded because as science approaches the cutting-edge, it tends to raise as many questions as it resolves, so there is always room for debate about what the science is actually saying. And even if scientists could confidently predict the societal consequences of global warming (which they can't), such knowledge would not dictate any particular path of action. So the current media hemorrhaging about the scientific "consensus" over global warming, triggered by the release of the latest IPCC assessment, will lose its glow as soon as the talk begins to get serious about what needs to be done.

Technology is different. Technology is itself the embodiment of reliable action. Technologies are cause-and-effect machines. And in this capacity, what's especially powerful about technologies is that often they can serve a variety of preferences simultaneously. A commuter who wants to reduce spending on gasoline, an environmental group that wants to reduce greenhouse gas emissions, and an automobile manufacturer that wants to develop new, profitable product lines all find their interests converging in, say, the development of hybrid vehicles. This is a trivially obvious example but it says something about the relationships between technology and politics that is absent from the relation of science and politics. People holding diverse and even strongly divergent values and interests may converge around a particular technology that can advance multiple interests. Technology, that is, can overcome political conflict not by compelling diverse interests and values to converge—the job often assigned to science—but by allowing them to co-exist in a shared sense of practical benefits. This does not mean that some people or groups may not reasonably oppose the use of a technology—but in so doing they choose not to share in the technology's ability to reliably achieve a certain outcome. They choose to marginalize themselves from the effectiveness of the technology.

Now in a sophisticated audience like this I need to make several things clear about the limits of my argument. First, when I use the term "technology" I mostly mean to refer to physical artifacts that embody some particular, predictable action, but I also want to include well-specified routines or protocols in this definition. Second, in speaking of what technologies *do*, I am focusing on the stripped-down action essence of the technology—the core of reliability—not whatever complexities may occur as a result of secondary and perhaps unanticipated interactions and consequences. Third, I'm not making a normative claim here—not yet, at least. I'm trying to be descriptive. Finally, I am not making a general argument about what *all* technology does, but a general argument about what *some* technologies can do. And I will not get too far into the question of why some technologies show this behavior and others do not, because I haven't figured that out yet.

Returning to the stratospheric ozone depletion story, we can schematically imagine an array of different constituencies involved in the negotiation of an international agreement to deal with the problem. Each of these constituencies can be characterized by some combination of values, interests, incentives, and ways of thinking about how the world works, which I'll call "ways of knowing." So, for example, international environmental NGO's, chemical companies, and the governments of developing countries, while of course not monolithic categories, nevertheless can be expected to embody rather distinctive assemblages of these sorts of attributes, especially when they are engaging one another in a debate over the interpretation of complex science and the regulation of an important chemical.

As I've said, the standard story is that the science drives a convergence of values, interests, and ways of knowing, as everyone comes to recognize the shared risk of ozone depletion and recognizes the right thing to do. But what really happened is that a new technology—HCFCs—offered to resolve the local source of conflict among the various key contending constituencies without demanding major change in their defining attributes.

And we're beginning to see exactly this type of phenomenon on the emissions end of climate change with ethanol. As described in a recent Economist article: "Farmers love [ethanol] because it provides a new source of subsidy. Hawks love it because it offers the possibility that America may wean itself off Middle Eastern oil. The automobile industry loves it, because it reckons that switching to a green fuel will take the global-warming heat off cars. The oil industry loves it because the use of ethanol as a fuel additive means it is business as usual, at least for the time being. Politicians love it because by subsidizing it they can please all those constituencies."[1] Ethanol is unsatisfactory in many ways, but the aggregation of disparate interests around specific technologies is something we'll continue to see in the emissions reduction arena, driving the incremental, and in some cases discontinuous, advance of decarbonizing technologies.

Now I want to say something about the difference between successful technologies and successful policies. In his classic 1959 paper "The Science of 'Muddling Through,'" Charles Lindblom explained how public policies come about in a highly contested and uncertain political environment where neither cause-effect chains nor objectives can be agreed upon. In such cases, he observed, "the test [of good policy] is agreement on policy itself, which remains possible even when agreement on values is not" (p.83). Lindblom goes on to say: "Agreement on policy [is] the only practicable test of the policy's correctness" (p. 84). The outcomes of a policy cannot be the proper judge of how good the policy is, because the system is usually too complex to specify how the policy is connected to the outcomes. Thus, the ability of the policy itself to organize competing political perspectives is the measure of how good the policy is.

A technology offers something a policy cannot: a reliable cause-effect chain that delivers a particular local outcome with great consistency. And even if different groups are drawn to this technology for different reasons, to advance different worldviews, it is this consistency of *outcome* that brings them together.

So climate change is actually two fundamentally different types of problems: one that is going to be amenable to resolution through technological intervention and continued innovation, should we choose to invest and regulate appropriately, and one that is going to be much more challenging, and will have to be confronted much more indirectly, much more in a "muddling through" mode, where progress is halting and likely to be considerably less satisfactory than we would like. One thing I find particularly troubling about the hijacking of the more difficult problem to motivate the resolution of the easier problem is that when we are on a much better path to decarbonizing the energy system, we will not be on a much better path to protecting vulnerable regions and people from climate impacts. Indeed, the inevitable increases in disaster losses and other negative impacts of climate in the coming decades will continue to be mobilized as a reason to continue to decarbonize, rather than as a reason to redress the social, economic, and environmental inequities that are at the root of climate vulnerability.

But another thing I find troubling is that by using the moral language of vulnerability to drive emissions reductions, rather than by framing it as a largely technical challenge, we have not moved nearly as decisively as we might toward emissions reductions because the focus has been

[1] "Castro was right," *Economist*, April 7-13, 2007, pp. 13-14.

on achieving conformity of worldview and behavior, rather than on accepting pluralism and understanding technology's capacity to harness such diversity through the reliability of technological outcomes.

Let me seek to generalize here by going back to the two unrelated problems I began with: immunizing children against diseases, and teaching children to read. These display much the same attributes as emissions reductions and vulnerability reductions, only they are not usually linked politically or ethically (although they could be.)

The first thing to recognize is that the diverse group of actors, interests, and ways of knowing that have converged around childhood immunization is every bit as complexly pluralistic as the group that continues to battle, in the U.S. at least, over competing approaches to teaching reading. Both cases are also characterized by a very well-defined goal, and a shared desirability of achieving that goal—preventing childhood disease; creating children who are sufficiently literate to succeed in today's society. Progress toward those goals is easily measured, so the success or failure of alternative actions aimed at achieving the goal can be fairly clearly assessed.

The ability to make progress on one but not the other manifests in a number of ways, not all of which may be obvious. First, disputes over cause-effect relations are much more rampant for reading than for vaccines. Second, and as a result of this, scientific research is prescribed and carried out on teaching reading, with the aim of resolving the controversies about what ought to be done for the reading problem. This is important, because scientific research in areas of ongoing value dispute related to complex system behavior tends to make those disputes worse, not better. This is one domain where the distinction between technology and science—so often over-asserted and over-reified—is actually profoundly important. The reliable essence of a technology (or effective routine) stands in stark contrast to the question-generating essence of scientific research on controversial problems. The reliability on the vaccine side also means that the diverse interests are arrayed around the technology in a complex and effective network that overcomes both political dispute and conflict about the technology to ensure its widespread delivery. The contested nature of competing approaches to reading means that the diverse interests remain in conflict, each making claims based on certain facts and experiences, to counter opposing claims supported in similar ways.

And even when the science is clear, if a reliable technological core of action is not available, the science does not necessarily provide a key to reliable practice. As Katrina and Mitch showed, even when the science is unequivocal from a descriptive or even predictive standpoint, if it cannot be applied to a reliable solution, its ability to drive convergence by diverse interests on appropriate measures to take is limited. Nor do neuroscientific insights into what the brain does during reading yet have much application to the realm of practice—though adherents of one pedagogical approach or another cite such research to support their preferences.

A related difference is that context strongly affects outcomes in the reading case, and is almost irrelevant in the vaccine case. In some sense this just restates, but from the opposite direction, the absence of a reliable core of action in the reading case. But another way to think about it is that the context-dependence of the process of teaching reading creates all sorts of constituencies that consider themselves experts because they have developed tacit knowledge, judgment, and

methods that may have proven effective for them, but which are not easily generalizable. They will seek to make the case that their proven approach works best, and are unlikely to be open to other proven approaches.

Now I want to insert emissions reductions back into the equation, because it seems to me to lie between vaccines on the one side and reading on the other, at least right now. It could well move more toward vaccines; I doubt it will move more toward reading, given historical and technological trends. Nevertheless, solving the emissions problem is a long-term challenge demanding appropriate public and private investments, sound policies, and effective politics. This transition will be driven by the decarbonizing capacity of individual technologies adopted in different ways and in different contexts—not by the effort to manage the global energy system for reduced emissions. A particular decarbonizing energy technology—say, biofuels or solar cells—are to the energy system as a particular vaccine is to the health system. Both systems may be unmanageably complex in terms of the ability to craft system-governing policies to achieve stipulated, outcomes, yet individual technologies may nevertheless contribute effectively to particular high-level goals.

Is my whole argument here just an apology for the technological fix? Well, yes and no. Let me put it slightly differently: it would be a good thing if we could recognize difficult problems that were amenable to technological fixes, and distinguish them from difficult problems that are not so amenable. This would help us recognize where we can expect to see fairly rapid progress toward desired goals, and where such progress is likely to be much more difficult to achieve. It would also help us understand where focusing on technological solutions to a problem is unlikely to help, and might even hurt. There would still be room for Neo-Luddism.

It also clarifies the meaning of expertise. Because where problems have the attributes of the reading challenge, the claims by experts that they know best about how to solve the problem should be recognized as inherently political. This is especially the case when the prescriptions offered are at the systems level—if we would just pay teachers more; if we could just go to all-year schooling; if we taught only phonics. Cause-effect chains are poorly enough specified at the system level that any scientifically based prescription is in fact policy entrepreneurship. In such domains, science is to be less trusted than technology.

I am not making a case for focusing investments and efforts on technological fixes at the expense of more difficult problems. In the case of adaptation to climate change, for example, we are hugely underinvested in both research and on-the-ground action that could reduce vulnerability to climate. But expectations for significant progress easily assessed over time scales even on the order of a decade or more should be modest. And I want to reiterate that the political failure in our overall approach to climate change has been on both ends of the continuum: we are acting as if vulnerability to climate can be solved by reducing emissions, which is wrong, and we are acting as if reducing emissions is essentially a problem of behavioral change in response to factual information, which is also wrong. These wrongs are compounded because they make the very hard problem—reducing vulnerability—seem easier than it is, and they have made the fairly straightforward (I won't say easy) problem—reducing emissions—harder than it needs to be.

My own reflections on these questions, and the discomfort that they have created for me, can be captured by what one might call the Progressive's Dilemma. If we perceive that a problem is caused by moral or ethical failure, then we want to solve that problem by correcting the failure, which means through behavioral change motivated by a clear understanding of both the moral and the factual elements of the problem. Solving a problem by addressing the underlying social causes seems both normatively and rationally more satisfactory than solving it by introducing a technology that gets us off the hook for our sins. Of course, such a position is a commitment to both moral and scientific absolutism, with all the irony that such a joint commitment entails. More practically, it is also a commitment to long, hard political work whose outcome may never be very satisfactory.

Technological fixes do not offer a route to moral or political redemption. So, for example, we might imagine a technology that can suck carbon dioxide out of the air and pump it into the ground or combine it with, say, Calcium, to turn it into inert rock. Such technologies are theoretically and probably even technically feasible; they may even someday become economically viable for scaling up to allow for direct management of atmospheric chemistry. This robs us of an opportunity to struggle against the aspects of fossil fuel consumption that we might find obnoxious, but if we find ourselves regretting that opportunity than it tells us that our concern about global warming is not simply one of its projected impacts, but of its cultural causes.

I am told, by someone who understands the state of research on machine-neural interfaces, that scientists are perhaps 20 years from being able to directly intervene in the brain to enhance various higher-level cognitive capacities, for example, the capacity to read with facility. Whether or not this is the case, it provides a thought experiment for moving the teaching of reading from the realm of the political and scientific to the realm of the technological and efficacious. Were we to achieve the capacity to download reading ability into any brain, we might regret the lost opportunity that lack of progress in teaching gives us to fight for better salaries for teachers, better home environments for children, or greater equity in wealth distribution. But of course we haven't been making much progress in those battles in the U.S. in any case, and it's doubtful that having a technological fix for teaching children to read would do much damage to those good causes—it might even advance them.

But one thing is clear, and this is where I will move toward my ending. Should such technological fixes appear, constituencies holding diverse interests, values, and ways of knowing would surely aggregate around them, because they would recognize a potent tool for acting in the world. Groups that chose to not take advantage of the reliable effectiveness of the technology—because it offended their values, or contradicted their ways of knowing—would be marginalized and disempowered. This might be perfectly acceptable as a general principle to some groups—consider, for example, the Amish, or other tightly knit, technology-avoiding groups in the U.S.—by dint of the strength of their value systems and coherence of their communities. But as a general matter, taking a principled stance against the use of an effective technology to resolve something widely acknowledged to be a problem is an inherently disempowering action. You are ceding effectiveness to others, whose interests and ways of knowing are now bound up in the use of that technology.

There are plenty of reasons to distrust claims that certain technologies will solve complex problems that have resisted solution in the past. There are probably thousands of software packages that promise to revolutionize the teaching of reading skills, but they have failed to do so, and will continue to fail, because they cannot tame the contextual complexity of the education process. But technological capabilities can also impose a simplifying order on problems that are complex in the absence of such capabilities. For the past forty years or so, progressive politics has been generally suspicious of technological fixes, perhaps as a reflection of the experience of the nuclear arms race, the growing appreciation of the damage we have done to our environment and the many conspicuous failures of international development aid. But I want to end with a suggestion that some notion of pragmatic technological progressivism needs to be resurrected as a part of any hopeful agenda for enhancing justice, equality, freedom, and even mutual understanding in the world.

I've pointed to four reasons why such a resurrection ought to be encouraged. First, the core reliability embodied in technologies is sometimes ideally suited for making progress on problems that are intractable when approached as political, behavioral, or moral problems. Second, in a world of finite attention and resources, we need to be smart in the way we choose to approach problems. We have not been particularly smart in the political approach to climate change. Third, effective technologies can act as political attractors, bringing together diverse and even conflicting constituencies who recognize a common interest in the outcomes that can be reliably achieved. Technology, that is, may be mobilized as a powerful tool for conflict resolution, for example if applied to disputes over limited natural resources. Finally—and flowing from the previous reasons—a decision to abjure a technology is a decision to abdicate the effectiveness and therefore the power to achieve one's aims that the technology confers. This seems to me like a very poor principle upon which to exercise political action.

Obviously the key is to discriminate: between problems that are amenable to technological fixes and those that are not; between technologies that are well-matched to the essence of a problem and those that are not; between claims of effectiveness that are well-supported and those that are not. Humans are an innovating species. The greatest source of reliable action in human affairs is not our institutions, cultures, or norms, but our inventions. Any approach to solving the many vexing challenges that face the world today needs to include this fundamental, if uncomfortable, reality of the human condition.

Acknowledgements: This talk strongly draws upon ongoing collaborations with Richard Nelson, Helen Ingram, and Anne Schneider, none of whom bear any responsibility for (or even awareness of) the abuses herein.