Climate Policy: Hard Problem, Soft Thinking

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Abstract

Climate change is more uncertain, more global, and more long-term than most issues facing humanity. This trifecta makes a policy response that encompasses scientific correctness, public awareness, economic efficiency, and governmental effectiveness particularly difficult. Economic and psychological instincts impede rational thought. Elected officials, who cater to and foster voters' misguided beliefs, compound the soft thinking that results.

Beliefs must change before unequivocal symptoms appear and humanity experiences the climate-change equivalent of a life-altering heart attack. Sadly, it may well take dramatic loss to jolt the collective conscience toward serious action.

In the long run, the only solution is a bottom-up demand leading to policies that appropriately price carbon and technological innovation, and that promote ethical shifts toward a world in which low-carbon, high-efficiency living is the norm. In the short term, however, popular will is unlikely to drive serious action on the issue.

Policy makers can and must try to overcome inherent psychological barriers and create pockets of certainty that link benefits of climate policy to local, immediate payoffs. It will take high-level scientific and political leadership to redirect currently misguided market forces toward a positive outcome.

Keywords

Climate change, global warming, climate instability; uncertainty, risk, fat tails, behavioral decision, single-action bias, cognitive dissonance, cognitive dismissal, probability neglect, prospect theory, loss aversion; public opinion; geoengineering, portfolio approach.

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1. Introduction

The complexities of climate science are compounded by the difficulties individuals and policymakers have in comprehending and responding to its uncertain, global, and long-term nature.

The basic science is clear, and has been for decades. Putting heat-trapping gases into the atmosphere traps heat. Higher temperatures cause more extreme climatic events. Humans are mostly to blame. But large uncertainties persist around the timing and impact. These uncertainties, many about threshold effects, and our human difficulties in thinking about either, challenge the formulation of an appropriate policy response.

The strong international dimension of the problem, among highly asymmetric parties, makes effective policy difficult. With five percent of the world's population, the United States is emitting twenty percent of global emissions now, and has emitted thirty percent of total greenhouse gases to date. Conversely, the United States accounts for twenty-five percent of global economic output, and, thus, emits less per unit of output than the world. Such a constellation of factors creates complicated moral and political debates.

Long time scales also play a key role. They introduce economic, moral, and ultimately political issues regarding the weighing of preferences across generations. Moreover, we will know too late where lies the edge of the precipice. Warning signs may be all around us, but, to non-scientists, they are subtle and inconclusive. The fundamental problem is one of translating science into accurate and informed public beliefs, and into appropriate policies.

Science can point to trends, identify thresholds, and establish strong links between climate change and human activities. But science appropriately speaks in probabilistic and often predictive terms. By contrast, political systems think and act in up-or-down votes: aye or nay, with no middle ground or uncertain consequences, and often with the belief that the pressing of a lever will solve a problem.

U.S. elected officials may actually lag behind public opinion. One careful poll reveals that 74 percent of American adults believe average global temperatures have increased over the past century, 75 percent of American adults say human behavior is substantially responsible for any warming that has occurred, and 86 percent overall say they want limits on how much air pollution businesses are allowed to emit (Krosnick 2010). However, politicians also respond to financial interests. Big Energy greatly outspends environmental groups, to the tune of 10:1 in the Congressional fights over a comprehensive climate bill in 2009 and 2010. Of course, seeking regulatory certainty, many energy companies also favored a bill.

Still, public opinion matters greatly, and it is highly malleable. This is where human psychology and behavioral sciences enter. For example, the "availability heuristic," first identified by Kahneman and Tversky (1972), refers to people predicting the overall

frequency of an event based on how readily they can bring an instance to mind. Events that are salient, recent, and proximate are assigned increased importance.

In the end, the outline of the necessary policy response is clear. Climate change is "the greatest example of market failure we have ever seen" (Stern 2007). The fundamental solution is simple. At least since Arthur Pigou's seminal work on *Wealth and Welfare* (1912), economists have known what to do: correct the market failure by internalizing the externalities, here by increasing the price of greenhouse gas pollution.

We also face an undercompensated mispriced positive externality, leading to not enough of a good thing. Companies and individuals undertake too little crucial research, development, and deployment of cleaner technologies because the information gained leaks to others. Pricing carbon appropriately would motivate substantial amounts of additional research, but would not capture this positive externality. That ought to be addressed via direct subsidies.[2] Both carbon pricing and subsidies are necessary, yet neither is sufficient by itself.

An important psychological problem with the focus on new technologies is that this imparts the wrong mental model for energy. When we think new technology, we think iPhones. Energy does not work this way, and consumers are not lining up to buy new, cleaner electrons at a premium. Cleaner energy technology will have to be cheaper than fossil energy to make any significant inroads.

People get stymied when they try to connect the dots between climate science and a policy response that even remotely approaches a global, first-best outcome. Awareness of the psychological barriers to clear thinking is not new. Munger (2005) provides a comprehensive list impeding financial decisions in "The Psychology of Human Misjudgment." *Climatic Change* published a special issue following a workshop on "Global Warming: The Psychology of Long Term Risk" (Oppenheimer and Todorov, 2006).[3] Allcott and Mullainathan (2010) list behavioral obstacles to sensible energy policy. Raihani and Aitken (2011) add a focus on the implications on collective decisions and the factors affecting the potential for cooperation in the provision of the critical public good (climate quality). Columbia's Center for Research on Environmental Decisions provides an excellent guide for scientists and others on how to communicate environmental policy better in light of the psychological obstacles (CRED 2009).

This paper aims to provide a compact yet comprehensive view of the way behavioral propensities affect our response to climate risks. We start by reviewing the difficulty of linking scientists' understanding to the public's perception. We then address additional obstacles to formulating an appropriate policy response. Along the way, we will raise many questions and provide some tentative answers.

Our major theme is clear: The nature of this problem leads predictably to some exceedingly poor thinking due to the challenge of comprehending situations that are

[2] See Adam Jaffe, Richard Newell and Robert Stavins (2005) and Daron Acemoglu, Philippe Aghion, Leonardo Bursztyn, and David Hemous (2010).
[3] See especially Elke Weber (2006).

highly uncertain, controversial, global, and time-delayed in scope. Strategic posturing by participants in the debate magnifies this challenge. We discuss ways in which useful policy can prevail.

2. Public (mis)perception of climate instability

Most of our analysis seeks to explain why the public and its leaders have such a difficult time recognizing the reality of the global warming problem. This lack persists despite widespread, indeed near universal, and profound concern in the expert community.

2.1 Expert attention to geoengineering

For a wake-up call on the urgency of the climate problem, consider the metaphors used by some of the world's most respected climate scientists as they talk about geoengineering. Emergency medicine analogies abound. Geoengineering is akin to "epinephrine" combating an acute allergic reaction, "planetary chemotherapy" or, perhaps most fitting, a "planetary tracheotomy." There would be plenty of potentially severe side effects and lots of unknowns, but it might well be what we would have to do, if we do not start serious mitigation efforts soon—and possibly even if we do.

The larger the probability of a climatic equivalent of a heart attack becomes, the more seriously we will have to prepare for the dangerous option of geoengineering. This much is clear to most climate scientists, however reluctant they are to talk about it. Yet, while scientists talk about emergency measures for a planet in peril, the public often seems disengaged at best and openly dismissive of serious climate policy at worst.

Geoengineering is important and controversial enough to merit a brief detour. It raises many questions, from fundamental ethical considerations to important geopolitical ones. We will not delve further into the ethics, except to say that we humans have clearly altered the atmosphere's basic chemistry already, quite possibly with devastating effects. That alone does not provide ethical justification for geoengineering. But it shows that there is a fine line between the "intentional large-scale manipulation of the earth's atmosphere"—an often-used definition of geoengineering—and the unintentional manipulation that has been our long-term practice.

A second consideration links to moral hazard, the observation that insured parties take excess risks.[4] Considering geoengineering as an option may tempt us to do less mitigation. That temptation must be resisted since geoengineering would neither address the root cause nor deal with all the problems. Stratospheric aerosols, for example, might help lower global temperatures, but they would not address ocean acidification.

[4] "Moral hazard" is technically a misnomer. It is not truly a moral hazard in the economic insurance sense, but rather a problem of transferring risk onto future generations.

By contrast, the cognitive shock linked to talk of geoengineering could lead to the opposite result. If the measures being considered by serious climate scientists resemble hard-to-imagine forces encountered in science fiction, as many are, then the climate problem must indeed be serious. Yet, that inference has yet to be drawn by the public.

In short, the public is not nearly as concerned about a warming and increasingly unstable climate as are the overwhelming majority of climate scientists. Such a disparity is not unusual. Scientists and the public have long differed in their assessments of risks. What is unusual, and disturbing, is that this risk is perceived to be so severe by scientists.[5]

Several reasons help explain the disparity. First we look briefly at some inherently hard problems before moving to psychology.

2.2 Wrong conceptions

A key difficulty is grappling with the difference between stocks and flows. Concentrations of greenhouse gas pollution determine temperatures. People of all stripes, though, have enormous difficulty drawing a distinction between this kind of stock problem, and the flow problems of regulating the spigot (Sterman 2008). We tend to think that if we only get around to turning off the spigot, the problem is over. However, the climate system is full of physical and time lags. Even if we begin to take sensible action now, climate instability will get worse for decades before it gets better.

Another inherently hard problem is grappling with threshold responses. We expect the future to look like the past. Thresholds are outside our realm of imagination. Worse, they are outside most scientific models. We assume them away. Yet other science tells us that there may be significant thresholds that, once crossed, would result in effectively irreversible changes. Moreover, many thresholds are closely interlinked, with often reinforcing feedback.

These inherently hard problems of climate policy are compounded by psychological obstacles and behavioral issues that often have no simple solution.

2.3 Single-action bias

“Action bias” is a well-established phenomenon: “individuals have a penchant for action, often for good reasons,” even in areas “where those reasons do not apply” (Patt and Zeckhauser 2000, Bar-Eli, Azar, Ritov, Keidar-Levin, and Schein 2007). People want to do something. It also turns out that they like to do one thing, assume the problem solved and then move on. That is what we label the “single-action bias.”

[5] See Zeckhauser and Viscusi (1990).

Homeowners might replace inefficient incandescent light bulbs with more efficient compact fluorescent bulbs, thinking that this single action suffices as their response to climate instability (CRED 2009). It allows folks to think of themselves as doing something good for the climate. Even a symbolic act may be sufficient.

In many situations, a portfolio approach, a mix of therapies, is required. That is when the single-action bias becomes relevant and troubling. If the treatment for a patient with Type II diabetes consists of exercise, diet, and medication, a patient driven by convenience may well opt for only taking pills.

If appropriate treatment for climate instability consists of subsidies for innovative technologies and R&D projects and pricing carbon directly or through a market for emissions allowances, policymakers driven by legislative ease may well opt for only one strand of the solution. Creating subsidies is relatively easy. Single-action bias would favor it over raising a critical price, a measure that big energy users would oppose.

2.4 Cognitive dissonance

As citizens, we get conflicting views and signals. The one that makes us most comfortable tends to prevail, a phenomenon called cognitive dissonance.[6] It is hard to reconcile our scientific understanding of climate instability with our generally rather energy-wasting lifestyles. This clearly biases us toward believing that the effects of our emissions are less harmful than commonly concluded by science.[7]

Emotion rather than reason tends to triumph in such conflicts. Leiserowitz (2004 and 2005) reports that the box-office hit *The Day After Tomorrow* had statistically significant impacts on risk perception among movie-goers relative to the general U.S. population. To influence the public, one moving picture proved worth 1,000 scientific articles.

We suspect that climate instability will only be taken seriously after some dramatic event. The Three Mile Island nuclear accident in 1979 killed no one directly, but it was highly dramatic, readily grasped, and intensively televised. A later investigation attributed less than a single cancer case to the accident (Kemeny *et al* 1979). By the time that report appeared six months later, public opinion had gelled. The accident effectively shut down the U.S. nuclear power industry. No new nuclear power plants were built for three decades. Cognitive dissonance can cut either way, to over or under-estimation of a risk.

[6] Leon Festinger (1957) wrote the seminal book on cognitive dissonance. Akerlof and Dickens (1982) provide an early economic interpretation. “Confirmation bias” is a special case of the more general phenomenon.
[7] Weinstein (1980) presents a comprehensive exploration of “unrealistic optimism.”

2.5 Cognitive dismissal

"Cognitive dismissal," our term, is a closely related psychological phenomenon. We tend to push out of our mind a problem that is too distant, too hard, or too removed from personal influence.

Curbing greenhouse gas emissions will require collective action. That is true within and across nations. Individual decision makers can do little to influence the final outcome. The simplest response to such impotence is dismissal.

The implication of cognitive dismissal at the national level is that bottom-up demand by the electorate is unlikely to lead to the kind of policy response that scientists tell us is necessary. Informed political and policy leadership will be required.

Berger, Brown, Kousky, and Zeckhauser (2010) identify three critical cognitive biases that impede probabilistic thinking on environmental problems: faulty tail thinking, probability neglect, and consequence neglect.

2.6 Faulty thinking about tails of distributions

Even people who might disagree on the seriousness of the climate problem would still be able to agree on one aspect: much of the expected loss from climate instability comes from the tail of the distribution, the kinds of low-probability, high-impact events that seem far-fetched but will dominate the final outcome.

Since low-probability events in any category are uncommon, one profitable way to learn about them is to look at them as a class. Thus, earthquake and fire losses might tell us something about flood losses, or even terrorist casualties.

The record of these disasters is clear. The distributions of losses have extremely fat tails. A salient indicator of this fact is that the largest ever loss is frequently larger, by a multiple greater than 2, than the second largest loss:

	Second Largest	Largest
Wildfires, 1988-99	Nevada (1999)	Yellowstone (1988)
Acres burned	288,200	1,585,000
Earthquakes, 1990-2005	Pakistan (2005)	Sumatra (2005)
People killed	80,361	283,106
U.S. Terrorist Attacks	Oklahoma City (1995)	9/11 (2001)
People killed	168	2,974

Weitzman (2009, 2010) brought the fat-tail debate to the fore of economic thinking on climate policy. His papers go beyond a critique of public (mis)perception of climate risks; they show how economists have underestimated tail risks in most of their

thinking. Policy makers address tail outcomes even less. They have a tendency to hope that something bad does not happen on their watch; and with low probability events, the chances are good that it will not.[8]

2.7 Probability neglect and consequence neglect

A fundamental error when weighing drastic outcomes is to ignore probabilities. Sunstein and Zeckhauser (2011) conclude that "when risks are vivid, people are likely to be insensitive to the probability of harm, particularly when their emotions are activated." Their experimental results show that individuals require little more compensation to receive a brief, painful, but non-dangerous electric shock with certainty than with a 1% probability. The subjects simply focused on the anticipation of the shock and not on its likelihood.

Global warming brings the potential for many high consequence losses. It matters greatly whether their chance of occurrence is 1 in 1,000,000 or 1 in 100. Yet we suspect that most citizens, and most leaders, would treat these risks as roughly equivalent.

The reverse of probability neglect is consequence neglect. If high-impact, low-probability events have a sufficiently high impact, that will swamp even extremely likely events in terms of expected losses. In some such cases, individuals focus overwhelmingly on what is likely to happen; they ignore the potential catastrophe.

Whether probabilities or consequences dominate is largely an empirical question. Nuclear war—a realistic threat for years in the 20th century—is one extreme example. Even its low probability justified large expenditures to prevent Nightfall.

2.8 Prospect theory and probability weighting

Even if the world could miraculously unite today and take concerted action to control greenhouse gas emissions, disaster due to the cumulative level of greenhouse gases could not be ruled out.

That seemingly self-evident statement has enormous impacts on the perception of the importance of climate policy. The probability-weighting component of prospect theory tells us that reducing the risk of a particular loss from 10 to 3 percent is perceived as not nearly so valuable as reducing it from 3 percent to zero (Kahneman and Tversky 1979). There is a psychological discontinuity at a zero percent chance that strikes a clear intuitive chord. This human attraction to certainty clashes directly with two features of

[8] Weitzman's analysis merits its own caveats. Yohe and Tol (2007) argue that Weitzman's results merit their own label: "Warning: Not to be taken to its logical extreme in application to real world problems." Kousky and Cooke (2009) have taken Weitzman's prescriptions one step further and argue that there are three important implications of extreme events for climate policy, dubbed "The Unholy Trinity": fat tails, tail dependence, and micro-correlations.

climate change: the inherent ambiguities of the underlying science, and the impossibility of securing complete safety from its dangers.

Policy makers and scientists cannot, in good faith, provide reassurance that any foreseeable policy will avoid disaster. "Solving" global warming is out. The goal should be to put in place the necessary policies in place to significantly trim the likelihoods of the worst consequences.

Advocates for strong climate policy often talk about the need to take many different steps at once because no single policy measure will solve the problem as a whole, thus requiring a strategy of "of many or all of the above." This kind of approach might be desirable, but it makes the implications of prospect theory that much more challenging. It is difficult to see a clear beginning and end, and there is little hope of removing any particular risk altogether.

2.9 Loss aversion

We are exceedingly reluctant to give up what we already have (Kahneman, Knetsch, and Thaler, 1990). This endowment effect makes losses count much more heavily than equivalent-sized gains.

Here losses threaten in two distinct domains: the losses directly related to climate instability on a warming planet, and the economic loss that established interests would incur in order to decrease emissions.

Some look at the world and see a warming climate, changing weather patterns, and other natural phenomena linked to rising greenhouse gases, all of which may prompt them to alter their ways of life to prevent a loss. Some others look at the world and see a comfortable existence based on machines, capital, and cheap fossil energy, all of which is threatened by potential climate policies. The first group will want serious and immediate climate–stabilizing action; the second will want to delay action as long as possible. What is clear, though, is that both reactions are exacerbated by loss aversion and that rational climate policy ought to focus on calculated rather than intuited costs. Unfortunately, there is ample evidence that the expected losses entailed by climatic instability will vastly exceed the economic losses from a transition to a low-carbon economy (EDF 2009).[9]

2.10 Herd behavior

It is generally much more comforting to follow everyone else—potentially even into an abyss—than to leave the herd and run the risks of being wrong and of possibly getting picked off by a predator.

[9] Hatfield-Dodds and Morrison (2010) connect loss aversion to misinformation about economic impacts.

Betting against the herd turned out to be the smarter financial strategy in 2008, at the height of the financial crisis. But merely being right in the long run is not sufficient. Investors could have easily been right about the housing bubble and its implications and still faced financial ruin. Anyone anticipating the bubble in the early 2000s would have lost a lot of money in every year up through 2007, had he bet that the crisis would materialize during those years.

A similar scenario may well be playing out for climate policy. Some long-term investors are betting that green technologies will fuel the future. Yet, in the meantime, traditional oil companies are making record profits. Similarly, global warming may harbor devastating consequences for low-lying coastal regions. Yet, beachfront properties still fetch exorbitant prices.

Herd behavior is one of the many psychological biases that is readily observed but hard to address. Moreover, individual biases are compounded in the policy arena, both because policymakers have biases on their own and because they aggregate and rebroadcast the biases of their electorates.

3. Challenges to a sensible climate policy, and possible responses

George H. W. Bush signed—and the U.S. Senate ratified—the 1992 Rio Earth Summit treaty vowing to prevent "dangerous anthropogenic interference with Earth's climate system." Bold words brought little legislation. Virtually nothing much has happened since in Washington, despite the increasingly frantic calls from scientists.

Once again, uncertainty, geography, and timing are mostly to blame. True, none of these elements is solely linked to climate policy. Many national security issues are equally controversial and global in reach; entitlement reform and many other policies share the long time horizon. But their combination distinguishes the climate-change issue.

Uncertainty supports denial and clouds judgment of individuals and legislators alike, for the latter often magnified through the collective voice of the electorate and the desire to channel the majority view. Faulty tail-thinking, probability neglect, consequence neglect, prospect theory, loss aversion, and indeed a whole host of behavioral proclivities influence legislators' behavior.

We turn now to two issues that are unique to climate instability on the policy-making level: the global and long-term nature of its consequences. We conclude this section by addressing the need for a diversified-portfolio approach to climate policy and to the ethical dimensions of the problem.

3.1 A global free-rider problem

While the costs of climate warming and its prevention are far from globally uniform, the free-rider problem is universal (Barrett 2007). Every person faces the same global reality of the private benefits versus the shared costs of greenhouse gas pollution. Worse, the costs, at least when calculated in terms of human suffering, are heavily skewed toward the poorest countries, nations that have historically benefited least from fossil fuel use. Thus the global commons problem poses unique challenges to fairness in international policy making. Symmetric commons problems offer symmetric solutions (Hardin 1968). Asymmetric commons problems suggest a multitude of solutions, with each participant offering a "logical" solution that is best for itself.

Some nations insist on a global 2005 baseline for greenhouse gas emissions; some insist on a 1990 baseline. Others focus on entirely different metrics, such as per-capita distributions or emissions per unit of GNP. Each bases its position on ethics and distributional equity. And this is not just strategic posturing. Ethical constructs and self-interest tend to reinforce one another.

Short of an appeal to individual ethics, there are largely two ways to break free from this deepening rut. One is a universal agreement involving all major emitting nations. Only an extreme optimist could think that possible, arguing that we all recognize the problem, and we all know the solution. This type of reasoning does not hold up when different nations strongly prefer different solutions, with good justifications for doing so.

The other possible solution is a focus on self-interest and how the first-mover advantage could conceivably trump any free-rider problem in the medium to long term. The up-front capital expenditures for a transition into a low-carbon world would be higher compared with relying on existing fossil-focused capital stock—hence, the resistance to change in the first place—but that equation may well reverse at some point, possibly soon. McKinsey (2010) has shown for the United States, as has the European Climate Foundation (2010) for Europe, how later operational cost savings overtake initial capital investments to make a transition to a clean economy virtually costless over a twenty- to forty-year time horizon in present discounted terms, once initial barriers are overcome.

Even then, though, it is difficult to get the timing right. There might well be an advantage for early movers, but not necessarily for the first movers. If that is the case, all will wait for others to go first. Moreover, some heavy polluting sectors might not offer first-mover advantage: no nation will scrap a recently constructed coal plant.

We caution against trying to build domestic political momentum on the message that effective action on climate change would be "costless" in present-discounted terms. This caution comes not from the standard, rational economic thinking that if it were costless, firms and individuals would already have taken appropriate measures on their own. Rather, market imperfections and the "soft thinking" proclivities outlined here often prevent low-hanging fruit from being plucked. Indeed the plausible maxim "no pain no gain" might obscure these opportunities to the electorate.

3.2 Election cycles and valuing the future

Timing is almost everything in politics. American politicians work in 2-, 4-, and 6-year election cycles, the demands of which stand in stark contrast to policy making for posterity. Voting citizens, even taking a long view, demand results. Yet climate change is a threat that matures over decades. The legislative process is poorly equipped to deal with its unusual challenges (Summers and Zeckhauser, 2010).

One particularly vexing issue is to weigh future generation's wellbeing against that of the present. Whether we think of the ethical justification, climate policy will be made by legislators who look to current citizens for their guidance. Future generations will be weighted only to the extent that current citizens care about them and their welfare. World War II secured the freedom of hundreds of millions of people for generations. But it was fought to vanquish a contemporaneous threat. That short-term payoff was sufficient.

Economists often focus on the discount rate, yet nothing close to a traditional discount rate applies here. If climate stability were something that could be bought with money, the money discount rate would be appropriate, but it can't. The relevant metric is about how current generations value their different successors, not how quickly money in the bank accumulates.

Moreover, the richer we are, the more we can afford to value the environment. Future generations are likely to be much richer and, thus, will place a higher value on unspoiled nature and on a stable climate. This relationship goes beyond merely calling for lower discount rates. It changes relative prices among future goods and favors preventive action on climate policy (Sterner 2009).

Finally, a crucial consideration is the physical property of climate instability: many of its adverse outcomes are irreversible. Commonly identified tipping points relate to melting polar ice sheets, and drastic alterations of ocean circulation, monsoons, and forests (Lenton 2007). Once a tipping point for such a phenomenon gets passed, Humpty Dumpty applies: no amount of future investment could reverse the consequences.

3.3 Portfolio approach to climate policy

No silver bullet that will eliminate the risks of climate change exists, indeed no collection of such bullets. Even were we to stop all greenhouse gas emissions today and shift into reverse, the long-term nature of the problem would guarantee warming beyond today's levels, with some chance of severe consequences.

Effective climate policy requires a portfolio approach encompassing three elements: mitigation, geoengineering, and adaptation. To be cost-effective, each of these approaches would be pushed to the level at which a marginal million dollars of

expenditure avoided the same expected losses. A central challenge is that no one knows the production function for the reduction of climate risk. Moreover, the risks across the different categories, in particular when planetary geoengineering is involved, is all but non-comparable.

Mitigation is the only approach that addresses the root causes—the only way to "seal the well." Geoengineering misses the root cause. It is an important emergency measure to have in reserve, not a solution, particularly given its many unknown and unknowable consequences.

The final element of the climate-policy portfolio comes in two parts: deliberate adaptation and suffering. Both are accommodations to living with the future climate, but they will take place in different social spheres. Rich nations will adapt; the poor will suffer. In fact, adaptation is one category, and we are showing its methods at massive scales, and it is heavily skewed toward rich nations. We build houses, wear clothes, decide where to live often to protect ourselves against unfavorable climates.

Choosing the right balance among these three portfolio options entails a certain amount of substitution. There may also be important areas of overlap among these classes of response. Localized, tangible adaptation might be linked to global, largely intangible mitigation efforts. For instance, an industrial facility could be rebuilt away from a threatened coastline. Such newer infrastructure would tend to be more energy efficient, thus aiding mitigation efforts as well.

Geoengineering could be coupled with both mitigation and adaptation. Painting roofs white, possibly the simplest way to invoke (small) albedo changes, would both mitigate and adapt. White roofs cool buildings in the summer, thus allowing people to simultaneously adapt to warmer outdoor temperatures and mitigate emissions by reducing air conditioning. Planting trees near human dwellings does the same.

The portfolio approach highlights the difficulties policy makers face in defining an effective climate policy. No single act or suite of acts copes sufficiently with the full range of climate-related issues. The best we can do is significantly diminish our risks. A small sliver of our GDP can do this. But the impossibility of a clear victory makes comprehensive climate legislation difficult to pass.

A successful climate response requires adaptive management. We will inevitably learn as we go along, and any policy ought to be flexible enough to respond. That will most likely mean ratcheting down any carbon cap or increasing the tax, but it could require the opposite.[10]

Either way, policy needs to be nimble and adaptable and must avoid lock-ins that decade-long treaties might provide. This stands in direct contrast with policy certainty of the kind that allows long-term energy investments. Navigating this tradeoff will not

[10] Murray, Newell, and Pizer (2008) argue how a cap-and-trade market can anticipate future policy changes and incorporate these anticipations into current prices.

be easy, although it is a rather pleasing problem compared to many others discussed here. It assumes already having a climate policy to begin with.

3.4 Comparative politics

If the psychological problems are generalizeable, how come some countries seem to have overcome them? The United States may be lagging behind, but the European Union, Brazil, or Costa Rica to name just three examples seem to be marching ahead with much more stringent climate policy. Several reasons account for this seeming discrepancy in effort levels.

For one, countries like Costa Rica, whose stated goal is to become carbon neutral by 2021, have carved out a policy niche. That is possible for a small country that is most commonly known as an "eco-tourism" destination rather than an industrial powerhouse. It is in the self interest of Costa Rica to take the eco niche, much as it is in the interest of Ben & Jerry's to specialize in organic, ethically sourced ice cream, while the largest ice cream purveyors make no such claims. Select consumers pay a premium for otherwise un- or undervalued services.

The niche explanation cannot hold for Brazil, for example, which has adopted a law stating its goal to reduce national emissions by around 37.5% below projected levels in 2020.[11] A partial explanation is that deforestation accounts for much of Brazil's emissions and that its general climate policy goal builds on an earlier aggressive plan in that one sector, justified by many reasons apart from protecting the atmosphere. Yet part of the explanation is that Brazil realizes that aggressive climate policy might help even its large economy. The same goes for the European Union.

A further strand of explanation for both Brazil and the EU is that technocrats in Brasilia and Brussels largely determine climate policy. Lobbyists clearly play significant roles in both places, but much less than in Washington, where the fossil fuel lobby spent $500 million in 2009 and 2010 to defeat climate legislation. That, combined with the primary election system, where candidates cater to vocal fringe groups within their own parties and a winner-take-all voting system, all but ensures that politicians lag behind the median voter in pushing climate policy. EU climate policy, in contrast, is relatively insulated and opaque. Moreover, Europeans are, by necessity, more open to higher levels of taxation. Yet even the EU's (and Brazil's) more aggressive policy stance are far too weak to achieve what scientists say is needed to stabilize the climate, and the current political/economic situation seems unlikely to allow a full adoption of scientific policy recommendations.

Another explanation, however, does come down to psychology and inherent difference in the electorate. Average European citizens may well be further along to accepting the scientific consensus and implications for climate policy than their US counterparts.

[11] Brazilian law nº 12,187, adopted in December 2009, established a national emissions reduction target of between 36.1% to 38.9% below projected levels in 2020.

Much like some Scandinavian countries often seem to be doing the right thing in other areas, even though it is not necessarily in their narrow self-interest, ethics may explain more than economics.

3.5 Ethics over self-interest

Rechanneling market forces must be the central element of climate policy. However, economics alone will not suffice. A more fundamental change in thinking is required, not least to realign political forces permanently and to secure the full support of all nations. Ethics must shift, broadly. Affluent nations do not countenance child labor. Universal ethics, not economic argument, dictates their policies. Indeed, bans on child labor are not protectionist under the World Trade Organization.

Climate policy must follow this lead. Eventually, the emission of carbon in significant quantity must be treated like the exploitation of children: something not to be done—not because it would not be profitable, but because it would not be ethical or tolerated.

4. Conclusion

The domestic "climate war" has produced much more noise than action for a long time.[12] Some of it is simply partisan strife, largely unrelated to the topic at hand. Other disagreements, however, stem from the fact that climate policy is truly a difficult problem.

This hard problem is made worse because of generally soft thinking about a brutal trifecta of factors: uncertainty, geography, and time. In each realm, deeply ingrained psychological biases impede rational thought. This soft thinking is harder to combat because of the significant resources at stake and the strong international incentive for nations to free-ride, reducing their economic contributions to any global approach. The need for a portfolio of responses and the recognition that complete success is unattainable make sensible climate policy less likely.

The problems identified here offer no simple solution. There is the clear need to try to overcome—and also, at times, to harness—the psychological propensities identified here to address the defining environmental issue of our times. Action will depend on an aroused electorate. As with any political measure, timing will be critical.

An effective level of engagement in the United States, for example, might come after a clear catastrophe linked to the unstable climate, a highly visible, dramatic event, such as the sudden deaths of most polar bears or similarly charismatic megafauna. Preparing a sensible, long-term policy response for just such a situation should be part of the nation's policy portfolio.

[12] See Pooley's (2010) comprehensive account.

Forward thinking politicians must also create what we call "pockets of certainty": steps with clear local, immediate benefits like more jobs, or direct monetary and nonmonetary payoffs. Similarly, one answer might be to recast climate policy as anything but. Some might be skeptical about climate science but clearly understand the need to conserve energy for the sake of "energy independence", or other morality tales like frugality as a virtue.

Lastly, the difficulty in defining a single, national policy response highlights the need for policy experiments. U.S. energy policy is largely made on the state level, which offers a unique laboratory for policy innovation. The same goes internationally.

For the moment, progress will depend on enlightened leadership from politicians willing to educate the public, and, when feasible, make the hard decisions that will secure the strong support of scientists and economists, and ultimately of the electorate.

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