ACCOUNTING FOR POLITICAL FEASIBILITY IN CLIMATE INSTRUMENT CHOICE

Jonathan M. Gilligan[*]

Michael P. Vandenbergh[**]

This essay argues for consideration of political opportunity costs in the criteria used to evaluate climate policy instruments. Law and policy debates typically evaluate policy instruments by their expected performance after adoption, tacitly excluding consideration of the timing of adoption. Under this standard, a comprehensive carbon pricing instrument, either in the form of a cap and trade program or a carbon tax, has emerged as the preferred approach. Yet, by excluding the political process from consideration, this standard obscures the effects of political feasibility on the timing of adoption. For many problems, the advantages of an optimal policy outweigh the advantages of a sub-optimal policy that will require less time and effort to adopt. The climate problem is different: the irreversibility of climate change, the possibility of tipping points in the climate system, and lag times in infrastructure investments combine to impose large costs on delay. Excluding political opportunity costs from instrument evaluation leads to a preference for slow, comprehensive remedies. The casualties in this process are incremental instruments that could buy time, facilitate the adoption of additional instruments, or complement existing instruments. This Essay proposes explicit consideration of political opportunity costs in evaluating climate policy instruments and applies this approach to several leading climate policies.

---

* Associate Professor, Department of Earth and Environmental Sciences, and Associate Director for Research, Climate Change Research Network, Vanderbilt University.

** David Daniels Allen Distinguished Chair in Law; Co-Director, Energy, Environment and Land Use Program, and Director, Climate Change Research Network, Vanderbilt University Law School. We would like to thank Linda Breggin, David Krantz, Jim Rossi, J.B. Ruhl, and Robert Socolow for comments. This Essay was supported by Vanderbilt University Law School and the Climate Change Research Network. Amanda Nguyen and Sarajane McMahon provided excellent research assistance.

I. INTRODUCTION

> "A good solution applied with vigor now is better than a perfect solution applied ten minutes later."[1]

Often, the most important issues in scholarly and policy debates receive insufficient attention because they fall between disciplinary lines. Climate instrument choice—whether involving cap and trade programs, emissions taxes, or clean-energy research and development—is perhaps the most tragic example of this phenomenon. Political opportunity costs fall outside the expertise of many legal scholars and economists who develop and evaluate climate mitigation instruments. By political opportunity costs, we mean both the effects of overcoming political barriers on the timing of adoption of the selected policy and the unrealized emissions reductions other policies could have achieved in the interim. Until the last several years, scholarship in law and economics has noted the importance of political feasibility but has given limited attention to political opportunity costs when evaluating the optimality of climate instruments.[2] We argue that the failure to account for political opportunity costs has delayed the development of incremental climate mitigation instruments without increasing the prospects for adoption of more comprehensive solutions. We also argue that several structural aspects of the climate threat—its irreversibility, its potential to produce globally catastrophic consequences, the prospect for unforeseen consequences due to tipping points and nonlinear cascade effects, and the long lag between enacting a policy and affecting emissions and global temperatures—require new approaches that account for political feasibility, and we identify emerging examples of these new approaches.

Three aspects of instrument choice are easily conflated but are particularly important for climate policy: the magnitude of the

---

[1] TACTICAL AND TECHNICAL TRENDS, NO. 30, MILITARY INTELLIGENCE SERV., WAR DEP'T 38 (1943). This statement has been attributed to General George S. Patton and has been quoted or paraphrased in a variety of forms and sources.

[2] *See* discussion *infra* notes 59–62. *But see* Charles E. Lindblom, *The Science of Muddling Through,* 19 PUBL. ADMIN. REV. 79, 84 (1959) (observing that the cost of resolving disagreements can be reduced by pursuing an incremental approach in which optimality is evaluated by ad hoc criteria that arise in the process of implementation, rather than by pre-defined objectives).

emissions reductions, the timing of the reductions, and the comprehensiveness of the policies designed to achieve the reductions. Many scholars and policymakers agree that large emissions reductions will be required to reduce the risk of catastrophic climate change, but important differences of opinion emerge over the timing of reductions. For many social problems, the timing of adopting a legal or policy response has limited significance. For issues such as health care, labor or immigration reform, problems may get worse at the national level and may be irreversible for any one individual, but few tipping points exist that will lead to irreversible harms in the event of delay at the national or international level.[3] For these types of problems, large changes in behavior may be required by the targets of the regulatory instrument, but the appropriate decision heuristic for instrument choice may downplay the importance of time of adoption. Similarly, incremental or partial near-term improvements may be valuable but are not essential.

Problems that are important but reversible when action is ultimately taken dominate the law and policy world.[4] The common structure of these problems suggests the need for large changes in behavior but not for urgent adoption. This structure also encourages the use of an implicit decision heuristic that only considers comprehensive policies, even if they delay action as compared to incremental policies.[5] This "panacea bias" supports and is supported by disciplinary boundaries that exclude political feasibility from consideration.[6] The exclusion of political feasibility concerns poses only a minor problem if delays are not important for assessing the performance of policy instruments. Yet, political feasibility is a vital concern if delay impacts those assessments. In addition, the panacea bias induces analysts to underestimate the difficulty of adopting comprehensive policies and to overestimate the

---

[3] A possible recent exception is the financial crisis of 2008, which posed risks of cascading loss of institutions and confidence. *See, e.g.*, Michael Vandenbergh & Jonathan Gilligan, *Macro Risks: The Challenge for Rational Risk Regulation,* 21 DUKE ENVTL. L. & POL'Y F. 401 (2011) (comparing the risks of catastrophic global warming to the 2008 financial crisis).

[4] For a discussion of reversibility in environmental law, see Cass R. Sunstein, *Beyond the Precautionary Principle,* 151 U. PA. L. REV. 1003 (2003).

[5] As Michael Levi points out, the climate policy debate typically asks whether a particular instrument will "solve" the climate problem. Michael Levi, *The Hidden Risks of Energy Innovation*, 70 ISSUES IN SCI. & TECH. 69, 78 (2013). Accounting for political opportunity costs is important whether the policy analyst is interested in improving cost-benefit analysis, e.g., John Bronstein, Christopher Buccafusco & Jonathan Masur et al., *Well-Being Analysis v. Cost-Benefit Analysis*, 62 DUKE L.J. 1603 (2013) and MATTHEW ADLER, WELL-BEING AND FAIR DISTRIBUTION: BEYOND COST-BENEFIT ANALYSIS (2012), or alternative approaches, DOUGLAS A. KYSAR, REGULATING FROM NOWHERE (2010).

[6] We thank David Krantz for suggesting the term "panacea bias."

extent to which incremental policies will undermine support for comprehensive policies.

For climate change, time is of the essence. Not only must a climate instrument achieve large overall emissions reductions, it must begin to do so quickly. A recent study analyzed the effects of four types of uncertainty (geophysical, technological, social, and political) on the costs associated with achieving various temperature targets and concluded that "political choices that delay mitigation have the largest effect on the cost-risk distribution, followed by geophysical uncertainties, social factors influencing future energy demand, and, lastly[,] technological uncertainties surrounding the availability of greenhouse gas mitigation options."[7] Other research suggests that due to the delays in adopting an emissions reductions scheme over the last eight years, a daunting level of emissions reductions is now necessary.[8] Delay affects both the magnitude of the emissions reductions that must be achieved and the costs of achieving reductions. Economist William Nordhaus has estimated that the cost of a fifty-year delay in reducing CO_2 emissions is $4.1 trillion,[9] and even this figure may be significantly understated.[10]

The importance of delay is not simply a matter of policy preference for precaution regarding environmental or other social risks. Several distinctive properties of climate change aggravate the costs of delay as compared to many other problems. Most air pollutants have short lifetimes and dissipate quickly once emissions are curtailed, but carbon dioxide and many other greenhouse gases have long lifetimes, making climate change irreversible for thousands of years.[11] Thus, intensified action in the future may not compensate for present delay. Even after greenhouse gas emissions cease, impacts of climate change will worsen for decades or centuries and then persist for millennia, so adjusting regulatory responses on the basis of observed impacts is not feasible.[12]

---

7 Joeri Rogelj et al., *Probabilistic Cost Estimates for Climate Change Mitigation,* 493 NATURE 79, 79 (2012) (letter).

8 Thomas F. Stocker, *The Closing Door of Climate Targets,* 339 SCI. 280, 281 (2013). *See also* NAT'L ACAD. SCI., LIMITING THE MAGNITUDE OF FUTURE CLIMATE CHANGE 82, 87 (2010) (stating that delay "would . . . make a challenging goal essentially unattainable").

9 William Nordhaus, *Why the Global Warming Skeptics Are Wrong,* N.Y. REV. BOOKS, Mar. 22, 2012, at 1.

10 *See* Vandenbergh & Gilligan, *supra* note 3, at 401–03.

11 Susan Solomon et al., *Irreversible Climate Change Due to Carbon Dioxide Emissions*, 106 PROC. NAT'L. ACAD. SCI. 1704, 1705 (2009) (finding that "the climate change that takes place due to increases in carbon dioxide concentration is largely irreversible for 1000 years after emissions stop"); David Archer et al., *Atmospheric Lifetime of Fossil Fuel Carbon Dioxide*, 37 ANN. REV. EARTH PLANET SCI. 117, 131 (2009) (calculating that "the mean lifetime of fossil fuel CO_2 is ~12-14 thousand years").

12 Solomon, *supra* note 11, at 1704.

Lock-in effects of investments in energy and transportation lead to significant lags between new policies and their impacts on emissions.[13] Unlikely but distressing outcomes are more central to policy analysis for climate change than for most hazards.[14] The possibility of unknown thresholds for runaway damage or runaway warming magnifies concerns about irreversibility and catastrophe.[15]

The law and policy literature on climate instrument selection has focused on the processes for policy development[16] and on how various instruments will perform if adopted.[17] The political feasibility of adopting these instruments can be equally important. Yet, after two decades of political resistance to major climate mitigation measures, the role of political feasibility in instrument choice and the implications of delay are only now beginning to be addressed.[18] Until recently, the debate has been divided between those advocating comprehensive and efficient but politically difficult remedies that have little prospect of being adopted in time,[19] and those who advocate remedies that can be

---

[13] NATIONAL RESEARCH COUNCIL, *supra* note 8, at 110 (stating that "long-term capital investments . . . can lock in emissions-intensive technologies").

[14] Martin L. Weitzman, *On Modeling and Interpreting the Economics of Catastrophic Climate Change*, 91 REV. ECON. & STAT. 1 (2009); Frank Ackerman et al., *Fat Tails, Exponents, Extreme Uncertainty: Simulating Catastrophe in DICE*, 69 ECOLOGICAL ECON. 1657 (2010); Robert H. Socolow, *High-Consequence Outcomes and Internal Disagreements: Tell Us More, Please*, 110 CLIMATIC CHANGE 776 (2011).

[15] Timothy M. Lenton et al., *Tipping Elements in the Earth's Climate System,* 105 PROC. NAT'L ACAD. SCI. 1786, 1792 (2008) (concluding that "a variety of tipping elements could reach their critical point within this century under anthropogenic climate change" and "[t]The greatest threats are tipping the Arctic sea-ice and the Greenland ice sheet, and at least five other elements could surprise us by exhibiting a nearby tipping point"); Stefan Wieczorek et al., *Excitability in Ramped Systems: The Compost-bomb Instability,* 467 PROC. ROY. SOC. A 1243, 1266 (2011) (reporting a possible tipping point in which rising temperatures could cause "a potentially catastrophic explosive release of peatland soil carbon into the atmosphere as the greenhouse gas carbon dioxide, which could significantly accelerate anthropogenic global warming").

[16] Jonathan Wiener, *Global Environmental Regulation: Instrument Choice in Legal Context*, 108 YALE L.J. 677, 750–55 (1999) (discussing beneficiary pays strategies to enhance climate instrument adoption); Robert N Stavins, *Policy Instruments for Climate Change: How Can National Governments Address a Global Problem*, 1997 U. CHI. LEGAL F. 293, 296–97 (considering the "feasibility in terms of political implementation and administration," of the instrument once it is enacted, but not the political feasibility of enacting it).

[17] Gilbert E. Metcalf & David Weisbach, *The Design of A Carbon Tax*, 33 HARV. ENVTL. L. REV. 499, 517 (2009); Reuven S. Avi-Yonah & David M. Uhlmann, *Combating Global Climate Change: Why A Carbon Tax is a Better Response to Global Warming Than Cap and Trade*, 28 STAN. ENVTL. L.J. 3, 40–46 (2009).

[18] *See, e.g.*, Avi-Yonah & Uhlmann, *supra* note 17, at 45; Joseph E. Aldy & Robert N. Stavins, *Using the Market to Address Climate Change: Insights from Theory and Experience* 21, 25–26 (Nat'l Bureau of Econ. Research, Working Paper No. 17488, 2011) (advocating taking a long view on political feasibility, emphasizing "long term trends" over "relatively brief" phenomena lasting "two decades" or less).

[19] *See, e.g.*, ALDY & STAVINS, *supra* note 18, at 21; Avi-Yonah & Uhlmann, *supra* note 17, at 45; Metcalf & Weisbach, *supra* note 17, at 517. Implicit recognition of political obstacles (e.g.

adopted in the near term but that will not achieve sufficient emissions reductions.[20] The former remedies address the magnitude issues but not the timing, and the latter address the timing issues but not the magnitude.[21] The structure of the climate problem requires attention to both.

We argue for an explicit debate about the appropriate decision heuristic for climate change and the adoption of climate instruments that are optimal when delay and other political opportunity costs are considered. Gersen and Posner have noted that "the timing of a law can be just as important as its content."[22] Instrument selection should balance the costs of policymaking necessary to produce a superior instrument (including the opportunity costs of delays) against the instrument's benefits relative to sub-optimal ones.[23] Few analyses of instrument selection for environmental policy explicitly consider the political costs of policymaking, however, or their effects on the timing of emissions reductions.[24]

We demonstrate that when the analysis accounts for both the timing and the magnitude of the reductions, the limitations of comprehensive measures that achieve large reductions too late and incremental measures that achieve prompt but small emissions reductions become clear. We discuss newly emerging lines of legal and policy scholarship that have begun to account for political feasibility, and we identify

---

opposition to new taxes) may explain many economists' focus on cap and trade programs rather than carbon taxes, despite the consensus that emissions taxes have lower deadweight loss. But, by now it is clear that even cap and trade faces significant opposition.

20 *See, e.g.*, TED NORDHAUS & MICHAEL SHELLENBERGER, BREAK THROUGH: WHY WE CAN'T LEAVE SAVING THE PLANET TO ENVIRONMENTALISTS (2009) (advocating modest climate efforts framed to appeal to near-term economic interests). A common theme is to advocate research and development funding for new technology that could obviate politically difficult choices, often in combination with modest measures to promote adaptation to climate hazards. ROGER PIELKE, JR., THE CLIMATE FIX: WHAT SCIENTISTS AND POLITICIANS WON'T TELL YOU ABOUT GLOBAL WARMING (2010); GWYN PRINS ET AL., THE HARTWELL PAPER: A NEW DIRECTION FOR CLIMATE POLICY AFTER THE CRASH OF 2009 34 (2010); Levi, *supra* note 5, at 78.

21 Many of those who have addressed political feasibility portray political realism as incompatible with policies that aim to meet widely accepted greenhouse gas concentration targets. *See, e.g.*, PRINS ET AL., *supra* note 20, at 34 (recommending a "switch from preoccupation with emissions targets . . . to commitments and methods to invest in energy innovation").

22 Jacob E. Gersen & Eric A. Posner, *Timing Rules and Legal Institutions*, 121 HARV. L. REV. 543, 543 (2007).

23 *See* Barbara Luppi & Francesco Parisi, *Optimal Timing of Legal Intervention: The Role of Timing Rules*, 122 HARV. L. REV. F. 18, 19–20 (2009).

24 For scholarship that notes the importance of political feasibility, *see* Jedediah Purdy, *The Politics of Nature: Climate Change, Environmental Law, and Democracy*, 119 YALE L.J. 1122 (2010); Robert N. Stavins, *A Meaningful U.S. Cap-and-Trade System to Address Climate Change*, 32 HARV. ENVTL. L. REV. 293 (2008); J.R. DeShazo & Jody Freeman, *Timing and Form of Federal Regulation: The Case of Climate Change*, 155 U. PA. L. REV. 1499, 1500 (2007).

viable new options.[25] We also propose a new approach to assessing policy instruments that explicitly weighs the political obstacles and their associated opportunity costs against the instruments' projected performance once adopted.

Our goal is not to provide the final word on the appropriate standard for reviewing climate instruments but to provoke the interdisciplinary dialogue necessary to generate a more useful standard. We expect that a comprehensive policy or assembly of policies to reduce greenhouse gas emissions will ultimately be necessary to avoid unacceptable risks but that such a policy will not materialize soon. In the meantime, our approach can identify effective bridging measures without obstructing more complete policy efforts.

II. THE STRUCTURE OF THE CLIMATE PROBLEM

The difficult collective action problems posed by climate change at the global, national, and local levels have been identified by scholars in numerous fields.[26] The magnitude of the emissions reductions necessary to substantially reduce the risk of catastrophic climate change has been apparent for some time, but the significance of delay has received much less attention until recently. We begin by examining the aspects of the climate problem that make timing a critical consideration and then turn to the implications for instrument choice.

Much climate policy discussion has focused on a target of preventing the average global temperature from rising more than 2°C above preindustrial levels. This target was reiterated during the 2010 Cancun meeting of the Conference of Parties as the maximum temperature rise consistent with satisfying the UNFCC mandate to "prevent dangerous anthropogenic interference with the climate system."[27] Although the 2°C target has been the subject of legitimate criticism—it is necessarily

---

[25] *See* discussion *infra* notes 80–99.

[26] *See, e.g.*, Richard Lazarus, *Super-Wicked Problems and Climate Change: Restraining the Present to Liberate the Future*, 94 CORNELL L. REV. 1153 (2009) (discussing implications); Thomas Dietz, Elinor Ostrom & Paul Stern, *The Struggle to Govern the Commons,* 302 SCI. 1907, 1908 (2003) (discussing limits of informal collective action solutions); SCOTT BARRETT, WHY COOPERATE: THE INCENTIVE TO SUPPLY GLOBAL PUBLIC GOODS 74-102 (2007) (discussing need for aggregate action by nations).

[27] United Nations Framework Convention on Climate Change, Conference of the Parties on its Sixteenth Session, Cancun, Mex., Nov. 29–Dec. 10, 2010, *Part Two: Action taken by the Conference of the Parties at its sixteenth session*, 5, FCCC/CP/2010/7/Add.1 (Mar. 15, 2011) (declaring a target of "hold[ing] the increase in global average temperature below 2°C above pre-industrial levels"); United Nations Framework Convention on Climate Change art. 2, May 9, 1992, 1771 U.N.T.S. 107 (committing signatories to "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system").

arbitrary and can become a distraction in policy debates—it does convey an important concept. The 2°C target is similar to the red line on a car's tachometer: it is not certain that the engine will fail if the tachometer goes above the red line, and it is also possible for the engine to fail when the tachometer is below the red line, but the red line represents a threshold above which the probability of engine failure rises dramatically.

Scientists cannot be certain that no harm will occur if warming remains below 2°C or that catastrophic consequences will occur if temperatures cross the threshold; rather, it represents a level above which risk rises rapidly.[28] Considerable scientific uncertainty exists about the exact relationship between temperature and the probability and severity of climatic damage, but it is widely accepted that the farther temperatures rise above 2°C, the greater the probability of severe damage.[29] Although there is nothing scientifically unique about 2°C, it represents a normative political judgment of the temperature above which the probability of severe consequences begins to rise unacceptably quickly.[30] Considerable disagreement exists among scientists over how feasible it is to meet the 2°C target. Some studies conclude that it may be impossible to cut emissions quickly enough to meet the target.[31] Others find the target to be achievable, but only if

---

28 By "risk" due to climate change, we mean both the probability and the severity of possible damage. Above 2°C, rising risk refers both to the rising probability of a certain severity damage and also the rising severity of damage that occurs with any degree of probability, such as five percent. *See, e.g.*, NATIONAL RESEARCH COUNCIL, IMPROVING RISK COMMUNICATION 32 (Nat'l Acad. Press 1989) (explaining that "the concept of risk further quantifies hazards by attaching the probability of being realized to each level of potential harm").

29 *See, e.g.*, Michael D. Mastrandrea & Stephen H. Schneider, *Probabilistic Assessment of 'Dangerous' Climate Change and Emissions Scenarios: Stakeholder Metrics and Overshoot Pathways, in* AVOIDING DANGEROUS CLIMATE CHANGE 253, 255–56 (Hans Joachim Schellnhuber et al. eds., 2006) (estimating a ninety percent probability that 2.1°C warming would have some dangerous consequences and a five percent probability that 3°C warming would be globally catastrophic).

30 Samuel Randalls, *History of the 2°C Climate Target*, 1 WILEY INTERDISC. REVS.: CLIMATE CHANGE 598, 601–03 (2010) (noting that the 2°C target emerged more "from a set of heuristics" as part of policy development than from rigorous scientific criteria and that it "may represent a boundary beyond which" major risks increase rapidly); Michael Oppenheimer, *Defining Dangerous Anthropogenic Interference: The Role of Science, the Limits of Science*, 25 RISK ANALYSIS 1399, 1405–06 (2005) (describing the scientific uncertainty that would allow "dangerous anthropogenic interference" to be defined as somewhere in the range of 1–4°C and noting the political process in which "dangerous temperatures . . . ostensibly have been derived within a framework based on natural science but with the addition of a precautionary criterion for managing risk and uncertainty," but that "what is regarded as 'dangerous' by policymakers and the lay public may well evolve over time").

31 Detlef P. van Vuuren et al., *RCP 2.6: Exploring the Possibility to Keep Global Mean Temperature Increase Below 2°C,* 109 CLIMATIC CHANGE 95, 111 (2009) (noting that "several papers have shown that excluding [negative emissions technology] could easily imply that the 2.6

many nations take immediate and drastic action to cut emissions.[32] One recent study concluded that without rapid emissions cuts, "the 2°C target will become unachievable after 2027, and the 2.5°C target will become unreachable after 2040."[33]

Confronting the growing likelihood of exceeding the 2°C target, scientists have begun to assess the dangers of 3°C or 4°C warming—levels we are likely to experience before 2100 if emissions continue to grow at their present trajectories[34]—and the consequences appear dire.[35] Observing that 4°C would be warmer than today by almost as much as today is warmer than the last ice age, the World Bank has warned that such temperatures would produce "unprecedented heat waves, severe drought, and major floods in many regions, with serious impacts on human systems, ecosystems, and associated services."[36] These heat

---

W/m^2 profile is out of reach"); Michael E. Schesinger et al., *A Fair Plan to Safeguard the Earth's Climate,* 3 J. ENVTL. PROTECTION 455, 459 (2012) (noting that "the 2°C target cannot be achieved for emissions trajectories that see equality" between rich and poor nations "and that poor nations are likely to protest about this inequality, implying that the political obstacles to meeting a 2°C target may be as daunting as the technological ones identified by van Vuuren et al.").

32 Glen P. Peters et al., *The Challenge to Keep Global Warming Below 2°C,* NATURE CLIMATE CHANGE (Dec. 2, 2012), *available at* http://www.nature.com/nclimate/journal/v3/n1/full/nclimate1783.html (concluding that "unless large and concerted global mitigation efforts are initiated soon, the goal of remaining below 2°C will very soon become unachievable"); Jasper van Vliet et al., *Copenhagen Accord Pledges Imply Higher Costs for Staying Below 2°C Warming*, 113 CLIMATIC CHANGE 551, 559–60 (2012) (noting that future action to reduce emissions "cannot fully compensate for the higher short-term emissions" so "significant emission reductions are required" in the next decade "if one aims to achieve the 2°C target with medium or likely probability").

33 Stocker, *supra* note 8, at 281.

34 LISA ALEXANDER ET AL., CLIMATIC CHANGE 2013: THE PHYSICAL SCIENCE BASIS (2013), Summary for Policymakers at SPM-15 (noting that "[i]ncrease of global mean surface temperatures for 2081-2100 relative to 1986-2005 is projected to likely be in the range[] [of] . . . 1.4°C to 3.1°C (RCP6.0) [and] 2.6°C to 4.8°C (RCP8.5) and that for RCP8.5, warming relative to 1850-1900 would be "as likely as not to exceed 4°C"); *id.* at SPM-15 (noting that the observed change between . . . 1850-1900 and [1986-2005] is 0.61°C," which brings the temperatures in 2081-2100 to 2.0°C to 3.7°C for RCP6.0 and 3.2°C to 5.4°C for RCP8.5; Tochihiko Masui et al., *An Emission Pathway for Stabilization at 6 Wm^{-2} Radiative Forcing*, 109 CLIMATIC CHANGE 59, 67 (2011) (noting that "RCP6 is obtained by imposing climate policies . . . through a global market for emissions permits," so without such policy interventions, RCP8.5 seems the most likely scenario, in which case the IPCC's conclusion is that warming would likely exceed 3°C and "as likely as not . . . exceed 4°C").

35 Mark New et al., *Four Degrees and Beyond: The Potential for a Global Temperature Increase of Four Degrees and Its Implications*, 369 PHIL. TRANSACTIONS ROYAL SOC'Y A: MATHEMATICAL, PHYSICAL & ENGINEERING SCI. 6, 6 (2011) (noting that "a + 4°C warming could result in the collapse of systems or require transformational adaptation out of the systems, as we understand them today"); WORLD BANK, TURN DOWN THE HEAT: WHY A 4°C WARMER WORLD MUST BE AVOIDED 23 (2012), *available at* http://climatechange.worldbank.org/sites/default/files/Turn_Down_the_heat_Why_a_4_degree_centigrade_warmer_world_must_be_avoided.pdf.

36 WORLD BANK, *supra* note 35, at xiii–xiv (2012).

waves could "exceed the adaptive capacities of many societies and natural systems."[37] Drought and heat could produce crop failures and famine in some regions, while sea level rise and intensified rainfall could produce catastrophic flooding in others.[38] In addition, unexpected tipping points could produce results much worse than those anticipated by this and other reports.[39] Thus, if keeping warming below 2°C becomes impossible, maintaining a level below 3°C or 4°C becomes a challenge with increasingly dire stakes the longer we delay action.

Disciplinary norms among natural and social scientists discourage use of language that could be seen as hyperbolic or emotional.[40] Perhaps as a result, national and international policymaking exhibit little sense of urgency or priority. Yet, even paranoids have enemies.[41] Expert assessments overwhelmingly agree that anthropogenic climate change is a real and serious threat.[42] More than three decades after the Charney Report warned that "a wait-and-see policy may mean waiting until it is too late,"[43] there is growing recognition that comprehensive national measures in the United States and many other countries will not be adopted in time.[44]

The international picture is similarly bleak. The 17th session of the Conference of Parties ("COP17") meeting in Durban yielded only a

---

37 *Id.* at xv.

38 *Id.* at xv–xvii, 5–7.

39 *Id.* at xvii–xviii (noting that "[a]s global warming approaches and exceeds 2°C, the risk of crossing thresholds of nonlinear tipping elements in the Earth system, with abrupt climate change impacts . . . increases [and] . . . [p]rojections of damage costs for climate change impacts . . . do not provide an adequate consideration of cascade effects"); *see also* Mastrandrea & Schneider, *supra* note 29, at 255.

40 *See, e.g.*, Levi, *supra* note 5, at 78 (describing policies advocated by "those who worry most about climate change" as "overwrought").

41 JOSEPH H. BERK ET AL., EVEN PARANOIDS HAVE ENEMIES: NEW PERSPECTIVES ON PARANOIA AND PERSECUTION (2012).

42 Matthew C. Nisbet & Teresa Myers, *The Polls—Trends Twenty Years of Public Opinion about Global Warming*, 71 PUB. OPINION Q. 444 (2007); J.J. MCCARTHY & INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2001: IMPACTS, ADAPTATION, AND VULNERABILITY: CONTRIBUTION OF WORKING GROUP II TO THE THIRD ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (2001); NATIONAL RESEARCH COUNCIL, AMERICA'S CLIMATE CHOICES (2011).

43 NAT'L RES. COUNCIL, CARBON DIOXIDE AND CLIMATE: A SCIENTIFIC ASSESSMENT: REPORT OF AN AD HOC STUDY GROUP ON CARBON DIOXIDE AND CLIMATE, at viii (1979).

44 Elinor Ostrom, *Nested Externalities and Polycentric Institutions: Must We Wait for Global Solutions to Climate Change Before Taking Actions at Other Scales?*, 49 ECON. THEORY 353–69 (2012) [hereinafter Ostrom, *Nested*]; Macro Steinacher, Fortunat Joos & Thomas F. Stocker, *Allowable Carbon Emissions Lowered by Multiple Climate Targets*, 499 NATURE 197–201 (2013); Joeri Rogelj et al., *2020 Emissions Levels Required to Limit Warming Below 2°C*, 3 NATURE CLIMATE CHANGE 405–12 (2013); Rogelj et al., *supra* note 7, at 79–83; Glen P. Peters et al., *The Challenge to Keep Global Warming Below 2°C*, 3 NATURE CLIMATE CHANGE 4–6 (2013).

non-binding agreement to work toward a new treaty that would begin reducing emissions by 2020,[45] and even if these efforts succeed, such a treaty will take years to produce substantial reductions. Several features of the climate change problem make timing a critical part of instrument selection: the irreversibility of climate change, the possibility of tipping points in the climate system, cascade effects in both natural systems and socioeconomic institutions, and lag times in infrastructure investments.

Irreversibility. Carbon dioxide and many other greenhouse gases have very long lifetimes, so concentrations will remain high for thousands or even tens of thousands of years after emissions cease.[46] Adjusting regulatory responses on the basis of observed impacts is not feasible because even after emissions cease, temperatures and climatic impacts (e.g. sea-level rise and mega-droughts) will intensify for decades or centuries and persist for millennia.[47] Unlikely but dangerous outcomes are more central to policy analysis for climate change than for most hazards.[48]

Tipping Points. The climate system may contain thresholds above which runaway damage may occur, such as unstoppable ice-sheet collapse or runaway warming due to emissions of methane from thawing tundra and the sea floor.[49] The World Bank notes that tipping points may occur in both the natural climate system and in human institutions, which may weaken or collapse in the face of climatic stresses.[50] If such tipping points exist, it would be difficult to detect them until they are crossed, and by then it would likely be too late to reverse course and avoid the consequences.

Cascade Effects. Climate impact assessments produce lists of possible consequences of climate change but do not generally consider

---

45 Dean Scott, *Pledge Toward 2020 Global Deal Ensures Decade of Inaction, World Bank Official Says*, ENV'T. REP. (BNA), at 68 (Jan. 13, 2012); J.M. Broder, *Climate Talks Bring Modest Agreement*, N.Y. TIMES, Dec. 12, 2011, at A9.

46 Archer et al., *supra* note 11, at 131.

47 Solomon et al., *supra* note 11, at 1704.

48 *See* sources cited *supra* note 11. For reviews in the legal literature, *see* Jody Freeman & Andrew Guzman, *Climate Change and U.S. Interests*, 109 COLUM. L. REV. 1531, 1554 (2009); Michael P. Vandenbergh et al., *Micro-Offsets and Macro-Transformation: An Inconvenient View of Climate Change Justice*, 33 HARV. ENVTL. L. REV. 303, 317–19 (2009); Jonathan S. Masur & Eric A. Posner, *Climate Regulation and the Limits of Cost-Benefit Analysis*, 99 CALIF. L. REV. 1557, 1584 (2011); Daniel A. Farber, *Uncertainty*, 99 GEO. L.J. 901, 923–27 (2011).

49 Lenton et al., *supra* note 15, at 1786–92 (concluding that "[t]he greatest threats are tipping the Arctic sea-ice and the Greenland ice sheet, and at least five other elements could surprise us by exhibiting a nearby tipping point"); Wieczorek et al., *supra* note 15, at 1266 (reporting a possible tipping point in which rising temperatures could cause "a potentially catastrophic explosive release of peatland soil carbon into the atmosphere"); WORLD BANK, *supra* note 35, at xvi (noting that tipping points become increasingly likely as temperatures approach 4°C).

50 WORLD BANK, *supra* note 35, at xvii.

how these events may interact nonlinearly to produce impacts beyond the sum of the individual effects. The recent World Bank report suggests that drought and crop failures might combine to reduce the work capacity of the population, significantly affecting gross domestic product and thereby weakening or destroying institutions that might be expected to respond to the water and crop stresses.[51] Although reductions in gross domestic product would also likely decrease carbon emissions, lag times in climate effects from emissions would likely result in reductions that are too late to forestall major changes in the climate. The World Bank report also notes that rising sea levels may induce mass migration sufficient to destabilize political and economic systems.[52]

Lag Times. Lock-in effects of investments in energy and transportation result in significant lags between new policies and their impacts on emissions.[53] Even if an overnight transformation of the political landscape produced widespread support for a comprehensive cap and trade system, a carbon tax, or a massive program for clean energy innovation and adoption, it would take years to assemble coalitions, pass laws, and implement the new measures—and years more to replace existing energy and transportation infrastructure.

Despite these dangers arising from delay, international and domestic climate policy processes are moving slowly, if at all. At the 2012 Doha meeting, the Conference of Parties to the UN Framework Convention on Climate Change noted "with grave concern[,] the significant gap" between the reductions in greenhouse gas emissions pledged by the parties and the reductions necessary to limit global warming to no more than 2°C.[54] Indeed, 2011 emissions of greenhouse gases were the highest levels recorded, until 2012 levels eclipsed them.[55] The global consensus that dangerous climate change can only be avoided with

---

51 *Id.* at xvii; *see also* John P. Dunne, Ronald J. Stouffer & Jasmin G. John, *Reductions in Labour Capacity from Heat Stress under Climate Warming*, 3 NATURE CLIMATE CHANGE 563–66 (2013).

52 WORLD BANK, *supra* note 35, at xvii–xviii. *But see* Matthew Walsham, ASSESSING THE EVIDENCE: ENVIRONMENT, CLIMATE CHANGE, AND MITIGATION IN BANGLADESH, at ix (2010) (noting that although climate change will likely have a large impact on migration, "[m]igration is a multi-causal phenomenon: even in cases where the environment is a predominant driver of migration it is usually compounded by social, economic, political and other factors").

53 NAT'L ACAD. SCI., *supra* note 8, at 87, 110 (2010) (stating that "long-term capital investments . . . have lifespans of 50 to 80 years and, thus, can lock in emissions-intensive technologies").

54 Conference of the Parties to the United Nations Framework Convention on Climate Change Dec. 2/CP.18, Rep. of the Conference of the Parties, 18th Sess., Nov. 26-Dec. 7, 2012, U.N. Doc. FCCC/CP/2012/8/Add.1, at 19 (Dec. 8, 2012).

55 Justin Gillis & John M. Broder, *With Carbon Dioxide Emissions at Record High, Worries on How to Slow Warming*, N.Y. TIMES, Dec. 3, 2012, at A6.

prompt and large emissions reductions conflicts with the minimal agreements to make such cuts.

Some policy proposals have emphasized the political infeasibility of comprehensive remedies and have largely focused on technology promotion. Although these proposals legitimately account for the current political climate, they offer the prospect for emissions reductions that fall far short of what is widely accepted as necessary to forestall dangerous climate change.[56] Discussing proposals to reform Congress, Mann and Orenstein compare such policies to preparing for a tsunami by building a thin line of sandbags while telling critics that at least the sandbags are better than nothing.[57]

Policy proposals for comprehensive carbon pricing instruments begin with the valid position that policy measures must match the scale of the hazards that they address. But, the focus on large-scale, comprehensive measures neglects the opportunity costs imposed by political obstacles and the danger that the optimal instrument may fail to meet its objectives due to delayed implementation. Moreover, by focusing on monolithic solutions, this approach neglects the possibility that an incremental strategy with smaller political opportunity costs might produce large results quickly and buy time to overcome the political obstacles to adopting more effective and, possibly, more comprehensive remedies.[58] We call this a "panacea bias"—an asymmetric credulity regarding the potential net benefits of comprehensive versus incremental solutions. In Part III, we outline an approach to climate instrument choice that accounts for the timing and magnitude of emissions reductions in the choice between incremental and comprehensive policies.

III. Pragmatic Instrument Evaluation for Climate Policy

We argue that climate instrument choice should not begin with a narrow concept of optimality and proceed to an application of that standard to select among climate instruments. Instead, the debate should begin one step earlier in the decision-making process—it should start with the appropriate methods for evaluating and choosing instruments. Regardless of the selected approach to evaluating climate policy

---

56 *See, e.g.*, Levi, *supra* note 5, at 70; PIELKE JR., *supra* note 20, at 224; PRINS ET AL., *supra* note 20, at 34.

57 THOMAS E. MANN & NORMAN J. ORENSTEIN, IT'S EVEN WORSE THAN IT LOOKS: HOW THE AMERICAN CONSTITUTIONAL SYSTEM COLLIDED WITH THE NEW POLITICS OF EXTREMISM 160 (2012).

58 Charles E. Lindblom, *Still Muddling, Not Yet Through*, 39 PUB. ADMIN. REV. 517, 520 (1979) (noting that "a fast-moving sequence of small changes can more speedily accomplish a drastic alteration of the status quo than can an only infrequent major policy change").

instruments, the analysis should account not only for the magnitude and cost of the emissions reductions that the instruments could achieve, but also for the opportunity costs of the time and effort required to enact them. Whether this approach is framed as an expanded form of optimality or as an alternative to optimality, such as satisficing (searching for any option that is "good enough" instead of comparing all possible options to determine the best), it replaces a narrow analytical focus with a broadly pragmatic perspective that reflects the unusual structure of the climate problem.[59]

Policies are often judged in perfectionist terms: second or third-best policies are rejected in favor of first-best policies. Proponents of cost-benefit analysis ("CBA") advocate choosing policies that will maximize net-benefit to society.[60] CBA reminds us that focusing too narrowly on reducing certain risks can blind us to others.[61] Bounded rationality suggests that there are costs to evaluating choices, and the time and effort required to determine the very best choice may cost more than the difference in value between the best option and a good-enough option.[62] Similarly, focusing too narrowly on the impact that a policy might have once it is implemented can blind us to the opportunity costs imposed by the political and technical obstacles to adoption and implementation.[63]

A. A New Standard

A next-best policy that can be quickly enacted and executed may do more good than a first-best one that is long delayed. But, if the best policy nevertheless has the prospect of performing significantly better than next-best policies, enacting a next-best policy today should not preclude pursuing the longer project of eventually complementing or replacing it with the very best one. Conversely, if an inferior policy can

---

59 Herbert A. Simon, *Rational Choice and the Structure of the Environment*, 63 PSYCHOL. REV. 129, 136 (1956).

60 *See* STEPHEN BREYER, BREAKING THE VICIOUS CIRCLE (1993); W. KIP VISCUSI, RATIONAL RISK POLICY (1998).

61 CASS R. SUNSTEIN, RISK AND REASON 107 (2001) ("[T]he goal [of CBA] is to overcome cognitive limitations by ensuring that people have a full, rather than limited, sense of what is at stake. People often miss the systemic effects of risk regulation; cost-benefit analysis is a way of putting these effects squarely on-screen."); BREYER, *supra* note 60, at 11 (recommending cost-benefit analysis to avoid "tunnel vision, a classic administrative disease . . . [in which the] single-minded pursuit of a single goal [goes] too far, to the point where it brings about more harm than good").

62 Simon, *supra* note 58; Herbert A. Simon, *Theories of Bounded Rationality*, *in* DECISION AND ORGANIZATION 161–76 (C. B. McGuire & Roy Radner eds., 1972).

63 Rogelj et al., *supra* note 7, at 79–83 (finding that a twenty year delay in action to reduce greenhouse gas emissions would dramatically increase the cost of mitigation and, "if mitigation action is delayed, simply spending more money on the problem in the future will not increase this probability [of successfully keeping warming below 2°C]").

be enacted immediately but has a significant prospect of eroding support for a far superior policy in the longer term, it may be worth opposing the former in favor of the latter, despite the delay. In short, one of the standards for evaluating next-best policies should be spillover effects on the likelihood of adopting first-best policies.

Comprehensive policies are often perceived to be superior (first-best) when compared to combinations of smaller, more focused (next-best) policies, but this perception may be wrong. More than three decades ago, Socolow observed that addressing a multifaceted environmental problem with multiple single-purpose measures may offer more flexibility and performance than a comprehensive multi-purpose project.[64] Rather than looking for a single unified policy to address a difficult problem, such as climate change, it may be more efficient to pursue a battery of "good enough" measures whose collective impact would meaningfully address the problem. This approach resembles the satisficing heuristic commonly applied to problems of bounded rationality, but whereas satisficing chooses the first good-enough candidate from a set of mutually exclusive options,[65] a standard of review that considers the timing of implementation will often recommend pursuing multiple good-enough policies from a set of compatible options.

This approach resembles proposals to address large environmental problems with "modular" approaches that "whittle away" at the problem through the coordinated actions of multiple agencies.[66] However, instead of focusing on agency coordination, we focus here on reducing obstacles to rapidly adopting public and private measures. The Stabilization Wedge concept builds on this point: it breaks the difficult problem of halting the growth of greenhouse gas emissions into a collection of fifteen separate policy "wedges," each of which reduces the rate of growth slightly using available technology, and which combine to produce a large collective impact.[67] Controversy around the stabilization wedge idea has focused on questions of whether enough wedges have been identified to compensate for business-as-usual

---

64 Robert Socolow, *Failures of Discourse: Obstacles to the Integration of Environmental Values into Natural Resouce Policy*, *in* WHEN VALUES CONFLICT : ESSAYS ON ENVIRONMENTAL ANALYSIS, DISCOURCE, AND DECISION 1, 30–33 (L. H. Tribe et al. eds., 1976).

65 Simon, *supra* note 62, at 168.

66 *See* Jody Freeman & Jim Rossi, *Agency Coordination in Shared Regulatory Space*, 125 HARV. L. REV. 1131 (2012); Jody Freeman & Daniel A. Farber, *Modular Environmental Regulation*, 54 DUKE L.J. 795 (2004); J. B. Ruhl & James Salzman, *Climate Change, Dead Zones, and Massive Problems in the Administrative State: A Guide for Whittling Away*, 98 CALIF. L. REV. 59 (2010).

67 Stephen Pacala & Robert Socolow, *Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies,* 305 SCIENCE 968 (2004).

growth of greenhouse gas emissions over 50 years.[68] But, these criticisms miss a larger point: even if the total emissions reduction from a set of wedges is inadequate to account for all business-as-usual emissions growth over a given period, they still can significantly reduce emissions growth over that time and can thus buy time to develop the revolutionary energy technology that both the advocates and the critics of wedges agree will ultimately be necessary.[69] For the political perfectionist, we note that comprehensive policies may, by dint of their sheer size and complexity, be much less popular than each of their parts: the Patient Protection and Affordable Care Act (commonly known as Obamacare) is very unpopular with the public, even though most of its major provisions are popular when considered separately.[70] In the climate policy arena, numerous proposals have attempted to address problems of perfectionism, including Pacala and Socolow's sustainability wedges,[71] Ostrom's polycentric governance,[72] Victor's international clubs,[73] Keohane's and Victor's regime complexes,[74] Stewart et al.'s bottom-up strategies,[75] and Dietz et al.'s behavioral wedges.[76]

---

[68] *See, e.g.*, ROGER A. PIELKE, JR., THE CLIMATE FIX 203–04 (2010) (asserting that "the Stabilization Wedge paper has been shown to be misleading and to dramatically understate the technological effort needed"); Steven J. Davis et al., *Rethinking Wedges*, 8 ENVTL. RES. LETTERS 011001 (2013) (asserting that "an unfortunate consequence of [the Stabilization Wedge] paper . . . was to make the solution seem easy"); Martin I. Hoffert, *Farewell to Fossil Fuels?*, 329 SCI. 1292, 1293 (2010) (finding that "the original wedges approach greatly underestimates needed reductions" and that "a total of twenty-five wedges" would be necessary to keep warming below 2°C). *But see* Robert Socolow, *Wedges Reaffirmed*, BULLETIN OF THE ATOMIC SCIENTIST (Sept. 27, 2011), http://thebulletin.org/wedges-reaffirmed (rejecting these criticisms, asserting that "the messages of the wedges paper are as important as ever" and arguing that "[a]chieving an emissions rate in 2061 no higher than today's is a goal that can be achieved by scaling up already deployed technologies . . . [a]nd an iterative process for resetting goals is essential, in order to take into account both new science and newly revealed shortcomings of 'solutions'").

[69] Hoffert, *supra* note 68.

[70] *Kaiser Health Tracking Poll*, KAISER FAMILY FOUNDATION (Apr. 1, 2012), http://kff.org/health-reform/poll-finding/kaiser-health-tracking-poll-april-2012/.

[71] Pacala & Socolow, *supra* note 67.

[72] Ostrom, *Nested*, *supra* note 44; Elinor Ostrom, *A Polycentric Approach for Coping with Climate Change* (World Bank Pol'y Res., Working Paper No. 5095, 2009).

[73] DAVID G. VICTOR, GLOBAL WARMING GRIDLOCK: CREATING MORE EFFECTIVE STRATEGIES FOR PROTECTING THE PLANET (2011); *see also* Aseem Pakash & Matt Potoski, *Green Clubs: Collective Action and Voluntary Programs*, 16 ANN. REV. POLI. SCI. 5.1 (2012).

[74] Robert O. Keohane & David G. Victor, *The Regime Complex for Climate Change*, 9 PERSP. ON POL. 7 (2011).

[75] *See, e.g.*, Richard Stewart, Michael Oppenheimer & Bruce Rudyk et al., *Building a More Effective Global Climate Regime Bottom-Up*, 14 THEORETICAL INQUIRIES L. 273, 281–304 (2013).

[76] Thomas Dietz, Gerald Gardner, Jonathan Gilligan, Paul C. Stern & Michael P. Vandenbergh, *Household Actions Can Provide a Behavioral Wedge to Rapidly Reduce US Carbon Emissions*, 106 PROC. NAT'L. ACAD. OF SCI. 18452, 18454–55 (2009).

One aspect of the panacea bias problem is the supposition that if a policy does not address international coordination, it is futile. This approach has contributed to the paralysis of U.S. and international climate policy.[77] Victor proposes cooperation among small clubs of nations as a superior approach to international coordination as it currently functions through the UNFCCC process.[78] At the other end of the spectrum, California's new cap and trade program, the Regional Greenhouse Gas Initiative, and other state and local initiatives demonstrate the political feasibility of sub-national action.[79] Although Victor's "clubs" proposal and other new international strategies are promising, we also argue that as the U.S. has both the second-largest national greenhouse gases emissions and one of the greatest per-capita emissions levels, it can play an important role as a unilateral actor. Our goal is to facilitate a more effective process for developing domestic climate policy.

B. Framework for Considering Political Opportunity Costs

We now step back to consider how best to account for political opportunity costs in the evaluation and selection of climate policy instruments. Morgan et al. wrote that global climate change is sufficiently different from other policy problems that "conventional tools of policy analysis, routinely applied, can lead to wrong or silly answers."[80] A large literature addresses planning and policy analysis for problems poorly suited for conventional rational utility maximization approaches[81] and considers alternatives to unified comprehensive

---

77 *See, e.g.*, Cass R. Sunstein, *The World vs. The United States and China? The Complex Climate Change Incentives of the Leading Greenhouse Gas Emitters*, 55 UCLA L. Rev. 1675, 1675 (2008) (asserting that, without binding commitments by China, "[p]roposals for unilateral action on the part of the United States seem to stem from an unruly mixture of confusion, hope, and a sense of moral obligation").

78 VICTOR, *supra* note 73. A complementary approach is to bypass public governance altogether in the near-term and harness private supply chain contracting. *See* Michael P. Vandenbergh, *Climate Change: The China Problem*, 81 S. CAL. L. REV. 905, 912 (2008).

79 *See, e.g.*, Justin Doom & Freeman Klopott, *Cuomo Proposes Lower Carbon Cap for Northeast Cap-and-Trade Plan,* BLOOMBERG (Jan. 9, 2013), http://www.bloomberg.com/news/2013-01-09/cuomo-proposes-lower-carbon-cap-for-northeast-cap-and-trade-plan.html (reporting that "[e]missions have declined about 30 percent from 2005 in the nine RGGI states").

80 M. Granger Morgan et al., *Why Conventional Tools for Policy Analysis Are Often Inadequate for Problems of Global Change*, 41 CLIMATIC CHANGE 271, 278 (1999).

81 Simon, *supra* note 59; Lindblom, *supra* note 2; Elinor Ostrom, *Beyond Markets and States: Polycentric Governance of Complex Economic Systems*, 100 AM. ECON. REV. 641, 665 (2010); Horst W. J. Rittel et al., *Dilemmas in a General Theory of Planning*, 4 POL'Y SCI. 155, 160 (1973); Jonathan Rosenhead et al., *Robustness and Optimality as Criteria for Strategic Decisions,* 23 OPERATIONAL RES. Q. 413, 415–18 (1972).

solutions.[82] Until recently, however, the policy and scholarly debate has continued to focus on comprehensive optimal solutions. Climate change has been widely described as a wicked, or even "super wicked" problem for policymaking.[83] Wicked problems are a class of intractable policy and planning problems, characterized by, among other factors, great uncertainties that limit predictive power; interconnectivity among their pieces, which prevents deconstructing a large problem into many smaller, more tractable ones; an enormous set of possible policy responses; and conflicts among stakeholders as to the appropriate policy goals.[84] Wicked problems cannot be solved optimally, both because criteria for judging solutions are subjective and disputed and because the complexity of the problem prevents accurately predicting how different measures will perform. We suggest drawing on the extant literature on both wicked problems and bounded rationality to develop a bi-focal standard of review that explicitly considers short-term factors, such as political feasibility and timing, without losing sight of long-term factors, including the magnitude of the hazard and the ultimate objective of managing that hazard.

Standard policy analysis evaluates policy instruments by considering the costs and benefits of executing the instrument and then applies a decision rule, such as maximizing the net benefit. We propose to extend this evaluation by explicitly considering the opportunity costs imposed by the political process for enacting and implementing the instrument. For climate policy, this can be integrated into existing frameworks for evaluating the costs and benefits of mitigation and adaptation policies. Alternatively, for those concerned about the inability of cost-benefit analysis to account for the structure of the climate change problem, it can be used as part of another structured decision-making process that does not quantify costs and benefits.

For mitigation policies, to the extent that we can predict "business-as-usual" emissions trajectories in the absence of new regulations, it is straightforward to compute how delays will affect the schedule of emissions reductions necessary to hit a target concentration of greenhouse gases and how great a delay will put a given target out of reach.[85] Computing the effect of delays, however, is complicated by

---

82 *See* Freeman & Farber, *supra* note 66, at 836–37; Ruhl & Salzman, *supra* note 66, at 60–62, 98–109; Ostrom, *A Polycentric Approach for Coping with Climate Change*, *supra* note 72, at 3–4; Ostrom, *Nested*, *supra* note 44, at 353–54.

83 *See, e.g.*, Lazarus, *supra* note 26, at 1159.

84 *Id.* (defining wicked problems); *see also* Rittel, *supra* note 81, at 160–69 (introducing the concept of wicked problems).

85 *See* Stocker, *supra* note 8, at 281; NAT'L ACAD. SCI., *supra* note 8, at 32–33, 38; Rogelj et al., *supra* note 43, at 406 (noting that in predicting future emissions, "the spread across models

uncertainties. Examples include the uncertainties associated with estimating the business-as-usual trajectory (1990 estimates completely missed the rapid growth of China's emissions, and a major effort was necessary to construct new "Representative Concentration Pathways" to allow models to account for the unanticipated acceleration of emissions), establishing the climate sensitivity parameter that connects greenhouse gas concentrations to temperature rise, and determining what temperature rise a policy should set as a target to avoid tipping points or catastrophic damage while at the same time keeping the costs of achieving that target commensurate with its benefits.[86]

For adaptation policies, scientists are still uncertain about many impacts of climate change over the coming century, but they understand factors such as sea level rise well enough to predict what types of adaptation may be necessary under different emissions scenarios. Information is also available about the costs of delaying the adoption of adaptation instruments, such as building enhanced water infrastructure for regions likely to face drought or revising land-use regulations for coastal communities facing sea-level rise.[87]

Although it may be possible to estimate the costs and benefits of delaying policy adoption, it is likely infeasible to prepare valuable quantitative estimates for the amount of time necessary to win support for controversial policies. Uncertainty about this critical piece of instrument evaluation means that attempts to optimize a climate policy will fail.[88] We face a problem closely related to bounded rationality. Bounded rationality occurs when an optimal decision exists but cannot

---

can be quite significant"); Rogelj, *supra* note 7, at 80–81 (observing that "social developments influencing energy demand . . . are . . . important" sources of uncertainty in forecasting business-as-usual emissions).

86 *See, e.g.*, PIELKE, *supra* note 20, at 12–15, 157–58 (asserting that these uncertainties make targets futile and counterproductive for policy design).

87 *See, e.g.*, Berry Gersonius et al., *Climate Change Uncertainty: Building Flexibility into Water and Flood Risk Infrastructure*, 116 CLIMATE CHANGE 411, 422 (2013) (describing "a way to use non-stationary probabilistic data for climate-proofing water and flood risk infrastructure"); Howard Kunreuther et al., *Risk Management and Climate Change*, 3 NATURE CLIMATE CHANGE 447–50 (2013) (describing a "robust decision-making" approach to manage adaptive measures, such as "the design of a facility to reduce the likelihood of damage from storm surge and sea-level rise"); Dylan E. McNamara & Andrew Keeler, *A Coupled Physical and Economic Model of the Response of Coastal Real Estate to Climate Risk*, 3 NATURE CLIMATE CHANGE 559–62 (2013) (analyzing the impact of sea-level rise and the effectiveness of adaptive flood-control measures in coastal communities under different scenarios).

88 *See, e.g.*, Rogelj, *supra* note 7, at 80, 81 (finding that "the dominant [uncertainty] is politics" because "the effect of global mitigation action delayed by two decades is much more pronounced than the consequences of uncertainty surrounding mitigation technology availability and future energy demands and renders even the geophysical uncertainties almost irrelevant").

be identified in practice.[89] Satisficing is a common approach to making decisions under bounded rationality,[90] but uncertainty and ambiguity may complicate this approach by making it difficult even to assess the satisfactoriness of an option. In such a case it may be useful to use non-probabilistic and robust decision-making approaches to developing criteria for acceptability. Using such criteria in conjunction with satisficing may be better suited to choosing climate instruments than optimization.[91]

Lindblom argues that public administration and policymaking require so many compromises among parties and entail so much unavoidable uncertainty that ends and means—typically distinct in theory and analysis—become indistinguishable in practice.[92] Accordingly, we do not propose a formal process for analyzing political opportunity costs but rather a framework that may prove helpful in assessing and assembling an adequate climate policy. In keeping with the limits on quantitative assessment regarding political opportunity costs, these guidelines are qualitative and focus more on asking whether or not an instrument is "good enough," instead of whether it is superior to another.

Several aspects of political opportunity costs are easily overlooked. We examine two that are particularly important given the structure of the climate problem.

Timing of Adoption. At the outset, the initial challenge is to assess the potential effect of overcoming political barriers on the timing of adoption (i.e. the delay while political obstacles are overcome) of the instrument under consideration. Multiple measures with modest impacts can add up to a significant effect, so screening candidates to eliminate trivial options may be better than ranking all options to choose the best one. Combining screening with ranking of secondary characteristics, such as potential emissions reductions, can help prioritize the search.[93]

Spillover Effects. Fighting to enact a measure entails opportunity costs both in the time lost waiting for adoption and in the resources expended on advocacy. The policy fight and the policy adopted also

---

89 *See, e.g.*, Simon, *Rational Choice*, *supra* note 59; Simon, *Theories of Bounded Rationality*, *supra* note 62.

90 Simon, *Theories of Bounded Rationality*, *supra* note 62, at 168.

91 *See, e.g.*, Kunreuther et al., *supra* note 87, at 449 ("Formal approaches, such as the maximization of expected utility or benefit-cost analysis, are difficult to apply in the presence of ambiguity with respect to the distribution of future climate scenarios. For most issues relevant to policy choices, the solution is to use more robust approaches to risk management that do not require ambiguous probabilities.").

92 Lindblom, *supra* note 2, at 83–84.

93 Gerd Gigerenzer & Daniel Goldstein, *Reasoning the Fast and Frugal Way: Models of Bounded Rationality*, 103 PSYCHOL. REV. 650, 651 (1996).

may affect the receptivity of the public and the political system to subsequent measures taken towards the same goal. Adopting one instrument could affect the chances of adopting other incremental or comprehensive instruments. If an incremental policy will undermine the likelihood of adopting a more effective policy, it may be undesirable. At the same time, the panacea bias may lead analysts to overestimate the likelihood of negative spillover effects from incremental policies.[94] Spillover effects will be difficult to assess and will resist quantification, but they should be the subject of explicit and careful debate.

Ironically, while those who focus on political feasibility often suggest emphasizing non-climate benefits to build a coalition that transcends the climate constituency, this rhetorical move may have negative spillover effects that diminish the prospects for incrementally achieving an adequate solution. Recent research suggests that public opinion on climate is largely shaped by media reports of politicians' statements on the topic.[95] If skeptical politicians continue to raise doubts about climate science, and politicians who agree with the scientific consensus substitute green jobs proposals and energy independence rhetoric for climate science discussion, the public may misinterpret the discourse, believe that climate change is not worthy of concern, and reduce support for additional measures whether incremental or comprehensive.

The consideration of political opportunity costs highlights the advantages of incremental policies. When comparing incremental climate instruments to comprehensive alternatives, several considerations are worthy of particular attention.

Complementarity. A concern about multiple policies is that they will undermine the performance of one another after their adoption. How will different measures fit together? Will feasible instruments complement or conflict with others on a similar time scale? Will the instrument complement or conflict with more comprehensive policies over the long term? Are they independent? Or are there synergies? Ostrom emphasizes that uncertainty over such interactions is precisely why we should pursue multiple measures at multiple scales of governance, in order "to learn which combined sets of actions are the most effective."[96]

---

[94] *See, e.g.*, GERNOT WAGNER, BUT WILL THE PLANET NOTICE?: HOW SMART ECONOMICS CAN SAVE THE WORLD 7 (2011) (arguing that single action bias research is a basis for not pursuing policies that target household behavior).

[95] *See* Robert Brulle et al., *Shifting Public Opinion on Climate Change: An Empirical Assessment of Factors Influencing Concern over Climate Change in the U.S.*, 2002-2010, 114 CLIMATIC CHANGE 169 (2012).

[96] OSTROM, *Nested*, *supra* note 44, at 4.

Flexibility. It is likely that the agency or organization executing a particular policy will need to make repeated changes to it before perfecting its implementation. Known uncertainties and unexpected consequences require that a policy be sufficiently flexible to evolve as administrators discover its strengths and weaknesses in practice as well as its interactions with other measures.[97] Flexible policies can be adjusted iteratively to optimize their performance and to maximize their complementarity with other measures.

Monitoring. Flexibility is of little use if we do not know how well the instrument is performing. Predicting the impact and cost of new policies is subject to uncertainty, so it will be critical to monitor the policy as it is implemented. Monitoring may also be more difficult and more important for multiple incremental policy approaches than for their comprehensive counterparts. When the basket of policies comprises many different parts, uncertainties apply not only to the individual pieces but also to their interactions within the overall policy.

Finally, a collection of measures that are politically feasible in the short-term may not be adequate in the long-term to address the problem of anthropogenic climate change. In time, a more complete basket of instruments or a single more comprehensive program of emissions reductions will likely be needed. Thus, to the extent possible, short-term policymaking should enable a smooth transition to a more comprehensive and unified policy or basket of policies. One major consideration here is how to transition from an initial phase, in which the measures are coordinated only loosely or not at all, to a mature phase, in which they function in a coordinated fashion to maximize synergies and minimize interference.[98]

C. Applying the Standard

How might this expanded approach look in practice? Here, we apply it to the two leading positions in the policy debates discussed above—the comprehensive carbon pricing instruments supported by many economists and the funding of research and development ("R&D") for inexpensive clean energy proposed by Prins et al.[99] Afterward, we identify several emerging approaches that reflect the types of considerations included in the expanded standard of review.

---

[97] *See* J.B. Ruhl & Robert L. Fischman, *Adaptive Management in the Courts*, 95 MINN. L. REV. 424, 426–36 (2010).

[98] Ruhl & Salzman, *supra* note 66, at 99; OSTROM, *Nested*, *supra* note 44, at 38–39.

[99] PRINS ET AL., *supra* note 20, at 30–32.

Cap and trade programs and carbon taxes emerge as the optimal remedy in the economics and legal literatures.[100] Moreover, after they weathered early concerns by environmentalists, they have become the preferred instruments at the domestic and global levels. These instruments appear to reduce emissions more efficiently than a command-and-control regulatory program directed at major greenhouse gas emitters.[101] Each is capable of producing optimally efficient reductions in greenhouse gas emissions, provided that the number of permits sold or the amount of tax assessed is based on accurate values for the marginal costs of climate change and emissions abatement.[102] Yet, political opposition to both policies has blocked them in Congress for more than a decade, and this opposition has only strengthened in recent years.[103] This political opportunity cost may represent trillions of dollars,[104] so our evaluation process would suggest that advocates of those policies consider adding other smaller and more politically acceptable measures to slow the growth of emissions in the short-term.

Political opportunity costs cannot be calculated precisely, largely because public opinion can change quickly and unexpectedly, as is demonstrated by the recent public opinion shift on same-sex marriage. But large uncertainties about the costs and benefits of implementing policies do not preclude their use as heuristics for examining the relative merits of competing options.[105] Our evaluation process would force consideration of political opportunity costs and their uncertainties and would thus be better than ignoring those costs.

Many critics of policies that focus on reducing energy demand or regulating emissions suggest that the only politically and technologically feasible policy is to encourage innovation in the energy sector in the hope of reducing the price of renewable energy below the price of fossil fuels.[106] Such measures would certainly pass our first criterion by having large impact. If realized, they would have the potential to solve the climate change problem in one stroke. As a

---

100 *See generally* Metcalf & Weisbach, *supra* note 17; Avi-Yonah & Uhlmann, *supra* note 17.

101 ATANAS KOLEV ET AL., INVESTMENT AND GROWTH IN THE TIME OF CLIMATE CHANGE, EUROPEAN INVESTMENT BANK 112 (Stephen Gardner ed., Econ. Dep't (EIB)/Bruegel 2012).

102 DALE W. JORGENSON ET AL., PEW CTR. ON GLOBAL CLIMATE CHANGE, THE ECONOMIC COSTS OF A MARKET-BASED CLIMATE POLICY, at xi (2008).

103 *See*, *e.g.*, David B. Spence, *Regulation, "Republican Moments," and Energy Policy Reform*, 2011 BYU L. REV. 1561, 1561–71 (2011).

104 *See* Nordhaus, *supra* note 9.

105 Cass R. Sunstein, *The Arithmetic of Arsenic,* 90 GEO. L.J. 2255, 2302 (2001) (noting that even when large uncertainties exist "an effort to trace both costs and benefits can inform inquiry, making decisions less of a stab in the dark").

106 PIELKE JR., *supra* note 20, at 224; PRINS ET AL., *supra* note 20, at 12; T. NORDHAUS & M. SHELLENBERGER, *supra* note 20, at 257–59.

general matter, support for federally funded research on energy technology has been popular for many years. The key questions for proposals that focus on clean-energy innovation concern the level of funding necessary, the time it would take a well-funded program to deliver clean energy technology, and how to shepherd the technology through the valley of death that separates successful laboratory demonstrations from marketable products. A clean-energy innovation program large enough to address climate change concerns may face even greater political opportunity costs than cap and trade or carbon taxes.[107] Support for solar and other clean-energy technology has received intense opposition,[108] which calls into question whether a sufficiently large innovation program can avoid the legislative gridlock encountered by emissions regulation bills.[109] Even if innovation is successful, Victor cautions against the "engineers' myth"—the assumption that once cheap, non-polluting energy technology becomes available, markets will quickly adopt it.[110] Thus, clean energy innovation alone seems unlikely to adequately address greenhouse gas emissions without more active government measures.

Fortunately, clean-energy innovation policies can mix well with other measures to address climate change. These policies are essential to mitigating climate change, but they cannot be its sole focus. As it is difficult to evaluate innovation programs, the history of energy technology policy is marked by exaggerated and premature declarations of triumph.[111] Revolutionary breakthroughs cannot be predicted,[112] so it would almost be impossible to determine whether a program designed to deliver such breakthroughs was on track. An energy innovation program could be compatible with a comprehensive emissions reduction program or a basket of incremental policies. Even if clean energy

---

107 Levi, *supra* note 5, at 74 ("[T]he prospect of substantial market intervention immediately sends the climate problem back whence technology was supposed to liberate it: the realm of grubby politics and ideology . . . . Indeed, the turn to technology may make ideological fights worse.").

108 Editorial, *The End of Clean Energy Subsidies*, N.Y. TIMES, May 5, 2012, at SR12; Matthew L. Wald, *Republicans Attack on Handling of Stimulus Money and Green Jobs*, N.Y. TIMES (Sept. 22, 2011), http://www.nytimes.com/2011/09/23/science/earth/23energy.html.

109 It is difficult to anticipate political responses in some cases. *See, e.g.*, Sean Collins Walsh, *GOP Bit to Void Light Bulb Law Fails,* N.Y. TIMES, July 12, 2011, at B2 (noting political opposition to energy efficient light bulb requirements).

110 VICTOR, *supra* note 77, at 7.

111 *Abundant Power from Atom Seen; It Will Be Too Cheap for Our Children to Meter, Strauss Tells Science Writers*, N.Y. TIMES, Sept. 17, 1954, at 5; Matthew L. Wald, *Report Questions Bush Plan for Hydrogen-fueled Cars*, N.Y. TIMES (Feb. 6, 2004), http://www.nytimes.com/2004/02/06/politics/06HYDR.html.

112 Matthew L. Wald, *For Energy Innovation, a Long Development Period*, N.Y. TIMES, Apr.13, 2012, at F9.

remained more expensive than fossil fuels, any reduction of its price would ease a transition to clean energy. In addition, as many critics of regulatory approaches have observed, it will be utterly impossible to prevent dangerous climate change unless we revolutionize clean energy technology.[113]

Several other approaches have emerged in recent years that reflect the types of considerations included in our expanded standard of review for climate instruments. At the domestic level, the Behavioral Wedge approach proposed by Dietz et al. seeks to reduce energy consumption by promoting non-intrusive, low cost measures at the household level.[114] The wedge comprises a collection of seventeen actions that could reduce U.S. CO_2 emissions by more than seven percent, satisfying our first criterion.[115] Policymakers in many cases can design wedge programs to avoid the political opposition that carbon pricing and restrictive regulations have encountered by relying on incentives, information, and marketing to induce voluntary action.[116] The Polycentric Governance approach advocated by Ostrom takes advantage of the heterogeneity of political feasibility at the state and local levels. Although major new climate instruments face almost insurmountable hurdles at the federal level as well as some state and local levels, meaningful measures are achievable in many states and localities.[117] The Polycentric Governance approach includes the adoption of many types of climate measures, ranging from Behavioral Wedges to carbon pricing and regulatory actions.[118] The key is that these approaches do not seek comprehensive solutions but contribute incrementally to the overall solution.[119]

---

113 PIELKE, JR., *supra* note 20, at 51–58; Roger A. Pielke, Jr., *An Evaluation of the Targets and Timetables of Proposed Australian Emissions Reduction Policies*, 14 ENVTL. SCI. & POL'Y 20 (2011); Roger A. Pielke, Jr., *Mamizu Climate Policy: An Evaluation of Japanese Carbon Emissions Reduction Targets,* 4 ENVTL. RES. LETTERS 044001 (2009); Roger A. Pielke, Jr. et al., *Dangerous Assumptions*, 452 NATURE 531 (2008); Martin. I. Hoffert et al., *Advanced Technology Paths to Global Climate Stability: Energy for a Greenhouse Planet*, 298 SCI. 981 (2002).

114 Dietz et al., *supra* note 76; *see also* Gerald T. Gardner & Paul C. Stern, *The Short List: The Most Effective Actions U.S. Households Can Take to Curb Climate Change*, 50 ENV'T 12 (2008); Amanda R. Carrico et al., *Energy and Climate Change: Key Lessons for Implementing the Behavioral Wedge*, 2 J. ENERGY & ENVTL. L. 61 (2011); Michael P. Vandenbergh & Anne C. Steinemann, *The Carbon-Neutral Individual,* 82 N.Y.U. L. REV. 1673 (2007).

115 Carrico et al., *supra* note 114, at 61.

116 Dietz et al., *supra* note 76, at 18453; Michael P. Vandenbergh et al., *Implementing the Behavioral Wedge: Designing and Adopting Effective Carbon Emissions Reduction Programs*, 40 ENVTL. LAW REP. 10547, 10548–50 (2010).

117 Ostrom, *Nested*, *supra* note 44, at 356–59.

118 *Id.*; *see also* Stewart, Oppenheimer & Rudyk, *supra* note 75 (advocating bottom-up approaches).

119 Further research, especially in the social and behavioral sciences, is necessary to better understand the opportunities to reduce greenhouse gas emissions and to identify best practices. K.

At the international level, Victor and Keohane have advocated focusing on "climate clubs" and "regime complexes," rather than waiting for comprehensive international agreements.[120] This approach likewise recognizes the opportunity costs of delay in gaining political support for a multilateral treaty that includes most, if not all, of the major emitting nations. Keohane and Victor have noted that some private organizations are addressing carbon emissions and include them in their regime complexes.[121] Similarly, several authors have argued that supply chain contracting and other private governance activities can bypass political infeasibility problems that exist at the nation-state level.[122] The approach of Chakravarty et al. also recognizes the political barriers to comprehensive climate instruments.[123] This approach does not seek to achieve all necessary emissions reductions, which would likely require including much of the global population. Instead, it argues that climate justice issues can be accounted for while still achieving large emissions reductions by focusing on achieving emissions reductions from the top billion individuals, regardless of their location around the globe.[124]

IV. CONCLUSION

Comprehensive climate approaches that will take a decade to adopt may appear preferable to immediate incremental approaches, but this is a function of the narrow standard of review, not an accurate comparison of the relative merits of the instruments. The nearly exclusive pursuit of comprehensive policies has led to insufficient focus on political opportunity costs, a subject that is outside the domain of many scholars who analyze climate instruments. The need for emissions reductions that are both large and prompt warrants a re-examination of the relative merits of incremental and comprehensive policies. We suggest a new framework for thinking about political opportunity costs and identify new policies that reflect the importance of these costs for climate change mitigation.

S. Gallagher & J. C. Randell, *What Makes U.S. Energy Consumers Tick?,* 28 ISSUES SCI. & TECH. 35 (2012); Paul C. Stern, *Contributions of Psychology to Limiting Climate Change*, 66 AM. PSYCHOL. 303 (2011).

120 VICTOR, *supra* note 73, at 10–12; Keohane & Victor, *supra* note 74, at 8–9.

121 Keohane & Victor, *supra* note 74, at 8.

122 *See* Michael P. Vandenbergh, Tom Dietz & Paul C. Stern, *Time to Try Carbon Labeling*, 1 NATURE CLIMATE CHANGE 4 (2011); Eric Orts, *Climate Contracts*, 29 VA. ENVTL. L.J. 197 (2011); Michael P. Vandenbergh, *The New Wal-Mart Effect: The Role of Private Contracting in Global Governance*, 54 UCLA L. REV. 913–970 (2007).

123 Chakravarty et al., *Sharing Global CO_2 Emissions Reductions Among One Billion High Emitters,* 106 PROC. NAT'L ACAD. SCI. 11884 (2009).

124 *Id.*