

Energy and Climate Change: A Climate Prediction Market

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ABSTRACT

Much of energy policy is driven by concerns about climate change. Views about the importance of carbon emissions affect debates on topics ranging from the regulation of electricity generation and transmission to the need for incentives to develop emerging technologies. Government efforts to fund and communicate climate science have been extraordinary, but recent polling suggests that roughly half of the American population is unsure or does not believe that anthropogenic climate change is occurring. Among some populations, belief in climate change is declining even as the climate science becomes more certain. Much of the doubt occurs among individuals who support free markets, and the doubt is fueled by the argument that governments and government-funded climate scientists are not accounting for information that is inconsistent with the climate consensus. This Article explores a private governance response: the creation of a prediction market to assess and communicate the implications of climate science. Markets not only allow the buying and selling of goods, but also provide information about the likelihood of future events. Research suggests that markets are often able to account for information that is outside of the conventional wisdom. In addition, individuals who are likely to doubt climate science may find markets to be credible sources of information. A climate market could take the form of an academic initiative along the lines of the Iowa presidential prediction market or could operate as a more traditional options market. Trading could occur over the types of predictions that matter for global climate change, such as the global average temperature or sea level in 2020 or 2100, with the current market value of the prediction signaling the likelihood of the outcome. The market will be subject to manipulation concerns, but experience with other prediction markets suggests that a climate prediction market could provide an accurate, credible, and widely disseminated signal about the status of the climate science.

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INTRODUCTION

This Article proposes a private governance response to one of the most difficult challenges to rational energy policy: the disconnect between scientific and public views on anthropogenic climate change. Research finds that approximately 97 percent of scientists who express views on anthropogenic climate change agree that the warming is real and is caused by human activity.¹ Yet as of 2013 only 49 percent of Americans believe climate change is caused by humans,² and the percentage of doubters has grown as the climate science has become more certain.³ The Intergovernmental Panel on Climate Change (IPCC) has issued five comprehensive reports since 1990, the most recent of which concludes that it is 95 to 100 percent certain “that human influence has been the dominant cause of the observed warming since the mid-20th century.”⁴ Commentators in public policy debates differ widely on whether the IPCC has understated or overstated the likelihood and extent of anthropogenic climate change harms, and viewpoints about anthropogenic climate change drive much of the energy law and policy debate.⁵ Those who view anthropogenic climate change as a serious threat advocate phasing out fossil fuels, investing in research and development of low-carbon technologies, and creating incentives for energy efficiency. Those who doubt the climate-science consensus often support fossil

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1. See John Cook et al., *Quantifying the Consensus on Anthropogenic Global Warming in the Scientific Literature*, ENVTL. RES. LETTERS, Apr.–June 2013, at 1, 4 (finding that 97 percent of scientific articles that addressed anthropogenic global warming agreed that the warming is real and is caused by human activity and that 96 percent of scientists “who authored papers expressing a view on [anthropogenic global warming] . . . endorsed the consensus.”).
 2. See ANTHONY LEISEROWITZ ET AL., YALE PROJECT ON CLIMATE CHANGE COMM’N & GEORGE MASON UNIV. CTR. FOR CLIMATE CHANGE COMM’N, CLIMATE CHANGE IN THE AMERICAN MIND: AMERICANS’ GLOBAL WARMING BELIEFS AND ATTITUDES IN APRIL 2013, at 6 (2013). Although higher percentages believe the climate is changing, these numbers are less valuable from a policy perspective because a belief that the climate is changing, but that humans are not causing it, is unlikely to generate support for government action to reduce carbon emissions.
 3. See *infra* Part I.A.
 4. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS 2 n.2, 15 (2013) [hereinafter IPCC 2013 REPORT] (stating that “[i]t is extremely likely that human influence has been the dominant cause of the observed warming,” and defining “extremely likely” to mean 95 to 100 percent likelihood).
 5. For example, some climate scientists have argued that the 2007 Intergovernmental Panel on Climate Change (IPCC) report understated concerns about sea-level rise. See, e.g., Keynyn Brysse et al., *Climate Change Prediction: Erring on the Side of Least Drama?*, 23 GLOBAL ENVTL. CHANGE 327, 332–33 (2013); Michael Oppenheimer et al., *The Limits of Consensus*, 317 SCIENCE 1505, 1505 (2007); Stefan Rahmstorf, Commentary, *A New View on Sea-Level Rise*, 4 NATURE REP. CLIMATE CHANGE 44, 44 (2010).

fuel use and oppose investments in low-carbon technologies and energy efficiency programs. Although energy policy debates are also heavily influenced by other considerations (such as price, non-climate environmental concerns, and energy security), views about climate science drive much of the difference in preferred energy policies.

Governments and advocacy groups have responded to the climate-science disconnect with more information and different framing, drawing on a deep body of research from the behavioral and social sciences.⁶ Some have argued that climate advocates should focus on connecting global warming to near-term harms, such as droughts, heat waves, and hurricanes.⁷ In recent years, however, it has become increasingly clear that the uncertainty inherent in attribution of near-term events may itself feed doubt and induce inaction.⁸ Sophisticated guides have been developed that describe how scientists should communicate climate concepts to the public, and many scientists have received media training.⁹ Vigorous debates have occurred over whether the issue should be framed as “climate change” or “global warming.” None of these efforts has succeeded in reducing the gap between the beliefs of climate scientists and roughly half of the general public.

This Article examines the potential for a private governance response to the climate-science disconnect: a climate prediction or futures market.¹⁰ The

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6. See, e.g., George Lakoff, *Why It Matters How We Frame the Environment*, 4 ENVTL. COMM. 70 (2010).
 7. For a discussion of this topic, see Elke U. Weber, *Experience-Based and Description-Based Perceptions of Long-Term Risk: Why Global Warming Does Not Scare Us (Yet)*, 77 CLIMATIC CHANGE 103 (2006).
 8. See, e.g., ROGER PIELKE, JR., THE CLIMATE FIX: WHAT SCIENTISTS AND POLITICIANS WON'T TELL YOU ABOUT GLOBAL WARMING, 175, 186–88 (2010) (noting that “[i]t is today not possible to identify the influence of accumulating carbon dioxide . . . in the global disaster record . . . much less in any region around the world; . . . an unequivocal link [is] unlikely to be found anytime soon,” and those who make exaggerated claims of such links risk “[l]ost credibility” and spur nonsensical accusations by skeptics “that all of climate science is a hoax or fraud”); Andrew C. Revkin, *Could Climate Campaigners' Focus on Current Events be Counterproductive?*, DOT EARTH BLOG (Aug. 20, 2013, 10:14 AM), <http://dotearth.blogs.nytimes.com/2013/08/20/could-climate-campaigners-focus-on-current-events-be-counterproductive>.
 9. See, e.g., AMERICA'S CLIMATE CHOICES: PANEL ON INFORMING EFFECTIVE DECISIONS & ACTIONS RELATED TO CLIMATE CHANGE, INFORMING AN EFFECTIVE RESPONSE TO CLIMATE CHANGE 14–17 (2010); RICHARD HAYES & DANIEL GROSSMAN, A SCIENTIST'S GUIDE TO TALKING WITH THE MEDIA: PRACTICAL ADVICE FROM THE UNION OF CONCERNED SCIENTISTS (2006); REPORTING ON CLIMATE CHANGE: UNDERSTANDING THE SCIENCE (L. Jeremy Richardson with Bud Ward eds., 4th ed. 2011); CLIMATE ACCESS, http://www.climateaccess.org/about_us (last visited Jan. 20, 2014) (providing access to climate communication research, blogs, and related tools).
 10. For a discussion of private governance responses to environmental problems, see Michael P. Vandenbergh, *Private Environmental Governance*, 99 CORNELL L. REV. 129 (2013). The term

prediction market could allow trading in global average surface temperature, sea level increases, Arctic sea ice loss, frequency of heat waves or droughts, and other climate outcomes. The trading could occur over the status of these outcomes in the near term and the long term, whether 2020, 2050, 2100, or 2500, and the market price could provide a signal of current views about the likelihood of the outcome. For example, a prediction or future could be that the global average temperature in the 2081–2100 period will be 2 °C over the preindustrial average. If this prediction is trading for a very low amount, the low value will raise questions about whether the climate-science consensus is overstating concerns about climate outcomes. If a 4 °C prediction in 2081–2100 is trading at a high price, the market signal will be that climate scientists are understating the concerns. Other factors, such as the effects of economic conditions, policies, and technology developments on global emissions pathways, may also be reflected in the price, but factors that moderate greenhouse gas emissions can only affect warming to the extent that greenhouse gases control the planet's temperature. Such bets would therefore largely reflect participants' beliefs about climate science, despite these complicating factors. The market-derived information could be communicated to the public via electronic and print media stories, through daily financial tables, and through media reports on policy debates.¹¹

A private climate prediction market could address two aspects of the climate-science disconnect: the accuracy of the scientific consensus on key aspects of anthropogenic climate change and the willingness of climate doubters to update beliefs about the climate science. First, a climate prediction market may provide a new test for the accuracy of the climate-science consensus. One of the principal concerns raised by those who reject the consensus view is that climate scientists are rejecting inconsistent data and studies because they are influenced by the pursuit of research funds, liberal political views, or groupthink. Research on prediction markets suggests that markets are often quite successful aggregators of knowledge on a topic, including information that is not accepted by the

“private” has been used to refer to markets in which only the employees or agents of a particular organization can participate, such as a private prediction market that a corporation might use to predict when a product will be completed, Tom W. Bell, *Private Prediction Markets and the Law*, 3 J. PREDICTION MARKETS 89, 89–90 (2009), but we use the term to mean a market that is private in the sense that it is established and managed by a nongovernmental entity but is open to all participants.

11. Research suggests that many people receive much of their climate information from media coverage of statements on climate by policymakers. See Robert J. 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, 175 (2012).

views of experts.¹² In short, if valuable information is being inappropriately excluded from the mainstream climate science, the climate prediction market may provide a means of demonstrating the importance of that information.

Second, the source of information plays an important role in belief formation, and markets may be a trusted source of information to many individuals who are also climate doubters. Climate doubters occur across the political spectrum, but they are heavily concentrated among conservatives and libertarians.¹³ Many conservatives and libertarians tend to reject information from traditional sources of climate news, but their support for free markets as policy instruments suggests that they may view markets as more credible sources of information across a wide range of topics.¹⁴ Markets are not likely to be a silver bullet, however;

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12. See *infra* notes 73–84, 128–216 and accompanying text. As we discuss in Part IV, the idea of a climate prediction market has been floated in blogs and in legal literature. See, e.g., Tom W. Bell, *Prediction Markets for Promoting the Progress of Science and the Useful Arts*, 14 GEO. MASON L. REV. 37, 46–47 (2006) (discussing sea level rise predictions on the Foresight Exchange in evaluating the value of “scientific prediction exchanges”); Shi-Ling Hsu, *A Prediction Market for Climate Outcomes*, 83 U. COLO. L. REV. 179 (2011) (proposing government adoption of a carbon tax and cap-and-trade system that would create a prediction market in climate outcomes); Robin Hanson, *It’s News on Academia, Not Climate*, OVERCOMING BIAS (Nov. 22, 2009, 1:00 PM), <http://www.overcomingbias.com/2009/11/its-news-on-academia-not-climate.html> (the author and commenters discussing climate prediction markets, damage futures, and catastrophe bonds); Dan Kahan, *Money Talks, & Without the Bias of Cultural Cognition: So Why Not Listen?*, THE CULTURAL COGNITION PROJECT BLOG (May 26, 2013, 9:15 AM), <http://www.culturalcognition.net/blog/2013/5/26/money-talks-without-the-bias-of-cultural-cognition-so-why-no.html> (discussing “an index of securities (and like instruments) the value of which depend on global warming actually occurring”); Roger Pielke Jr., *Betting on Climate*, CSTPR COLORADO (June 14, 2005, 6:32 AM), http://cstpr.colorado.edu/prometheus/archives/climate_change/000462betting_on_climate.html (suggesting research on a prediction market “that would allow trading based on specific predicted outcomes such as the weather”); Nate Silver, *Best Idea of the Day: Climate Change Futures Markets*, FIVETHIRTYEIGHT.COM (Nov. 23, 2009, 6:57 PM) <http://www.fivethirtyeight.com/2009/11/best-idea-of-day-climate-change-futures.html> (proposing government-sponsored climate change futures market). Our contributions are to demonstrate that private institutions can create a climate prediction market that bypasses the gridlock that would be faced by an effort to establish a government prediction market and to explain why private markets are particularly well suited to reaching the moderates and conservatives who make up a large share of the climate doubters in the United States.
 13. See *infra* notes 23–47 and accompanying text; see also Yuko Heath & Robert Gifford, *Free-Market Ideology and Environmental Degradation: The Case of Belief in Global Climate Change*, 38 ENV’T & BEHAV. 48 (2006). For a discussion of climate doubt among libertarians, see Chris Rapley, *Time to Raft Up*, 488 NATURE 583 (2012); George Monbiot, *Why Libertarians Must Deny Climate Change*, in *One Short Take*, GUARDIAN (Jan. 6, 2012), <http://www.theguardian.com/environment/georgemonbiot/2012/jan/06/why-libertarians-must-deny-climate-change>.
 14. See *infra* notes 115–119; see also John T. Jost et al., *Fair Market Ideology: Its Cognitive-Motivational Underpinnings*, 25 RES. ORGANIZATIONAL BEHAV. 53 (2003); Wendy Larner, *Neo-liberalism: Policy, Ideology, Governmentality*, 63 STUD. POL. ECON. 5 (2000); Joel Spring, *Research on Globalization and Education*, 78 REV. EDUC. RES. 330, 343–44 (2008); David Willetts, *Modern Conservatism*, 63 POL. Q. 413, 413–15 (1992).

even individuals who generally place great faith in markets may be inclined to reject market-generated information if it conflicts with other values, and their media sources may ignore or ambiguate the message from a climate prediction market.¹⁵ Nonetheless, willingness to wager one's own money on one's beliefs has widely been seen as a source of credibility on both the left and the right.¹⁶ This information also may be useful in shifting the views of political moderates. Although most climate doubters tend to be politically conservative, a substantial minority (29 percent) of climate doubters identify as political moderates.¹⁷ The members of this group are not as ideologically opposed to climate science as their conservative counterparts, may gather information from a wide range of media sources, and may be particularly able to shift their views on climate change if provided with credible alternative sources of information.

The private climate prediction market concept draws on the emerging interest in identifying private governance initiatives that can complement and fill gaps in public governance. In Part I, the Article examines beliefs about climate science in the United States and suggests that more or better-framed information is important but insufficient to motivate support for major shifts in energy policy. Intrinsic problems arising from complexity and lag times in the climate system cannot be overcome entirely, but Part II focuses on two aspects of the climate science that contribute to the disconnect between climate scientists and doubters: concerns about the accuracy of the climate science and distrust of government-sourced climate-science information. These problems are grounded in skepticism about the role of government, a concern that private markets may be well-positioned to address. Part III outlines the contours of a private prediction market that could be established promptly within the current legal framework and that could generate credible, accurate, and widely disseminated assessments of the climate science. The goal is not to advance market theory or to identify the optimal design of a climate prediction market but to demonstrate

15. See discussion *infra* notes 189–193. For a discussion of the influence that ambiguation can have on social norms, see Lawrence Lessig, *The Regulation of Social Meaning*, 62 U. CHI. L. REV. 943, 1010–12 (1995).

16. See, e.g., PAUL SABIN, THE BET: PAUL EHRLICH, JULIAN SIMON, AND OUR GAMBLE OVER EARTH'S FUTURE 134, 137 (2013) (“Complaining that Ehrlich made wild statements without ever facing the ‘consequences of being wrong,’ Simon said, ‘I’ll put my money where my mouth is’ and asked Ehrlich to do the same. . . . For both sides, the real winnings would be bragging rights and the chance to prove that they were right about the future course of history.”); Jim Giles, *Climate Sceptics Place Bets on World Cooling Down*, 436 NATURE 897 (2005).

17. See ANTHONY LEISEROWITZ, ET AL., YALE PROJECT ON CLIMATE CHANGE COMM’N & GEORGE MASON UNIV. CTR. FOR CLIMATE CHANGE COMM’N, GLOBAL WARMING’S SIX AMERICAS IN MARCH 2012 AND NOVEMBER 2011, at 44 tbl.17 (2012), available at <http://environment.yale.edu/climate-communication/files/Six-Americas-March-2012.pdf>.

that a near-term approach is feasible given current legal constraints. Part IV turns to longer-term solutions and suggests that if regulatory hurdles can be overcome, a more robust climate prediction futures market can be developed to address the climate-science disconnect.

I. DOUBTING IN AMERICA—UNPACKING PUBLIC OPINION

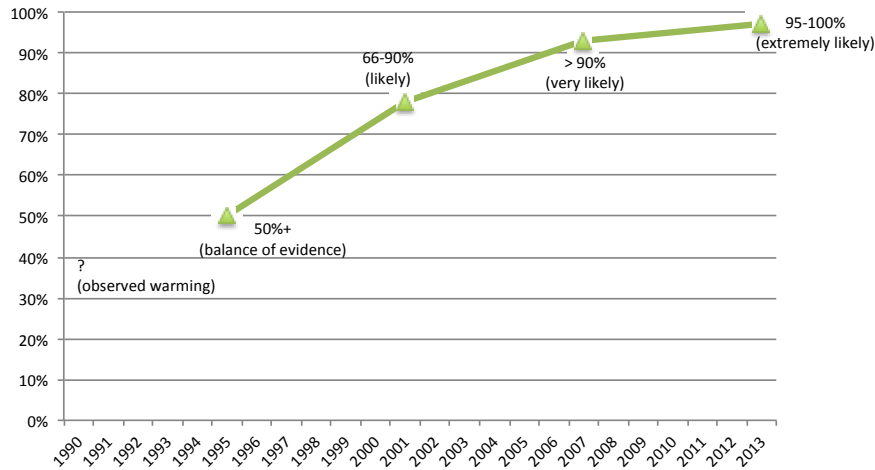
By looking behind public polling data, it is possible to understand many of the sources of the disconnect between the views of climate scientists and those of the general public. This discussion examines the answers to three questions: Who is accepting and rejecting the climate science? To what extent is a concern that scientists are rejecting certain data or studies influencing doubts about climate science? To what extent is the source of the climate-science information influencing beliefs about the science?

A. Views on Climate Science

The IPCC consists of hundreds of experts convened by the United Nations (UN) and the World Meteorological Society, and its reports are reviewed and approved by the governments of most countries. The IPCC has issued five climate change reports, and these reports have expressed an increasing likelihood that anthropogenic climate change is occurring. Figure 1¹⁸ charts the conclusions regarding anthropogenic climate change beginning with the IPCC's first assessment report in 1990 and concluding with the statement in the recently released 2013 summary for policymakers.

18. This figure is assembled from the conclusions presented in the five IPCC assessment reports issued from 1990 to 2013. See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, POLICYMAKERS SUMMARY, at xxix (J.T. Houghton et al. eds., 1990) [hereinafter IPCC 1990 REPORT], available at http://www.ipcc.ch/ipccreports/far/wg_I/ipcc_far_wg_I_spm.pdf; INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 1995 4–5 (J.T. Houghton et al. eds., 1996), available at https://docs.google.com/uc?export=download&confirm=no_antivirus&id=0B1gFp6Ioo3aka3NsaFQ3YIE3XzA; INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2001: SYNTHESIS REPORT 5 box SPM-1, 31 tbl.SPM-3 (2001) [hereinafter IPCC 2001 REPORT], available at http://www.grida.no/climate/ipcc_tar/vol4/english/pdf/spm.pdf; INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, SUMMARY FOR POLICYMAKERS 3 n.6, 10 (2007), available at <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf>; IPCC 2013 REPORT, *supra* note 4, at 2 n.2, 15.

FIGURE 1. IPCC: Likelihood That Observed Climate Change Is Mostly Anthropogenic



Although the first assessment report, released in 1990, did not address the issue directly (noting only that “observed warming” had occurred), each subsequent report has included language addressing the likelihood of anthropogenic climate change. From 1995 to 2013, each report used language indicating an increasing likelihood that humans are contributing to climate change, and the last three reports provided quantitative estimates of that likelihood. The conclusions from these four reports increase from “a balance of evidence” (which we assume to be something over 50 percent), to “likely” (which the IPCC concludes is over 66 percent), to “very likely” (over 90 percent according to the IPCC), to “extremely likely” (95 to 100 percent).¹⁹ Research suggests that 97 percent of the climate scientists who publish most often in the field of climate science concur with the IPCC’s principal conclusions regarding anthropogenic climate change, and the vast majority of the peer-reviewed publications on the topic do as well.²⁰

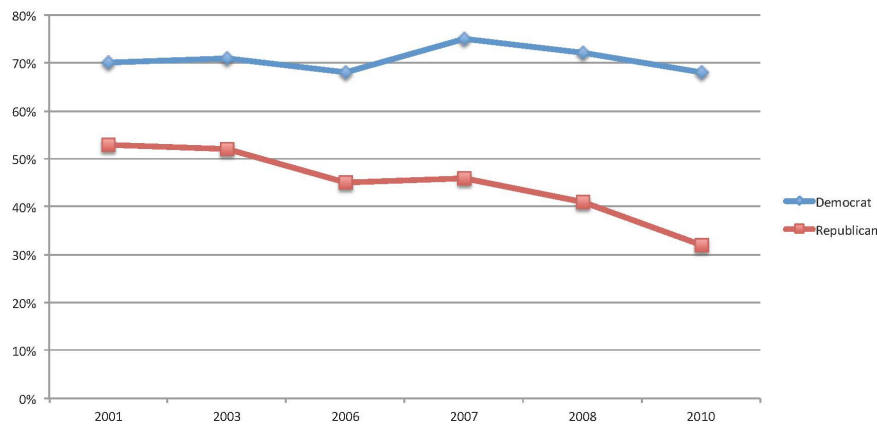
These trends in views among climate scientists contrast with trends in public beliefs over this period. As research by Aaron McCright suggests (Figure 2), beliefs in anthropogenic climate change have not increased along with the scien-

19. IPCC 1990 REPORT, *supra* note 4, at 4; IPCC 2013 REPORT, *supra* note 4, at 2 n.2.

20. See Naomi Oreskes, *Beyond the Ivory Tower: The Scientific Consensus on Climate Change*, 306 SCIENCE 1686 (2004); see also Cook et al., *supra* note 1, at 4 (concluding that 97.1 percent of the 4000 academic papers that considered the cause of climate change since 1991 pointed to humans, 1.0 percent were uncertain, and 1.9 percent concluded that people were not a factor).

tific consensus, and political beliefs predict a substantial share of climate doubt. Doubts about the climate science in the United States show a clear liberal-conservative orientation, with conservatives making up the vast majority of the doubters. For example, as Figure 2 indicates, in 2010 roughly 70 percent of Democrats, but only 30 percent of Republicans, believed that changes in the earth's temperature over the last century are due more to human activities than to natural causes. Other research has shown that a large minority of political moderates doubts climate science.²¹

FIGURE 2. Percentage of Americans Who Believe That Climate Change Is Mostly Anthropogenic²²



In addition, the divergence of views is increasing. Although the certainty expressed in major climate-science reports has increased since 2001, the percentage of Democrats who accept the science has not changed, and the percentage of Republicans who accept the science has fallen by almost half (from roughly 50 percent to 30 percent). As the science has become more certain, beliefs have become increasingly polarized, with climate change doubt and conservative ideology going

21. See LEISEROWITZ ET AL., *supra* note 17, at 44.

22. Original by Aaron M. McCright and Riley E. Dunlap (based on 10 pooled 2001–2010 Gallup polls of representative samples of 1000 or more adults); see also Aaron M. McCright & Riley E. Dunlap, *Cool Dudes: The Denial of Climate Change Among Conservative White Males in the United States*, 21 GLOBAL ENVTL. CHANGE 1163 (2011); Aaron M. McCright & Riley E. Dunlap, *The Politicization of Climate Change and Polarization in the American Public's Views of Global Warming, 2001–2010*, 52 SOC. Q. 155, 193 (2011).

hand-in-hand.²³ In fact, conservative trust in science in general has been declining over the past 40 years.²⁴ Recent research suggests that this declining trust in science among conservatives may be related to concerns that scientific research will provide evidence that justifies calls for additional environmental or public health regulations.²⁵

In the face of the deep disconnect between the increasing body of climate-science information and the decreasing acceptance of that information by conservatives, it is important to understand how information is located, assessed, and accepted or rejected. In the last decade, significant advances have been made in the understanding of how individuals form beliefs about policy-relevant scientific issues. Although some have argued that conservatives do not accept climate change because they are closed-minded,²⁶ lack scientific education on climate change,²⁷ or irrationally reject data and reason,²⁸ other research has shown that lack of knowledge or information is not the driving cause of climate-science doubt.²⁹

B. Values

Many of the reasons for rejecting anthropogenic climate change are somewhat logical at the individual level. The gap between scientists and doubters stems from a cognitive function that rejects information that threatens core values. Psychologists have identified dozens of features of cognition that make cli-

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23. See ANTHONY LEISEROWITZ ET AL., YALE PROJECT ON CLIMATE CHANGE COMM'N & GEORGE MASON UNIV. CTR. FOR CLIMATE CHANGE COMM'N, GLOBAL WARMING'S SIX AMERICAS IN SEPTEMBER 2012, at 42 (2013); PUBLIC POLICY POLLING, NATIONAL SURVEY RESULTS: MARCH 27–30, 2013 (2013) (noting that 71 percent of those who believe global warming is a hoax are “very conservative”).
 24. See Gordon Gauchat, *Politicization of Science in the Public Sphere: A Study of Public Trust in the United States, 1974 to 2010*, 77 AM. SOC. REV. 167, 167 (2012).
 25. See Aaron M. McCright et al., *The Influence of Political Ideology on Trust in Science*, ENVTL. RES. LETTERS, Oct.–Dec. 2013, at 1.
 26. See Dan M. Kahan, *Ideology, Motivated Reasoning, and Cognitive Reflection*, 8 JUDGMENT & DECISION MAKING 407, 408 (2013).
 27. See Dan M. Kahan et al., *The Tragedy of the Risk-Perception Commons: Culture Conflict, Rationality Conflict, and Climate Change 1* (Yale Law Sch., Cultural Cognition Project, Working Paper No. 89, 2011), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1871503.
 28. See Irina Feygina et al., *System Justification, the Denial of Global Warming, and the Possibility of “System-Sanctioned Change,”* 36 PERSONALITY & SOC. PSYCHOL. BULL. 326, 327–28 (2010); Kahan et al., *supra* note 27, at 13–14.
 29. See Dan M. Kahan et al., *The Polarizing Impact of Science Literacy and Numeracy on Perceived Climate Change Risks*, 2 NATURE CLIMATE CHANGE 732 (2012).

mate science particularly hard for individuals to accept.³⁰ In fact, the problems are so difficult they have become known as “dragons.”³¹

Research by Dan Kahan and colleagues has examined how people process information to conform to their core values and their communities’ preferences.³² To describe the difference in value sets, this research borrows worldview distinctions from psychology that square fairly well with liberal and conservative ideologies.³³ An egalitarian-communitarian individual values “collective attention to individual needs” and may be distrustful of industry or institutions they view as distorting equality.³⁴ Individuals who hold these views often are more liberal and more likely to vote Democratic than the general public. In contrast, hierarchical-individualists value social structure and oppose restriction on autonomy.³⁵ These individuals are often more conservative and more likely to vote Republican.³⁶ Liberals and conservatives also tend to rely on different values to guide moral decision-making. Liberals tend to focus more on the amount of harm an event might cause and the degree of fairness involved, whereas conservatives also incorporate notions of loyalty, respect for authority, and purity into moral judgments.³⁷

These differing values are even more important when people feel threatened. Research on system justification has shown that when people are under threat, they often react by upholding the status quo of their society.³⁸ Other theorists argue that when people are reminded of their mortality, they focus more on their core values, to the exclusion of outside groups or worldviews.³⁹ Climate science is inherently threatening because it implies both threats to one’s general health and safety due to the physical effects of climate change and also threats to one’s lifestyle if major behavioral or regulatory changes are imposed as a part of

30. See Robert Gifford, *The Dragons of Inaction: Psychological Barriers That Limit Climate Change Mitigation and Adaptation*, 66 AM. PSYCHOL. 290 (2011); AM. PSYCHOLOGICAL ASS’N TASK FORCE ON THE INTERFACE BETWEEN PSYCHOLOGY & GLOBAL CLIMATE CHANGE, PSYCHOLOGY & GLOBAL CLIMATE CHANGE: ADDRESSING A MULTIFACETED PHENOMENON AND SET OF CHALLENGES 64–69 (2009), available at <http://www.apa.org/science/about/publications/climate-change-booklet.pdf>.

31. See Gifford, *supra* note 30, at 290–91.

32. See Kahan et al., *supra* note 27, at 11–13.

33. See *id.* at 733 (“Cultural-world-view and political-orientation measures are modestly correlated.”).

34. *Id.* at 732.

35. See *id.*

36. See *id.* at 733.

37. See Jesse Graham et al., *Liberals and Conservatives Rely on Different Sets of Moral Foundations*, 96 J. PERSONALITY & SOC. PSYCHOL. 1029, 1029 (2009).

38. See John T. Jost et al., *A Decade of System Justification Theory: Accumulated Evidence of Conscious and Unconscious Bolstering of the Status Quo*, 25 POL. PSYCHOL. 881, 890 (2004).

39. See Jeff Greenberg et al., *Terror Management Theory of Self-Esteem and Cultural Worldviews: Empirical Assessments and Conceptual Refinements*, 29 ADVANCES EXPERIMENTAL SOC. PSYCHOL. 61, 65–66 (1997).

mitigation. Thus, liberals and conservatives may react to threatening climate information by retreating to their differing core values. This retreat in reaction to climate threats may help explain the widening gap between the climate change beliefs of Republicans and Democrats even as more climate science has been released.⁴⁰

Part of the polarization in views of the climate science also can be blamed on the portrayal of climate change as closely aligning with liberal values and countering conservative values.⁴¹ A person having a hierarchical-individualist worldview equates climate change acceptance with acceptance of restriction, the failure of industry, and higher taxes.⁴² Polling indicates that these perceptions influence how individuals respond to the implications of climate change.⁴³ Republicans view increased government regulation as a substantial risk and rank decreased dependence on foreign oil as a primary benefit of climate and energy policy.⁴⁴ This suspicion of the regulatory implications of climate change leads conservatives to reject the science itself.⁴⁵ In addition, among those described as doubtful or dismissive of climate change, the expected negative effects of increased climate or energy regulation greatly overshadow any benefits.⁴⁶ Recent polling suggests that government intervention might be rejected by more than just conservatives: A record high of 72 percent of Americans reported in 2013 that big government is the greatest threat to the future of the United States.⁴⁷ A natural next step is to frame climate policy as a means of reducing dependence on foreign oil, creating green jobs, or increasing efficiency. Yet these reframing efforts have failed to

40. See Riley E. Dunlap & Aaron M. McCright, *A Widening Gap: Republican and Democratic Views on Climate Change*, 50 ENV'T: SCI. & POL'Y FOR SUSTAINABLE DEV., Sept.–Oct. 2008, at 26.

41. See Christine Woodside, 'Egghead,' *Political Brawl and Quarrel Factors in Reporting on Climate*, YALE F. ON CLIMATE CHANGE & MEDIA (Oct. 25, 2012), <http://www.yaleclimatemediaforum.org/2012/10/egghead-political-brawl-and-quarrel-factors-in-reporting-on-climate> (comment of Katharine Hayhoe, climate scientist, Texas Tech University).

42. See Dan M. Kahan et al., *Cultural Cognition of Scientific Consensus*, 14 J. RISK RES. 147, 148–49 (2011).

43. See LEISEROWITZ ET AL., *supra* note 23, at 13 (finding via polling that Americans who are “dismissive” of climate change see few benefits and many drawbacks in the country “tak[ing] action to reduce global warming/fossil fuel use”).

44. EDWARD MAIBACH ET AL., GEORGE MASON UNIV. CTR. FOR CLIMATE CHANGE COMM'N & YALE PROJECT ON CLIMATE CHANGE COMM'N, A NATIONAL SURVEY OF REPUBLICANS AND REPUBLICAN-LEANING INDEPENDENTS ON ENERGY AND CLIMATE CHANGE 6 (2013).

45. See Stephan Lewandowsky et al., *The Role of Conspiracist Ideation and Worldviews in Predicting Rejection of Science*, PLOS ONE, OCT. 2013 (showing that free-market worldviews predict rejection of scientific findings that have regulatory implications, such as climate change).

46. See LEISEROWITZ ET AL., *supra* note 23, at 12–13.

47. See Jeffrey M. Jones, *Record High in U.S. Say Big Government Greatest Threat*, GALLUP (Dec. 18, 2013), <http://www.gallup.com/poll/166535/record-high-say-big-government-greatest-threat.aspx>.

overcome the widespread public resistance to emissions reduction policies and the rejection of the scientific consensus. Instead efforts to reframe climate issues as matters of energy security or defense may backfire, as doubters believe that they are being duped into adopting costly social policies for thinly disguised reasons.⁴⁸

C. Confirmation Bias

The importance of values and worldviews cannot be overstated. People typically do not gather facts on an issue and then form a worldview; they begin with a worldview and seek out facts that are consistent with it. A wide range of psychological research has shown support for this confirmation bias—people’s tendency to seek out and remember only information that supports the beliefs they hold already and avoid information that might contradict those beliefs or preferences.⁴⁹ This bias is so well documented that theorists have called it “the best known and most widely accepted notion of inferential error to come out of the literature on human reasoning.”⁵⁰ Neurological findings suggest that confirmation bias is especially likely to occur for values that are strongly emotional, such as political beliefs.⁵¹ A statistical review of people’s choice of information sources show that people prefer information that confirms their beliefs even when faced with equally useful opposing information.⁵² Not surprisingly, researchers have explained the decreasing public concern about climate change as being due to confirmation bias among climate doubters.⁵³

48. See Teresa A. Myers et al., Letter, *A Public Health Frame Arouses Hopeful Emotions About Climate Change*, 113 CLIMATIC CHANGE 1105, 1109–11 (2012).

49. People engage in motivated reasoning. See generally Ziva Kunda, *The Case for Motivated Reasoning*, 108 PSYCHOL. BULL. 480 (1990). For a discussion about how bets may reduce doubters’ perception of scientists as only presenting information that serves their financial or liberal interests, see *infra* notes 92 to 95 and accompanying text. See also Kate Sweeny et al., *Information Avoidance: Who, What, When, and Why*, 14 REV. GEN. PSYCHOL. 340 (2010).

50. JONATHAN ST. B. T. EVANS, BIAS IN HUMAN REASONING: CAUSES AND CONSEQUENCES 41 (1989).

51. See Drew Westen et al., *Neural Bases of Motivated Reasoning: An fMRI Study of Emotional Constraints on Partisan Political Judgment in the 2004 U.S. Presidential Election*, 18 J. COGNITIVE NEUROSCIENCE 1947 (2006).

52. See William Hart et al., *Feeling Validated Versus Being Correct: A Meta-Analysis of Selective Exposure to Information*, 135 PSYCHOL. BULL. 555 (2009).

53. See Lorraine Whitmarsh, *Scepticism and Uncertainty About Climate Change: Dimensions, Determinants, and Change Over Time*, 21 GLOBAL ENVTL. CHANGE 690, 698–99 (2011).

D. Other Influences

Individuals also have a strong motivation to conform their beliefs to those of their peers, and the rejection of climate science can be thought of as a reasonable response for those who want to fit in with a community that holds similar views.⁵⁴ Community interactions and views are highly influential on a person's beliefs.⁵⁵ One poll showed that those with strong views on climate change—whether acceptance or doubt—were more likely to share their global warming beliefs with their friends than segments holding more moderate views.⁵⁶ As a result, engagement with the issue among friends tends to amplify, not mitigate, the effects of values and community.⁵⁷

Simply providing more climate-science information using existing approaches is unlikely to reverse this effect.⁵⁸ The quantity of climate-science information emanating from government agencies and advocacy groups is unprecedented. In addition to the IPCC reports discussed above,⁵⁹ the national academies of science in many countries have generated reports both on their own and in conjunction with one another.⁶⁰ The U.S. Global Change Research Program and the National Research Council have produced multiple reports, as have

54. See, e.g., Kahan et al., *supra* note 29, at 734; Kahan et al., *supra* note 27, at 12.

55. See Justin C. Rolfe-Redding et al., Republicans and Climate Change: An Audience Analysis of Predictors for Belief and Policy Preferences 17 (Nov. 7, 2011) (unpublished manuscript) (noting that “[t]he more individuals interact with their network on a topic, the more likely they are to be influenced by their network’s views”), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2026002.

56. Edward W. Maibach et al., *Identifying Like-Minded Audiences for Global Warming Public Engagement Campaigns: An Audience Segmentation Analysis and Tool Development*, 6 PLOS ONE e17571 (2011).

57. Lawrence C. Hamilton, *Education, Politics and Opinions About Climate Change Evidence for Interaction Effects*, 104 CLIMATIC CHANGE 231, 236–37 (2011).

58. See, e.g., Daniel Sarewitz, *How Science Makes Environmental Controversies Worse*, 7 ENVTL. SCI. & POLY 385, 396, 389 (2004) (arguing that “when political controversy exists, the whole idea of ‘reducing uncertainty’ through more research is incoherent” because “more information provides an ever-larger pool out of which interested parties can fish differing positions”) (quoting Michael D.N., *Barriers and Bridges to Learning in a Turbulent Human Ecology*, in BARRIERS AND BRIDGES TO THE RENEWAL OF ECOSYSTEMS AND INSTITUTIONS 461, 473 (Lance H. Gunderson & Stephen S. Light eds., 1995)).

59. See *supra* note 18.

60. See, e.g., DEPT FOR FOOD, ENV'T AND RURAL AFFAIRS, UNITED KINGDOM, U.K. CLIMATE CHANGE RISK ASSESSMENT: GOVERNMENT REPORT (2012) (identifying climate adaptation priorities), available at <https://www.gov.uk/government/publications/uk-climate-change-risk-assessment-government-report>; NAT'L DEV. AND REFORM COMM'N, CHINA, CHINA'S POLICIES AND ACTIONS FOR ADDRESSING CLIMATE CHANGE (2012) (discussing national climate agenda), available at <http://www.ccchina.gov.cn/WebSite/CCChina/UpFile/File 1324.pdf>.

national and state legislative committees.⁶¹ Advocacy groups have distributed general reports on the climate science and reports tailored to specific aspects of the science and climate consequences, and they have conducted multimedia public information campaigns. Media coverage of climate science and reports summarizing the climate science have been extensive for almost three decades. Yet studies suggest that science literacy and numeracy deepen the degree of climate change doubt among conservative-leaning participants. The most extreme climate doubters report being twice as likely to closely follow science and technology news as the average individual in the United States.⁶² Thus, increasing the number of climate-science reports is unlikely to address the disconnect between climate-science experts and doubters.

Individuals' beliefs about climate change also are strongly influenced by what they have seen or not seen in the weather.⁶³ Studies suggest that outdoor temperature, indoor temperature, and whether there is a dead plant in the room all may influence belief in human-caused climate change.⁶⁴ Like direct communication about climate change, however, the weather's implications are interpreted according to one's value system.⁶⁵ One might think that farmers who have experienced recent droughts or heat waves would have shifted their beliefs about anthropogenic climate change, but studies show that this has not happened for many farmers: Many can accurately recall only those past weather events that align with their beliefs on climate change, whereas others accept that the climate is changing but deny that human activity is the cause.⁶⁶ This con-

61. See, e.g., NAT'L RESEARCH COUNCIL, AMERICA'S CLIMATE CHOICES (2011); U.S. GLOBAL CHANGE RESEARCH PROGRAM, <http://globalchange.gov> (last visited Jan. 15, 2014).

62. LEISEROWITZ ET AL., *supra* note 17, at 34.

63. See, e.g., Jason Koebler, *After Cold Winter, American Attitudes Chill on Global Warming*, U.S. NEWS & WORLD REP. (May 9, 2013), <http://www.usnews.com/news/articles/2013/05/09/after-cold-winter-american-attitudes-chill-on-global-warming-american-opinion-on-climate-change-seems-to-rise-and-fall-with-the-temperature>; Bryan Walsh, *Why Seeing Is Believing—Usually—When It Comes to Climate Change*, TIME, Dec. 3, 2012, <http://science.time.com/2012/12/03/why-seeing-is-believing-usually-when-it-comes-to-climate-change>.

64. See, e.g., Nicolas Guéguen, *Dead Indoor Plants Strengthen Belief in Global Warming*, 32 J. ENVTL PSYCHOL. 173, 176–77 (2012); Jeff Joireman et al., *Effect of Outdoor Temperature, Heat Primes, and Anchoring on Belief in Global Warming*, 30 J. ENVTL. PSYCHOL. 358 (2010) (noting factors that affect climate beliefs).

65. Anthony Leiserowitz, *Weather, Climate, and (Especially) Society*, WEATHER, CLIMATE, & SOC'Y 87, 88 (2012).

66. Teresa A. Myers et al., *The Relationship Between Personal Experience and Belief in the Reality of Global Warming*, 3 NATURE CLIMATE CHANGE 343, 344 (2013). Anecdotal evidence suggests some farmers have shifted their belief about whether climate is changing, but they have not shifted belief about the cause of climate change. See David Biello, *Why Farmers Don't Believe in Climate Change*, SLATE, Jul. 26, 2013, at http://www.slate.com/articles/technology/future_tense/2013/07/farmers_don_t_believe_in_climate_change_but_maybe_that_s_ok.html ("Take, as an example of skepticism, Iowa corn farmer Dave Miller, whose day job is as an economist for the

trasts sharply with the assessments of scientists who live and work near those farmers.⁶⁷

Prior beliefs have a particularly strong effect on shaping perceptions of the weather for those who are certain about their views of climate change.⁶⁸ Disasters tend to tighten social networks, so experiencing extreme weather may induce individuals with strong convictions to become even more entrenched in cultural and political ideology.⁶⁹ Connecting an extreme weather event to climate change discourse thus may motivate some climate believers, but it may only reinforce a climate doubter's conviction. For those who are less engaged, experience with weather is slightly influential.⁷⁰ The influence of experience depends in large part on forming the connection between the increasing severity of weather and climate change.⁷¹ In addition, the ability to place climate change in a concrete observation does appear to increase perception of climate change risk for many groups.⁷²

Iowa Farm Bureau. As Miller is happy to explain, it's not that farmers in Iowa don't think climate change is happening; it's that they think it's always been happening and therefore is unlikely to have much to do with whatever us humans get up to down at ground level.”)

67. One hundred fifty climate scientists from thirty-six colleges and universities throughout Iowa recently declared that “Iowa’s soils and agriculture remain our most important economic resources, but these resources are threatened by climate change.” GENE TAKLE ET AL., IOWA CLIMATE STATEMENT 2013 (Oct. 18, 2013), *available at* http://bio.cgrer.uiowa.edu/climate/Iowa_Climate_Statement_2013.pdf; *see also* Pat Curtis, *Scientists Say Climate Change Is Challenging Iowa Agriculture*, RADIO IOWA (Oct. 18, 2013), <http://www.radioiowa.com/2013/10/18/scientists-say-climate-change-is-challenging-iowa-agriculture>. The state of Nebraska could not find any scientists who would accept grant money to study climate change while “excluding the role of humans in changing the climate.” Nancy Gaarder, *State Climate Change Study May Go Begging for Scientists*, OMAHA WORLD-HERALD (Oct. 24, 2013), <http://www.omaha.com/article/20131024/NEWS/131029338/1707#state-climate-change-study-may-go-begging-for-scientists>.
68. *See* Myers et al., *supra* note 66, at 345; *On Point with Tom Ashbrook: What to Do About Climate Change?*, NAT’L PUB. RADIO (Dec. 6, 2012), <http://onpoint.wbur.org/2012/12/06/climate> (comments of Anthony Leiserowitz).
69. *See* George Marshall, *Reasons Why Climate Change Disasters Might Not Increase Concern About Climate Change*, CLIMATE CHANGE DENIAL (Nov. 6, 2012, 2:07 PM), <http://climatedenial.org/2012/11/06/reasons-why-climate-disasters-might-not-increase-concern-about-climate-change>.
70. Myers et al., *supra* note 66, at 345; *see also* Tina Rosenberg, *A Change in Weather on Wall Street*, N.Y. TIMES (Nov. 7, 2012), http://opinionator.blogs.nytimes.com/2012/11/07/a-change-in-the-weather-on-wall-street/?_php=true&_type=blogs&_r=0 (describing how Hurricane Sandy brought more attention to climate change and a call to action from Mayor Michael Bloomberg). For a recent study, *see* Rudiman et al., *When Truth Is Personally Inconvenient, Attitudes Change: The Impact of Extreme Weather on Implicit Support for Green Politicians and Explicit Climate-Change Beliefs*, 24 PSYCHOL. SCI. 2290, 2290 (2013).
71. *See* Marshall, *supra* note 69.
72. For example, one caller to NPR’s *On Point* said that she regularly watches Bill O’Reilly, loves America, and used to be a climate change skeptic but changed her mind and viewpoints after seeing the documentary *Chasing Ice*. NAT’L PUB. RADIO, *supra* note 68, at 12:37.

In sum, the rejection of the climate science consensus is largely driven by conservatives, for whom climate science represents an opposing ideology of increased government intervention. This motivated reasoning leads climate doubters not only to reject the policies to mitigate climate change, but also to question the motivations of the scientists and government bodies who report on the problem of climate change. This distrust of the sources of climate messages contributes to doubt about the science itself and prevents widespread acceptance of climate science findings.

II. ACCURACY AND CREDIBILITY

Worldviews and basic social and cognitive processes are unlikely to change on any time scale relevant to climate mitigation, suggesting that efforts to address the disconnect between climate-science experts and doubters should work with, rather than against, this backdrop. A climate prediction market may affect two concerns frequently articulated by climate-science doubters. The first is the accuracy of the climate science—whether climate scientists, because of liberal or professional bias or other reasons, are excluding data or studies from consideration and thus reporting inaccurate research findings. The second is the credibility of the information source—whether government-funded research and reports can be trusted.

A. Accuracy of Information

The argument that climate-science predictions are inaccurate because climate scientists have excluded data or studies from consideration is a common criticism. According to this critique, information that would undermine the conclusion that anthropogenic climate change is occurring or that it is likely to cause harms worthy of substantial investments in mitigation has been omitted from the climate-science literature.⁷³ In the last two decades, climate doubters have argued

73. See, e.g., Myron Ebell, *Avoid Energy and Global Warming Policies that Pose Greater Risks than Global Warming*, in COMPETITIVE ENTERPRISE INST., *Liberate to Stimulate: A Bipartisan Agenda to Restore Limited Government and Revive America's Economy* 17–18 (Ivan Osorio & Wayne Crews eds., 2011); Nicholas Dawidoff, *The Civil Heretic*, N.Y. TIMES, March 25, 2009, http://www.nytimes.com/2009/03/29/magazine/29Dyson-t.html?sq=Freeman&_r=0; Louise Gray, *Copenhagen Climate Summit: Global Warming 'Caused by Sun's Radiation'*, TELEGRAPH (Dec. 8, 2009, 5:10 PM), <http://www.telegraph.co.uk/earth/copenhagen-climate-change-confe/6762640/Copenhagen-climate-summit-global-warming-caused-by-suns-radiation.html>; Patrick J. Michaels, *Putting Headlines Ahead of Science*, CATO INST. (Jan. 2, 2014), <http://www.cato.org/publications/commentary/putting-headlines-ahead-science>; Jay Yarow, *Sorry, The EPA Isn't Censoring Staffers Who Think Global Warming is a Hoax*, BUS.

that information about urban heat islands, trends in solar irradiation and cosmic rays, the effects of aerosols and clouds, the Medieval Warm Period and other forms of natural temperature variation, the growth of Antarctic sea ice, and the leveling off of temperature increases during 1998–2012 have been inappropriately excluded from consideration in the IPCC reports and other summaries of the scientific literature.⁷⁴

In addition, some have argued that the exclusion of relevant information has occurred one step earlier in the process: that climate scientists have rejected papers from inclusion in peer-reviewed journals because of their conclusions, not because of the quality of the data or analysis.⁷⁵ According to these critiques, the result of these exclusions is unsupported scientific conclusions that feed alarm about the harms of climate change and the need for emissions reductions.⁷⁶ To address doubters' critiques about exclusion of specific data or theories and the functioning of the peer-review process, a climate prediction market will need to account for all types of information, so long as the information improves the accuracy of the prediction.

At least in theory, a market could provide a means to address the concern that inconvenient data or studies are being excluded from the climate-science literature and climate-science reports. Economists have demonstrated that markets have the ability to aggregate information,⁷⁷ and such luminaries as F.A. Hayek and Eugene Fama have argued that markets aggregate decentralized information better than a central authority does.⁷⁸ Whether markets are better than a central authority may depend on many factors, but it is widely accepted that in many cas-

INSIDER (Jul. 6, 2009), <http://www.businessinsider.com/sorry-the-epa-isnt-shutting-down-its-critics-2009-7>.

74. See *supra* note 73; *Global Warming & Climate Change Myths*, SKEPTICAL SCIENCE, <http://www.skepticalscience.com/argument.php> (last visited Jan. 17, 2014); John Platt, *Upcoming IPCC Climate Change Report Leaked by Skeptics*, MOTHER NATURE NETWORK (Dec. 20, 2012, 11:44 AM), <http://www.mnn.com/earth-matters/climate-weather/stories/upcoming-ipcc-climate-change-report-leaked-by-skeptics>.
75. James Wright, *Climategate and the Peer Review Process*, SKEPTICAL SCIENCE, <http://www.skepticalscience.com/Peer-review-process.htm> (last updated Dec. 24, 2010); DONNA LAFRAMBOISE, *THE DELINQUENT TEENAGER WHO WAS MISTAKEN FOR THE WORLD'S TOP CLIMATE EXPERT* 43–47 (2011); PATRICK J. MICHAELS, *MELTDOWN: THE PREDICTABLE DISTORTION OF GLOBAL WARMING BY SCIENTISTS, POLITICIANS, AND THE MEDIA* 137–42 (2004).
76. See, e.g., Wright, *supra* note 75.
77. See, e.g., Kay-Yut Chen & Charles R. Plott, *Information Aggregation Mechanisms: Concept, Design, and Implementation for a Sales Forecasting Problem 2* (Cal. Inst. of Tech., Div. of the Humanities and Soc. Sciences, Working Paper No. 1131, 2002), available at <http://www.hss.caltech.edu/SSPapers/wp1131.pdf>.
78. See Eugene F. Fama, *Efficient Capital Markets II*, 46 J. FINANCE 1575, 1607–08 (1991); F. A. Hayek, *The Use of Knowledge in Society*, 35 AM. ECON. REV. 519, 524–26 (1945).

es prices coordinate individual knowledge so that it is communicated to a wider audience.⁷⁹ Studies of various types of experimental and controlled markets suggest that although markets are often not absolutely efficient, prices typically incorporate information from many sources over time, provided that transaction costs and information costs are low.⁸⁰ As Saul Levmore has noted, however, a prediction market on any given topic need not be efficient (if efficient is defined as a solution that cannot be outperformed) to be a valuable policy instrument; it simply needs to be accurate, and well-functioning prediction markets generate accurate information.⁸¹

Well-designed markets have the ability to aggregate decentralized and asymmetrical information.⁸² Behavioral studies suggest that in some cases markets do not capture all information efficiently because of cognitive errors by investors: Markets are efficient in simple and controlled settings, but in actual securities markets, complexities, human error, and obstacles impede informational efficiency.⁸³ Simple markets—those trading only a few assets—are particularly well equipped to capture available public information, however, and possibly the privately held beliefs of market participants.⁸⁴ The landscape of climate change information is decentralized and asymmetric, which has led to misinterpretation and vulnerability. For instance, belief that the scientific community will not publish articles from dissenting climate scientists creates disbelief in the consensus—which increases doubt of all scientific evidence for climate change. A market may not make the distinction between information that

79. See Fama, *supra* note 78, at 1575; Hayek, *supra* note 78, at 526.

80. See Fama, *supra* note 78.

81. See Saul Levmore, *Simply Efficient Markets and the Role of Regulation: Lessons from the Iowa Electronic Markets and the Hollywood Stock Exchange*, 29 J. CORP. L. 589, 592 (2003). In an absolutely efficient market—one in which all information is incorporated into prices—an investor cannot profit from obtaining information because the price has already automatically incorporated the information, leaving no room for arbitrage. See Robert Forsythe et al., *Asset Valuation in an Experimental Market*, 50 ECONOMETRICA 537, 559–60 (1982); Robert Forsythe et al., *Futures Markets and Informational Efficiency: A Laboratory Examination*, 39 J. FIN. 955, 975 (1984).

82. See e.g., Chen & Plott, *supra* note 77, at 2.

83. Behavioral finance research suggests that although simple markets can be very efficient, noise arising from the cognitive errors of traders can dominate in the aggregate market. See Jeeman Jung & Robert J. Shiller, *Samuelson's Dictum and the Stock Market*, 43 ECON. INQUIRY 221, 227–28 (2005). For a review, see MICHAEL ABRAMOWICZ, PREDICTOCRACY: MARKET MECHANISMS FOR PUBLIC AND PRIVATE DECISION MAKING 219 (2007) (quoting ROBERT J. SHILLER, THE NEW FINANCIAL ORDER: RISK IN THE 21ST CENTURY 14 (2003) (noting that Robert Shiller, a leading behavioral finance theorist, believes that “the aggregate stock market in the United States in the last century has been driven primarily by psychology and fads”).

84. See ABRAMOWICZ, *supra* note 83; Jung & Shiller, *supra* note 83, at 227–28; Charles R. Plott & Shyam Sunder, *Efficiency of Experimental Security Markets with Insider Information: An Application of Rational-Expectations Model*, 90 J. POL. ECON. 663, 692–93 (1982).

is within the mainstream of climate-science thinking and information that is not, and thus a market may not be subject to this type of bias. As a result, climate doubters may be more likely to trust markets as impartial sources of information than they do mainstream scientists.

B. Credibility of Source

The second basis for resistance to climate science is the perceived lack of credibility of the climate-science process. Trust of source is critical to acceptance of new information. Research suggests that distrust leads recipients to reject information across many domains.⁸⁵

1. Scientists

In recent years, empirical studies have demonstrated that perceptions about whether a scientist has an agenda are particularly important when scientists engage in activism. One unpublished study showed an increase in climate-change doubt when a scientist explained climate change with a plea to take action, as opposed to just explaining climate change.⁸⁶ Other research has shown that people are resistant to information if it comes from an environmental activist, especially if they have negative stereotypes about environmentalists.⁸⁷ Climate scientists, especially those who engage in activism, might be seen in a similar light by climate doubters. This is particularly important given that trust in environmental sources is a major predictor of climate-science acceptance.⁸⁸ Furthermore, these findings suggest that environmental-activist groups are unlikely to be viable alternative sources of climate-science information.

The role of the federal government in the funding, execution, and publication of climate science also appears to fuel concerns among some doubters. “Big government” is one of the political bogeymen of modern conservatism,⁸⁹ and the

85. Paul Voosen, *Scientists Struggle with Limits-And Risks-Of Advocacy*, GREENWIRE, July 9, 2012, available at <http://www.eenews.net/stories/1059966968>.

86. *Id.*

87. See Nadia Y. Bashir et al., *The Ironic Impact of Activists: Negative Stereotypes Reduce Social Change Influence*, 43 EUR. J. SOC. PSYCHOL. 614 (2013).

88. See Thomas Dietz et al., *Support for Climate Change Policy: Social Psychological and Social Structural Influences*, 72 RURAL SOC. 185, 203 (2007).

89. See generally Daniel Béland & Francois Vergnolle de Chantal, *Fighting “Big Government”: Frames, Federalism, and Social Policy Reform in the United States*, 29 CAN. J. OF SOC. 241 (2004); GEORGE LAKOFF, *MORAL POLITICS: HOW LIBERALS AND CONSERVATIVES THINK* (2d ed. 2002); Joshua J. Dyck, *Political Distrust and Conservative Voting in Ballot Measure Elections*, 63 POL. RES. Q. 612 (2010).

political right is likely to distrust information coming from (or perceived to be influenced by) the federal government. This distrust of government is no small obstacle given that most of the major climate-change reports are compiled by scientists working in conjunction with or funded by federal and international governmental entities such as the UN, the Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration (NOAA), and the IPCC. Distrust about government science reports may be particularly acute when these reports are paired with recommendations to increase government regulation or oversight.⁹⁰

Given this mistrust of the hidden agendas of scientists and politicians, it is not surprising that, on occasion, climate scientists and doubters have backed their statements with monetary bets. Phrases such as “put your money where your mouth is” and “pay up or shut up” are not just schoolyard taunts. Psychological research has shown that following a public commitment to a cause, people are more likely to follow through on related behaviors and beliefs and are less likely to be persuaded by contradictory information.⁹¹ Theorists have offered different explanations for why this occurs,⁹² but many have argued that people want to be and look consistent.⁹³ Those who are inconsistent in their views or change their positions often face social sanctions: They tend to be viewed negatively by others and to be seen as hypocrites or flip-floppers.⁹⁴ Yet public statements alone do not seem to persuade doubters of the honest motives of climate scientists or the government agencies who support and report their work.

90. See Lewandowsky et al., *supra* note 45, at 7–8.

91. See Robert B. Cialdini & Melanie R. Trost, *Social Influence: Social Norms, Conformity, and Compliance*, in THE HANDBOOK OF SOCIAL PSYCHOLOGY, Vol. 2, 151, 177–79 (Daniel T. Gilbert, Susan T. Fiske & Gardner Lindzey eds., 4th ed. 1998).

92. See generally Alice H. Eagly & Shelly Chaiken, *Attitude Strength, Attitude Structure, and Resistance to Change* in ATTITUDE STRENGTH: ANTECEDENTS AND CONSEQUENCES 413 (Richard E. Petty & Jon A. Krosnick eds., 1995) (arguing commitment leads to defensiveness); Mahesh Gopinath & Prashanth U. Nye, *The Effect of Public Commitment on Resistance to Persuasion: The Influence of Attitude Certainty, Issue Importance, Susceptibility to Normative Influence, Preference for Consistency and Source Proximity*, 26 INT'L J. RES. IN MARKETING 60 (2009); Lewis E. Holt, *Resistance to Persuasion to Explicit Beliefs as a Function of Commitments and Desirability of Logically-Related Beliefs*, 16 J. PERSONALITY & SOC. PSYCHOL. 583 (1970) (arguing commitment makes attitudes more salient); Frederick J. Pauling & Robert E. Lana, *The Effects of Pretest Commitment and Information Upon Opinion Change*, 29 EDUC. AND PSYCHOL. MEASUREMENT 653 (1969) (arguing that commitment strengthens confidence).

93. See LEON FESTINGER, A THEORY OF COGNITIVE DISSONANCE (1957); Robert B. Cialdini & Noah J. Goldstein, *Social influence: Compliance and Conformity*, 55 ANN. REV. PSYCHOL. 591 (2004).

94. ABRAHAM H. MASLOW, TOWARD A PSYCHOLOGY OF BEING (2d ed. 1968); Eunkook M. Suh, *Culture, Identity, Consistency, and Subjective Well-Being*, 83 J. PERSONALITY AND SOC. PSYCHOL. 1378 (2002) (noting that although negative reactions to inconsistency were found in American samples, they were not shown for South Korean populations).

Doubters may believe that scientists have nothing to lose by overstating the risks of climate change, whereas they have grant funding, political favor, and status to gain by lying or exaggerating the truth. Bets may reduce doubters' perception of scientists as only presenting information that serves their financial or liberal interests. Betterers will lose money if they are betting against what they truly expect to happen, so they have less incentive to lie. The most famous bet of this type involved commodities (metals), not climate change, and occurred between Paul Ehrlich and Julian Simon.⁹⁵ This Ehrlich-Simon bet has reached nearly mythological status among those who believe that environmentalists' fears in resource depletion are misplaced. In several famous cases, climate scientists on opposing sides of the climate change debate have challenged each other to put their money where their mouths are. The reluctance of a prominent climate contrarian to follow through on his offer to bet against global warming led his critics to charge that his doubt about climate change is disingenuous, while a successful bet by another doubter was trumpeted as a conclusive refutation of global warming.⁹⁶ A climate prediction market could serve as a more formal way for scientific, political, and activist elites, as well as laypeople, to demonstrate their confidence in their own views in a way that risks their financial well-being if they are dishonest.

2. Media

Liberals and conservatives seek out and rate information sources based on alignment with their values.⁹⁷ Possibly as a result of this biased information seeking, studies suggest that people at both political extremes tend to be overly con-

95. See, e.g., SABIN, *supra* note 16.

96. See, e.g., *Climate Sceptics Place Bets on World Cooling Down*, *supra* note 16 (noting that "Richard Lindzen, a meteorologist at the Massachusetts Institute of Technology who questions the extent to which human activities are influencing climate [said] he was willing to bet that global temperatures will drop over the next 20 years," but that when climate scientist James Annan offered a bet, "Lindzen wanted odds of 50-to-1 against falling temperatures," and that in general, most "climate sceptics refused to wager money"); James Delingpole, *Global Warming: Red-Faced Climatologist Issues Grovelling Apology*, TELEGRAPH (Jan. 13, 2012), <http://blogs.telegraph.co.uk/news/jamesdelingpole/100129892> (interpreting Annan's belief in global warming as "wilful self-delusion" and his losing the bet as "punishment[] for failure" of his science); Tim Hartford, *More or Less*, BBC RADIO 4 (Jan. 15, 2012), <http://www.bbc.co.uk/programmes/b0196v3z>, at 14:45 (reporting on another bet, which Annan lost).

97. Matthew C. Nisbet, *Communicating Climate Change: Why Frames Matter for Public Engagement*, ENV. MAG., Mar.-Apr. 2009, <http://www.environmentmagazine.org/Archives/Back%20Issues/March-April%202009/Nisbet-full.html> (noting that "[u]nfortunately, quality news coverage is only likely to reach a small audience of already informed and engaged citizens. Just as in other debates, such as stem cell research, abortion, or gun control, the rest of the public either ignores the coverage or reinterprets competing claims based on partisanship or self-interest, a tendency confirmed across several decades by public opinion research.").

vinced of the superiority of their beliefs.⁹⁸ Recent research has shown that people who feel superior about their beliefs about hydraulic fracturing become even more certain of those beliefs after reading articles about the issue, even when those articles contradict their viewpoint.⁹⁹ In addition, the more extreme individuals' political positions are, the more those individuals tend to overestimate their knowledge about the subject.¹⁰⁰ This phenomenon may be an important reason why some conservatives reject the conclusions of most climate scientists. In one study, participants were asked to evaluate the expertise of an author of a fictional book about climate change. After seeing a book excerpt in which the author argued that climate change risks were high, only 23 percent of conservatives (identified in the study as hierarchical-individualists) believed that the author was a climate change expert, as compared to 62 percent of the overall sample. These studies suggest that the perceived reliability of a source is often based on its alignment with a value system.¹⁰¹

Polling has demonstrated that those with strong political ideologies are highly selective in the news sources they trust: 73 percent of conservative Republicans and 70 percent of liberal Democrats only trust a few sources, as compared to 55 percent of all respondents.¹⁰² Furthermore, although all respondents preferred a neutral delivery of news, conservative Republicans were more likely than others to prefer news that was tailored to their viewpoint.¹⁰³ A 2010 report showed that a large majority of audiences for trusted conservative news sources consider themselves to favor business but oppose government action.¹⁰⁴ These audiences also ranked last in percentage of members considering themselves to be environmentalists.¹⁰⁵

98. See Kaitlin Toner et al., *Feeling Superior Is a Bipartisan Issue: Extremity (Not Direction) of Political Views Predicts Perceived Belief Superiority*, 24 PSYCHOL. SCI. 2454 (2013).

99. See Kaitlin Toner Raimi & Mark Leary, *Belief Superiority in the Environmental Domain: Attitude Extremity and Reactions to Fracking*, J. ENV. PSYCHOL. (2014) (in press).

100. See Philip M. Fernbach et al., *Political Extremism is Supported by an Illusion of Understanding*, 24 PSYCHOL. SCI. 939 (2013).

101. Kahan et al., *supra* note 42, at 162–63.

102. THE PEW RESEARCH CTR., IN CHANGING NEWS LANDSCAPE, EVEN TELEVISION IS VULNERABLE 33 (2012).

103. *Id.* at 32 (noting that 36 percent of conservative Republicans prefer news that supports their views, as compared to 29 percent of liberal Democrats and 20 percent of Independents). In a recent interview, Justice Antonin Scalia discussed his sources of information, stating that “[w]e used to get the Washington Post, but it just . . . went too far for me. I couldn’t handle it anymore. . . . [T]hey became so shrilly, *shrilly* liberal.” Jennifer Senior, *In Conversation: Antonin Scalia*, N.Y. MAG., Oct. 6, 2013, <http://nymag.com/news/features/antonin-scalia-2013-10>.

104. THE PEW RESEARCH CTR., IDEOLOGICAL NEWS SOURCES: WHO WATCHES AND WHY 56, 60 (2010).

105. *Id.* at 59–62.

In addition, the presentation of climate issues in the media affects the processing of climate information, which often leads to confusion about climate science.¹⁰⁶ For example, Republicans' most trusted news source,¹⁰⁷ Fox News, covers climate change as if it is in a state of uncertainty and hosts more guests who doubt climate change than other television news sources.¹⁰⁸ The disproportionate viewpoints make it difficult for viewers to assess accurately the widespread acceptance of anthropogenic climate change among climate-science experts.¹⁰⁹ Not surprisingly, watching Fox News is correlated with a lower rate of climate-change acceptance, and research finds that "conservative media use decreases trust in scientists which, in turn, decreases certainty that global warming is happening. By contrast, use of non-conservative media increases trust in scientists, which, in turn, increases certainty that global warming is happening."¹¹⁰

Climate-change communication experts disagree over whether the confusion about the scientific consensus is a cause or effect of climate-change doubt. Polls indicate that belief about scientific consensus and acceptance of climate change is related.¹¹¹ Kahan's work shows a large gap in the percentage of hierarchical-individualists who believe the scientific community is in agreement on climate change compared to the percentage of egalitarian-communitarians, indicating that belief in a consensus is a function of valued-based information selection.¹¹² Other studies suggest that for people who are less involved in an issue, knowing there is a scientific consensus is the strongest predictor of climate-change acceptance. These studies prescribe clearer and more frequent delivery of scientific information.¹¹³ Polls suggest that awareness of a consensus would in-

106. See, e.g., Katherine Bagley, *Both Sides in Climate War Blamed for Cherry-Picking Attribution Research*, INSIDE CLIMATE NEWS, May 14, 2013, <http://insideclimatenews.org/print/25808>.

107. PUBLIC POLICY POLLING, NATIONAL SURVEY RESULTS: JAN. 31–FEB. 3, 2013 (2013), http://www.publicpolicypolling.com/pdf/2011/PPP_Release_National_206.pdf.

108. Lauren Feldman et al., *Climate on Cable: The Nature and Impact of Global Warming Coverage on Fox News, CNN, and MSNBC*, INT'L J. PRESS/POL. 3, 6 (2011).

109. See, e.g., *id.* at 11–12.

110. Jay D. Hmielowski et al., *An Attack on Science? Media Use, Trust in Scientists, and Perceptions of Global Warming*, PUBLIC UNDERSTANDING SCI. 1 (2013), available at <http://pus.sagepub.com/content/early/2013/04/01/0963662513480091>; see also Feldman et al., *supra* note 108, at 20–21 (concluding that among Republicans, those who watched a lot of Fox News were the least accepting of climate change science).

111. See LEISEROWITZ ET AL., *supra* note 17, at 18.

112. See Dan Kahan, *Fixing the Communications Failure*, 463 NATURE 296–97 (2010); see also Kahan, *supra* note 29, at 734 (stating that "[w]hat guides individual risk perception . . . is not the truth of those beliefs but rather their congruence with individuals' cultural commitments" (emphasis added)).

113. See Cook et al., *supra* note 1, at 1, 6; Rolfe-Redding et al., *supra* note 55, at 25 (finding that belief in scientific agreement was the best predictor of climate change belief in their model).

crease the concern of most climate advocates but would fail to reach climate doubters.¹¹⁴

3. Markets

Receiving information from a trusted source may be the best predicate for believing the information, and markets may be more trusted than many other sources. The prospect that conservatives or moderates who doubt climate science might trust prediction markets is enhanced by the association between distrust of climate science and endorsement of free-market ideology.¹¹⁵ On the surface, markets appear to align closely with conservative values, but are conservatives more likely to credit information from markets than from other sources? Even if they are, to what extent is the increased acceptance of market-based information likely to overcome the problem of rejection of information that is inconsistent with worldviews or values? Trust in free markets could take the form of believing that markets efficiently allocate resources or that they provide accurate information about future events, but the latter is at issue here. The limited available empirical research suggests that conservatives, perhaps including those who doubt climate change, trust markets generally, but the research does not address trust in markets to convey information.¹¹⁶ Despite the lack of empirical research on this subject, it is reasonable to assume that conservatives would not trust markets to manage large societal issues if they believed that these markets relied on incorrect information.

Conservatives may not fully trust markets to be error-free sources of information, but they may still consider them less biased or inefficient than the federal agencies that currently provide climate information. For example, research on social trust has found that conservative-leaning participants vary more than liberal-leaning participants in terms of which types of social institutions are worthy of trust regarding the management of environmental issues. Specifically, conservative participants put more trust in local government institutions than national institutions, but liberals put equal trust in local and national institutions.¹¹⁷ Environmental issues that require a national response—such as climate change—

114. LEISEROWITZ ET AL., *supra* note 17, at 37.

115. See Lewandowsky et al., *supra* note 45, at 4.

116. See generally Jost, et al., *supra* note 14; Larner, *supra* note 14; Willetts, *supra* note 14.

117. See Timothy C. Earle & George Cvetkovich, *Culture, Cosmopolitanism, and Risk Management*, 17 RISK ANALYSIS 55, 56 (1997) (referring to “pluralism” as a more conservative mindset, compared to the more liberal-leaning “cosmopolitanism”).

thus may be particularly distasteful to conservatives if they are handled by government agencies rather than free markets.

In addition, anecdotal examples suggest that conservatives trust markets more than government agencies to make policy judgments, although this could result from differing views about the relative ability of markets and agencies to allocate resources or to assess information about future events. For instance, business publisher and former presidential candidate Steve Forbes has stated that “[w]e would do infinitely better trusting the markets instead of the mandarins at the Federal Reserve.”¹¹⁸ Similarly, libertarian presidential candidate Ron Paul has talked at length about how he trusts the markets more than he trusts federal agencies.¹¹⁹ In short, it is plausible that conservative trust in free markets as policy instruments spills over to trust in markets as accurate sources of information, but surprisingly little research has been done on this topic.

C. Current Market-Based Information

Although much of the emphasis in climate communications has been on the framing, content, and dissemination of climate-science information, research suggests that the source of the information may be equally important. Some efforts are under way to address the source of the information as a barrier to acceptance of climate science, but the declining correspondence between the views of climate scientists and conservatives suggests much room for improvement. The research on political polarization, values, and cultural cognition suggests that understanding and updating the beliefs of doubters regarding the climate science may require information that arises from sources that are credible to conservatives and that do not threaten values. Information conveyed through a private market may not address the latter, but it may address the former. One prompt response is for advocacy groups to collect and publish information about how private corporations are talking about, planning for, and acting on the climate science. A number of nonprofit groups (for example, Ceres, the Carbon Disclosure Project, the World Resources Institute, and the Climate Action Partnership) and for-profit corporations (for example, McKinsey and UBS AG) have issued reports noting that private firms are responding to anthropogenic climate change, but these initiatives could be expanded and pursued with more vigor.

118. See Steve Forbes, *Steve: The Fed Needs a Leash*, FORBES (Jan. 11, 2010), <http://www.forbes.com/2010/01/08/forbes-federal-reserve-intelligent-investing-audit.html>.

119. See Interview with Ron Paul, U.S. Congressman, *I Trust the Markets Much More Than the Rating Agencies*, RONPAUL.COM (Aug. 8, 2011), <http://www.ronpaul.com/2011-08-08/ron-paul-i-trust-the-markets-much-more-than-the-rating-agencies>.

In some cases, the corporate statements and actions arise from sources that are likely to be surprising to conservatives and moderates. An example is ExxonMobil, which has some of the best-regarded energy-policy expertise among petroleum companies. Its 2012 Annual Energy Outlook projects that Organisation for Economic Co-operation and Development (OECD) countries will have placed a \$60-per-ton price on CO₂e (carbon dioxide equivalent) by 2030 and \$80 by 2040.¹²⁰ By 2030, many of the open questions about climate science may be resolved, and presumably the policies of OECD countries will reflect, at least roughly, the then-current state of the science. In other words, ExxonMobil projects that after two decades of additional climate-science developments, the major industrial countries will be sufficiently concerned about anthropogenic climate change to have put a substantial price on carbon.¹²¹ Many other companies, including ConocoPhillips, Chevron, BP, Shell, American Electric Power, and Duke Energy, are also planning based on an assumption that carbon will be taxed.¹²² Similarly, many of the largest firms in the world report that the responses to climate change pose a substantial risk.¹²³ The Securities and Exchange

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120. EXXONMOBIL, 2012 THE OUTLOOK FOR ENERGY: A VIEW TO 2040 29, 31–33 (2012). The carbon dioxide equivalent (CO₂e) of a mixture of greenhouse gases represents the amount of pure carbon dioxide that would produce the same warming, thus providing a common scale for comparing different mixtures. See JOHN T. HOUGHTON, GLOBAL WARMING: THE COMPLETE BRIEFING 147–48 (4th ed. 2009).
121. Although this does not necessarily mean that ExxonMobil has determined that anthropogenic climate change is occurring (the carbon tax prediction could reflect the view that the governments of the Organisation for Economic Co-operation and Development (OECD) countries will be responding to inaccurate climate science or public views of the climate science in 2030 and 2040), recent comments by ExxonMobil spokesperson Alan Jeffers suggest that the company would support a revenue-neutral carbon tax. See Coral Davenport, *Large Companies Prepared to Pay Price on Carbon*, N.Y. TIMES, Dec. 5, 2013, <http://www.nytimes.com/2013/12/05/business/energy-environment/large-companies-prepared-to-pay-price-on-carbon.html> (“If Congress does take up climate change legislation in the future, Mr. Jeffers said Exxon Mobil would support a carbon tax if it was paired with an equal cut elsewhere in the tax code—the same policy that Mr. Gore has endorsed.”). In addition, it is reasonable to assume that Exxon’s management believes that after twenty to thirty years of additional climate developments and additional climate-science research, the OECD governments will be better informed than they are now, and that this information will have increased (rather than decreased) concern about the climate.
122. For a discussion of corporate responses to climate change, see *id.* (“More than two dozen of the nation’s biggest corporations, including the five major oil companies, are planning their future growth on the expectation that the government will force them to pay a price for carbon pollution as a way to control global warming.”).
123. See CDP, SECTOR INSIGHTS: WHAT IS DRIVING CLIMATE CHANGE ACTION IN THE WORLD’S LARGEST COMPANIES? GLOBAL 500 CLIMATE CHANGE REPORT 2013, at 10 (2013), available at <https://www.cdproject.net/CDPResults/CDP-Global-500-Climate-Change-Report-2013.pdf> (indicating that 83 percent of the world’s largest companies see a material risk posed by the physical impacts of climate change).

Commission filings of many publicly traded corporations disclose these risks,¹²⁴ and the public statements and policy advocacy of many insurance companies suggest that they have identified climate risks that are consistent with the scientific consensus.¹²⁵

Advocacy groups could develop media campaigns to publicize these types of conclusions by major corporations. Would learning about a projection from ExxonMobil or other major oil companies, the securities disclosures of other companies, or the climate responses of major insurers be more persuasive to climate doubters than learning about a climate-science report from the IPCC, the federal government, or the National Academies of Science? Research remains to be done on the nuances of these issues, but the social science of climate beliefs to date suggests that it may. The shortcoming of these kinds of advocacy-group-driven approaches, even if they convey market-related information that may be

124. For example, ExxonMobil's most recent annual report (known as a 10-K) filed with the Securities and Exchange Commission states that:

Due to concern over the risk of climate change, a number of countries have adopted, or are considering the adoption of, regulatory frameworks to reduce greenhouse gas emissions. These include adoption of cap-and-trade regimes, carbon taxes, restrictive permitting, increased efficiency standards, and incentives or mandates for renewable energy. These requirements could make our products more expensive, lengthen project implementation times, and reduce demand for hydrocarbons, as well as shift hydrocarbon demand toward relatively lower-carbon sources such as natural gas. Current and pending greenhouse gas regulations may also increase our compliance costs, such as for monitoring or sequestering emissions.

Exxon Mobil Co., Annual Report (Form 10-K) 3 (Feb. 27, 2013). The effects of climate science and mitigation efforts on the near-term value of firms with heavy fossil fuel exposure are not clear, however. See, e.g., Saqib Rahim, *'Cynical' Market Shrugs Off Latest Climate Warning on Fossil Fuels*, ENERGYWIRE (Oct. 4, 2013), <http://www.eenews.net/energywire/stories/1059988359> (stating that in response to the IPCC noting that not all fossil fuels can be burned if the 2 °C goal is to be met, Nell Minow, a corporate governance expert and former head of the proxy advisory firm Institutional Shareholder Services Inc., concluded that "[t]he market is quite cynical, and they know the difference between what's good to do and what people are going to do").

125. See Al Gore & David Blood, *The Coming Carbon Asset Bubble*, WALL ST. J., Oct. 30, 2013, at A15 (warning that future greenhouse gas emissions regulations will turn fossil fuel reserves into stranded assets, thereby destroying shareholder value); Eduardo Porter, *For Insurers, No Doubts on Climate Change*, N.Y. TIMES, May 14, 2013, <http://www.nytimes.com/2013/05/15/business/insurers-stray-from-the-conservative-line-on-climate-change.html>; Andrea Vittorio, *IPCC Report Said Likely to Spur More Action From Businesses, Investors on Climate*, BLOOMBERG BNA (Sept. 27, 2013) (quoting insurance industry expert Lara Mowery for the proposition that climate change "should be of significant concern" for how insurers and reinsurers plan and shape their business going forward"); *Climate Change is a Subject That Concerns Us All*, MUNICH RE, http://www.munichre.com/en/group/focus/climate_change/default.aspx (last visited Mar. 21, 2014); Dan Kahan, *More Market Consensus on Climate Change: 97% of Insurance Companies Agree (& Hedge Funds Too!)*, CULTURAL COGNITION PROJECT (May 24, 2013, 2:10 AM), <http://www.culturalcognition.net/blog/2013/5/24/more-market-consensus-on-climate-change-97-of-insurance-comp.html>. For a discussion of climate risks from a corporate perspective, see U.S. CLIMATE ACTION PARTNERSHIP WEB SITE, <http://www.us-cap.org> (last visited Mar. 21, 2014).

credible to doubters, is that they are only likely to reach a small percentage of the population.¹²⁶ Anecdotal evidence suggests that few people are aware of these types of corporate actions, and the reports about them have not succeeded at widely publicizing the activities of these types of market-based sources.¹²⁷ An initiative that assesses the climate science more directly and communicates market-based assessments of climate information more widely may be more influential.

III. A PRIVATE CLIMATE PREDICTION MARKET

For a private prediction market to address the disconnect between climate scientists and doubters, it should perform three functions: (1) aggregate climate-science information accurately, (2) provide a credible source of that information for doubters, and (3) communicate that information to enough doubters to make the effort worth the cost. The long lag times associated with climate mitigation also suggest the need to act quickly to address the climate-science disconnect. The goal of Part III is not to explore the nuances of market theory or to propose adoption of a specific type of climate prediction market. Instead, this Part examines the feasibility of a private climate prediction market in the United States by evaluating the potential for a market to serve these three functions and by identifying the design features that may be necessary given existing legal constraints.

Several commentators have raised the possibility of a climate prediction market,¹²⁸ and climate prediction efforts to date have included a play-money

126. The media has noted some market indicators that are helpful in aggregating industry information on climate change, but the coverage seems to have had little effect on the climate-change debate. See, e.g., Kahan, *supra* note 125; *Unburnable Fuel*, ECONOMIST, Mar. 4, 2013, <http://www.economist.com/news/business/21577097-either-governments-are-not-serious-about-climate-change-or-fossil-fuel-firms-are> (noting that companies do not appear to expect a restriction on fossil fuel because market valuations do not reflect the loss of reserves).

127. In addition, some conservatives may be unaware of the number of other conservatives who believe that anthropogenic climate change is occurring. Psychological research on “pluralistic ignorance” has shown that people act in accordance with how they think their peers behave, even when that perception is incorrect. Deborah A. Prentice & Dale T. Miller, *Pluralistic Ignorance and Alcohol Use on Campus: Some Consequences of Misperceiving the Social Norm*, 64 J. PERSONALITY & SOC. PSYCHOL. 243, 244 (1993). Addressing this phenomenon by conveying accurate information about the extent of belief among conservatives may have some effect. See Coral Davenport, *The Coming GOP Civil War Over Climate Change*, NAT’L JOURNAL MAG, May 9, 2013, <http://www.nationaljournal.com/magazine/the-coming-gop-civil-war-over-climate-change-20130509> (noting that 52 percent of Republicans believe climate change is occurring, including influential party members, but strong incentives exist to keep climate change belief secret); Kahan, *supra* note 125.

128. See Hanson, *supra* note 12; Kahan, *supra* note 12; Pielke, *supra* note 12; Silver, *supra* note 12 (suggesting that it would be best to “run the markets through a major, cross-national platform such as the United Nations, IMF or World Bank, so as to encourage participation and create liquidity”). See also Bell, *supra* note 12, at 47 (discussing sea-level rise predictions); Hsu, *supra* note 12, at 206–

market (Foresight Exchange), a market in contracts that was available to U.S. investors until recently (Intrade the Prediction Market Limited), and a market that is available to foreign investors (iPredict).¹²⁹ Scholars also have produced several detailed proposals for climate-futures markets, modeled on catastrophe bonds, to allow hedging against the risks of global climate change, such as flooding due to sea-level rise.¹³⁰ In addition, several prediction markets do not allow trading in climate outcomes but include features relevant to a climate prediction market.¹³¹

Despite a number of obstacles, these early efforts have demonstrated that it is possible to establish a prediction market in the types of outcomes that matter for global climate change,¹³² although no real-money market is available to U.S. investors and none of the markets has generated widespread media attention thus

13 (discussing combined government-created tax and cap-and-trade program designed to predict climate outcomes).

129. See Bell, *supra* note 12 (discussing Foresight Exchange sea-level contracts). Weather and climate futures are traded on the Chicago Mercantile Exchange. See Randy Cerveny, *Hedging Your Weather Bets: The Science of "Weather Futures" Trading*, WEATHERWISE MAG., Nov.–Dec. 2010, at 38–43. See also *Scientific Issues*, IPREDICT, <https://www.ipredict.co.nz/app.php?do=browse&cat=46> (last visited May 23, 2013) (providing data on sea-level contracts on the iPredict market). iPredict offers three contracts for sea-level rise between April 2012 and February 2015. Two of them are binary, paying out \$1 only if the outcome occurs. The third is indexed. See *Scientific Issues*, *supra*. It pays out \$0.01 for every centimeter (1 percent of one meter) rise in sea level. See *Scientific Issues*, IPREDICT, https://www.ipredict.co.nz/app.php?do=contract_detail&contract=IPCC5.SEALEVEL.MAX (last visited May 23, 2013). Although iPredict has an estimated 6000 registered users, the activity and volume on these contracts are low, which may prevent the market from making accurate predictions. See FUSEWORKS MEDIA, *iPredict Launches Stocks for 2014 General Election*, VOXY (Jan. 16, 2012, 5:33 PM), <http://www.voxy.co.nz/politics/ipredict-launches-stocks-2014-general-election/5/112495>; see also Bell, *supra* note 12, at 62–63 (arguing for changing U.S. law rather than accessing international prediction markets); Andrew S. Goldberg, Note, *Political Prediction Markets: A Better Way to Conduct Campaigns and Run Government*, 8 CARDOZO PUB. L. POL'Y & ETHICS J. 421, 429 (2010).
130. See, e.g., Daniel Bloch et al., *Applying Climate Derivatives to Flood Risk Management*, WILMOTT J., Nov. 2011, at 88–103; Daniel Bloch et al., *Cracking the Climate Change Conundrum with Derivatives*, 2 WILMOTT J. 271 (2010); Daniel Bloch et al., *Pricing Climate Derivatives With Nonlinear Models*, WILMOTT J., Mar. 2012, at 46–59, available at <http://onlinelibrary.wiley.com/doi/10.1002/wilm.10092/abstract>.
131. See Bell, *supra* note 10, for a discussion of the term “Prediction Market” over other terms for the concept. But see Robert W. Hahn & Paul C. Tetlock, *Using Information Markets to Improve Public Decision Making*, 29 HARV. J.L. & PUB. POL'Y 213, 219 (using the term “information markets”).
132. See Bell, *supra* note 10, at 58 (“Consider . . . how journalists might use the real-money price of a [contract] to clarify the controversy over global climate change”). See also Hsu, *supra* note 12, at 200–206 (discussing literature on prediction markets). On a related note, scholars have proposed climate derivatives markets for risk hedging and for using weather-derivatives markets as prediction markets to improve forecasts. See, e.g., Bloch et al., *Applying Climate Derivatives to Flood Risk Management*, *supra* note 130; Bloch et al., *Cracking the Climate Change Conundrum with Derivatives*, *supra* note 130; Amiyatosh K. Purnanandam & Daniel Weagley, *Can Markets Discipline Government Agencies? Evidence From the Weather Derivatives Market* (Working Paper, May 22, 2013), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2139185.

far. Shi-Ling Hsu has proposed a large-scale prediction market coupled with a comprehensive emissions-regulation scheme that includes both carbon taxes and tradable permits.¹³³ Such a market would have the merit of serving simultaneously as a source of credible information about climate science and also as a tool for regulating emissions. It also would have the advantage of scale: It would doubtless have significant volume, and it thus would both engage a wide range of viewpoints and be difficult to manipulate.¹³⁴ The market could not be implemented without major new climate legislation, however, and we doubt that the U.S. Congress will pass such measures any time soon. Moreover, by coupling the prediction market to the price of emissions taxes, Hsu acknowledges that the market would reflect predictions not only of climate change, but also of policy change, and that this would “dilute[] the signal for climate science.”¹³⁵ Such a scheme has merit if a stable regulatory regime can be enacted, but since skepticism about climate science is a major impediment to enacting regulations, its role as a prediction market to build public confidence in climate science faces a chicken-and-egg dilemma. For this reason, we propose a simple and pure prediction market that does not require climate legislation. This Part explores a near-term, private option that is viable under the existing regulatory structure, and the following Part examines long-term options that may require regulatory changes.

A. Core Design Elements

The recent history of prediction markets suggests that commodities and securities regulations are not well equipped for capital markets in ideas. Nevertheless, frameworks exist to create a prediction market with a minimum of delay that accurately captures information about climate change, clearly signals the probability of events brought on by climate change from a source credible to conservatives, and operates within the scope of the law.

1. Legal Constraints

A prediction market’s success may be a function of its treatment by regulators as much as its design. A climate prediction market will be legally vulnerable if it runs afoul of the regulatory authority of the Commodity Futures Trading Commission (CFTC) or the Securities and Exchange Commission (SEC) or is considered gambling under federal or state law. Gambling laws are a concern,

133. Hsu, *supra* note 12.

134. *Id.* at 232, 238.

135. *Id.* at 244.

although a prediction market should differ from gambling in that trading serves the end of aggregating and revealing prices rather than entertainment, and trading will benefit more heavily from skill than luck.¹³⁶ The SEC's jurisdiction is limited in the prediction market area, leaving the CFTC as the leading regulatory agency.¹³⁷

Under the terms of the Commodity Exchange Act, the CFTC has authority over goods, services, rights, and interests in which "contracts for future delivery are presently or in the future dealt in,"¹³⁸ including event contracts.¹³⁹ In addition, the Dodd-Frank Act, which was adopted after the 2008 financial crash, gave the CFTC express jurisdiction over event contracts.¹⁴⁰ In determining whether an event contract should be approved for trading, the Dodd-Frank Act provides for the CFTC to determine whether the event contract is against public interest. An event contract is against public interest if it involves any illegal activity under state or federal law, terrorism, assassination, war, gaming, or any similar activities.¹⁴¹ Furthermore, registered entities may not trade in contracts that are contrary to public interest.

The CFTC interprets these statutory provisions to mean that any contract involving the enumerated activities or any similar activities is against public policy and should not be approved for trading.¹⁴² To distinguish between futures contracts and gambling, the CFTC applies an economic-purpose test to determine if an event contract is contrary to public interest.¹⁴³ A contract cannot have an economic purpose if it does not have significant hedging¹⁴⁴ or price-basing utili-

136. Many states define gambling as the payment of money upon the occurrence of an uncertain event. See Self-Certification by N. Am. Derivatives Exch., Inc., Order Prohibiting the Listing or Trading of Political Event Contracts 2 n.1 (Apr. 2, 2012) (Commodity Futures Trading Comm'n Apr. 2, 2012), <http://www.cftc.gov/ucm/groups/public/@rulesandproducts/documents/ifdocs/nadexorder040212.pdf>. For a discussion of how prediction markets differ from gambling in means and ends, see Bell, *supra* note 12, at 67–68, 91–92.

137. See 7 U.S.C. § 1a(8) (2012); 7 U.S.C. § 2(c)(2) (2012).

138. 7 U.S.C. §§ 1a(9), 2(a) (2012).

139. See 7 U.S.C. § 7a-2(c)(5)(C) (2012).

140. See Bell, *supra* note 10, at 94–96 (discussing the CFTC's control over prediction markets before the enactment of the Dodd-Frank Act). For a proposal regarding prediction markets, see Robert W. Hahn & Paul C. Tetlock, *A New Approach for Regulating Information Markets*, 29 J. REG. ECON. 265 (2006).

141. Dodd-Frank Wall Street Reform and Consumer Protection Act § 745, 7 U.S.C. § 7a-2(c) (2012); 17 C.F.R. § 40.11 (2012).

142. 17 C.F.R. § 40.11 (2012); Self-Certification by N. Am. Derivatives Exch., Inc., *supra* note 136, at 3.

143. Self-Certification by N. Am. Derivatives Exch., Inc., *supra* note 136, at 3.

144. The CFTC defines hedging as a substitute for transactions at a later date to reduce risk if values fluctuate. See 17 C.F.R. 1.3(z) (2012). Hedging is an insurance policy against potential unfavorable economic conditions.

ties.¹⁴⁵ A climate prediction contract may be vulnerable because it may not have significant hedging abilities and because the CFTC requires a contract to offer price basing utility (to provide a price discovery function in the markets).¹⁴⁶ In short, although a substantial amount of uncertainty exists about the ultimate regulatory treatment of a climate prediction market, and the treatment may depend in large part on the types of instruments that are traded, the regulatory requirements may limit the commercial availability of a climate prediction market in the near term.

Another option is available, however, and that is a small-scale academic prediction market. The Iowa Electronic Market (IEM) provides an example of such an option. The IEM, which is operated by the University of Iowa, began as a way to predict presidential elections, but it has also hosted markets on other political elections and policy matters,¹⁴⁷ including Federal Reserve monetary policy.¹⁴⁸ The IEM is the only real-money market (as opposed to a play-money market, such as the Hollywood Stock Exchange, which offers contests over movie receipts and Oscar winners¹⁴⁹) of this type in the United States. The CFTC has authority to exempt contracts from regulations “[i]n order to promote responsible economic or financial innovation and fair competition,” so long as the exemption will serve the public interest.¹⁵⁰ The CFTC relied on this authority in

145. Price basing is a part of price discovery and provides a benchmark for a commodity's price going forward to promote efficient transactions in that commodity and related commodities. See Concept Release on the Appropriate Regulatory Treatment of Event Contracts, 73 Fed. Reg. 25669, 25672 n.16 (May 7, 2008) [hereinafter Concept Release].

146. Self-Certification by N. Am. Derivatives Exch., Inc., *supra* note 136, at 3 (“[T]here is no situation in which the Political Event Contracts’ prices could form the basis for the pricing of a commercial transaction involving a physical commodity, financial asset or service . . .”).

147. See CASS SUNSTEIN, *INFOTOPIA* 108 (2006); Goldberg, *supra* note 129, at 427; Cass R. Sunstein, *Group Judgments: Statistical Means, Deliberation, and Information Markets*, 80 N.Y.U. L. REV. 962, 1029–31 (2005); *Historical Data*, IOWA ELECTRONIC MARKETS, <http://tippie.uiowa.edu/iem/archive/historicaldata.cfm> (last visited May 22, 2013).

148. See Stanley W. Angrist, *Iowa Market Takes Stock of Presidential Candidates*, WALL ST. J., Aug. 28, 1995, at C1; *Iowa Electronic Markets*, THE UNIV. OF IOWA COLL. OF BUS., <http://tippie.uiowa.edu/iem/> (last visited Feb. 14, 2014).

149. Unlike the Iowa Electronic Market (IEM), the Hollywood Stock Exchange uses pretend money to place bets on the outcome of movie revenues. Although it is not as accurate as the IEM, the Hollywood Stock Exchange may be the most accurate forecast of weekend box-office revenues. JAMES SUROWIECKI, *THE WISDOM OF CROWDS* 20 (2004). In 2000, the Hollywood Stock Exchange correctly predicted all Oscar winners, beating another prediction based on academy member ballots. *Id.* at 19–20.

150. See 7 U.S.C. § 6(c) (2012); Concept Release, *supra* note 145, at 25670; Letter from Andrea M. Corcoran, Dir., Div. of Trading and Mkts., CFTC, to George R. Neumann, Prof. of Econ., Univ. of Iowa (June 18, 1993), available at <http://www.cftc.gov/files/foia/repfoia/foirf0503b004.pdf> [hereinafter June 1993 Letter From Corcoran to Neumann]; Letter from Andrea M. Corcoran, Dir., Div. of Trading and Mkts., CFTC, to George R. Neumann, Professor of Econ., Univ. of

providing a no-action letter to the IEM in 1992. The letter stipulates that the IEM may offer these markets without CFTC oversight based on representations that the directors do not receive compensation, the maximum investment is \$500, and the number of traders will not exceed 2000.¹⁵¹ Since the political markets are primarily for research and education rather than profit, the CFTC concluded that there is no public need to regulate them.¹⁵² Research suggests that these limits have not affected the accuracy of the market.¹⁵³ In fact, the investment limit may not limit accuracy—it may help neutralize diverse risk preferences in traders and discourage manipulation attempts.¹⁵⁴

Whether a non-profit, research-focused prediction market could receive the same exemption today remains unclear. If the CFTC has decided that event contracts are contrary to public interest, then they also may be excluded from this statutory provision. Nonetheless, operating under a no-action letter along the lines of the one awarded to the IEM may be the best option for a climate-change prediction market in the current regulatory environment. In short, the IEM best encapsulates the fundamental characteristics of a well-designed prediction market without facing many legal obstacles that could take years to overcome.¹⁵⁵

2. Design Elements

The instruments traded on the new climate prediction market would include predictions about various climate outcomes. For example, it may be possible to buy or sell a prediction that the global mean temperature change or global

Iowa (Feb. 5, 1992), *available at* <http://www.cftc.gov/files/foia/repfoia/foirf0503b002.pdf> [hereinafter Feb. 1992 Letter From Corcoran to Neumann].

151. June 1993 Letter From Corcoran to Neumann, *supra* note 150, at 3.

152. *See, e.g.*, June 1993 Letter From Corcoran to Neumann, *supra* note 150, at 4–5; *About the IEM, IOWA ELECTRONIC MARKETS*, <http://tippie.uiowa.edu/iem/about> (last visited June 26, 2013). Although the CFTC no-action letter spares the IEM from the Commodity Exchange Act, it does not prevent regulatory action from other entities, such as the SEC or the states. *See* June 1993 Letter From Corcoran to Neumann, *supra*, at 4–5. The no-action letter has offered practical, if not legal, protection against threatened suits from other states, however. Bell, *supra* note 10, at 107 n.58 (2009) (stating that “[w]e have been threatened several times with suits by various states but so far the CFTC coverage has been our trump card” (quoting email from Professor George R. Neumann, Member, IEM Board of Directors, to Tom W. Bell (Jan. 29, 2007))).

153. Joyce E. Berg, et al., *Prediction Market Accuracy in the Long Run*, 24 INTL. J. FORECASTING 285, 298–99 (2008).

154. JOYCE E. BERG & THOMAS A. REITZ, MARKET DESIGN, MANIPULATION AND ACCURACY IN POLITICAL PREDICTION MARKETS: LESSONS FROM THE IOWA ELECTRONIC MARKETS, 4–5 (July 2013).

155. *See* SUROWIECKI, *supra* note 149, at 21 (“[G]iven the right conditions and the right problems, a decision market’s fundamental characteristics—diversity, independence, and decentralization—are guaranteed to make for good group decisions.”).

mean sea-level rise in 2020, 2050, or 2100 will be at the midpoint of a particular IPCC scenario.¹⁵⁶ To reduce transaction costs, very precise, detailed descriptions of the predictions will be important, including descriptions of the source of data, the algorithm for computing the mean, and the time period over which outcomes are averaged. At the same time, if the market is to signal information about the accuracy of the climate science to non-experts, the predictions will need to be comprehensible. Two examples of recent bets between a climate scientist and doubters provide examples of the level of precision that may be needed and demonstrate that it is possible to specify the terms sufficiently clearly to avoid ambiguity, while also keeping the bet simple enough to be widely understood by the public.¹⁵⁷

Temperatures at specific points in Greenland or the Arctic may be more valuable early indicators of anthropogenic climate change than temperatures in the U.S. and may focus attention on the importance of Arctic temperature change. The market could develop an option based on temperatures as reported by specific organizations and using specific methods at those locations. Other indicators that could be the subject of trading include changes in ocean acidification, the occurrence of heat waves and droughts, and other events that are the subject of climate debates. Even if the events will not occur for five, ten, or fifteen years, the market value today will be a signal of the likelihood of the outcome at the date of maturity. The market will be subject to manipulation concerns, as any market is, but over the long run financial concerns can be expected to trump ideological concerns so long as the market is properly designed and the marginal trader is motivated by profits.¹⁵⁸

A quick check of the comments section of almost any Internet-based climate change news story or blog post will turn up vigorous, heated criticism of the climate science, the motivations of the scientists, and the merits of reducing car-

156. See, e.g., IPCC 2013 REPORT, *supra* note 4, at 8 (providing in Figure SPM.3 global mean surface-temperature change and global mean sea-level rise for 2046–2065 and 2081–2100 for four scenarios).

157. David Adam, *Climate Change Skeptics Bet \$10,000 on Cooler World*, GUARDIAN, Aug. 18, 2005, <http://www.theguardian.com/environment/2005/aug/19/climatechange.climatechangeenvironment> (noting the specification of whether the average temperature from 2012–2017, as measured by a specific climate monitoring center, would be warmer than the average temperature from 1998–2003); see also Hartford, *supra* note 96, at 15:00–16:45, (announcing the results of a 2007 bet between James Annan and David Whitehouse, over whether the temperature measured by the Hadley Climate Centre would set a new record temperature by 2011).

158. See BERG & REITZ, *supra* note 154, at 7. For a larger commercial market, there may need to be regulatory supervision to detect and prevent egregious attempts to manipulate it. See Justin Wolfers & Eric Zitzewitz, *Prediction Markets*, 18 J. ECON. PERSP. 107, 118 (2004) (“[A]s long as marginal trades are motivated by profits . . . prices will reflect the assessments of (unbiased) profit motive.”).

bon emissions. Climate doubters have an oversized effect on public opinion by vigorously scanning and participating in the comments of numerous blogs.¹⁵⁹ These die-hard skeptics make up only 7 percent of the population, but their large Internet presence leaves casual readers with the impression that climate doubt is more widely held than it is. These skeptics may be the least likely to be influenced by even a market signal about the climate science, but most individuals who do not follow the climate-science consensus are not as firm in their beliefs.¹⁶⁰ The group of less engaged moderate-to-conservative climate doubters (as opposed to the vocal skeptics) may be the most promising recipients of the information generated by a climate prediction market.

3. Accuracy

Several conditions are likely to be important for a climate prediction market to aggregate information effectively. First, the number of traders should be sufficiently large to enable their aggregate information to give way to an accurate prediction.¹⁶¹ Particularly important to the market are well-informed and profit-motivated marginal traders.¹⁶² A climate-change prediction market would have to attract traders who invest the time to learn about the views that form the climate-science consensus, as well as any relevant views that fall outside the consensus, and to reward these traders for their information. Information cannot pay off if all participants hold the same information and beliefs, so some disagreement between participants is imperative.¹⁶³ Prediction markets tend to work better when they concern events that are widely discussed and where pub-

159. See, e.g., Naomi ORESKES & ERIK M. CONWAY, *MERCHANTS OF DOUBT*, 169-215 (2010) (discussing the outsized influence of the vocal minority of climate deniers). See also Riley E. Dunlap & Aaron M. McCright, *Organized Climate Change Denial*, in *THE OXFORD HANDBOOK OF CLIMATE CHANGE AND SOCIETY* 153 (John S. Dryzek, Richard B. Norgaard & David Schlosberg eds. 2011) (“In recent years, these conservative media outlets have been supplemented (and to some degree supplanted) by the conservative blogosphere, and numerous blogs now constitute a vital element of the denial machine.”).

160. Cook et al., *supra* note 1, at 1, 6.

161. See Joyce Berg et al., *Results from a Dozen Years of Election Futures Markets Research*, in *HANDBOOK OF EXPERIMENTAL ECONOMICS RESULTS* 742, 748 (Charles R. Plott & Vernon L. Smith eds., 2008).

162. See Robert Forsythe et al., *Anatomy of an Experimental Political Stock Market*, 82 *AM. ECON. REV.* 1142, 1158-60 (1992); Wolfers & Zitzewitz, *supra* note 158, at 118 (noting that as long as marginal trades are motivated by profit rather than politics, prices will reflect assessments of unbiased profit motive).

163. See Berg, et al., *supra* note 161, at 748; Wolfers & Zitzewitz, *supra* note 158, at 12.

lic information is ambiguous.¹⁶⁴ Climate change is similar to election outcomes in demonstrating these characteristics.

Second, the market should offer contracts that generate dispute prior to maturity but are easily adjudicated at maturity.¹⁶⁵ Contracts in a climate-change prediction market should be based on events that are evidence of climate change, have a disinterested, widely acknowledged judge, and are of interest to participants. To illustrate, a contract based on the global mean combined land and ocean surface temperature in 2030 in a specific IPCC scenario, as determined by any of several standard temperature measurements (for example, satellites and ocean monitoring devices) may be a good contract because it would relate directly to climate change, have a predetermined and unbiased adjudicator, and differences exist among scientists about the outcome. To avoid excessive sensitivity to year-to-year fluctuations that are due to weather rather than climate, it may be preferable to specify ten-year or twenty-year averages, so a bet on 2030 could be defined as the average between 2020 and 2030. A contract based on temperature measurements for which there is substantial disagreement or on the frequency or severity of weather events for which there is no consensus about measurement techniques is less likely to form the basis of a good contract. Other viable contracts might include sea levels at decadal intervals beginning in 2020 and continuing through at least 2100 (later years are also possible, and the IPCC has noted that sea levels are likely to rise for hundreds of years after 2100 even if carbon emissions start dropping precipitously by 2050),¹⁶⁶ the extent of Arctic sea ice, the number of heat waves above a particular magnitude, the number or extent of droughts, and changes to U.S. Department of Agriculture plant-hardiness zones.¹⁶⁷

164. Wolfers & Zitzewitz, *supra* note 158, at 121.

165. *See id.* at 120.

166. *See* IPCC 2001 REPORT, *supra* note 18, at 17 (showing that carbon dioxide concentration, temperature, and sea level continue to rise after emissions are reduced in Figure SPM-5); *see also* IPCC 2013 REPORT, *supra* note 4, at Figure SPM.9 (indicating that sea levels in each scenario are still rising as of 2100). For a discussion of other climate outcomes that could be traded, *see* Hsu, *supra* note 12, at 24, 220–26.

167. Plant-hardiness zones have shifted as the climate has warmed. For a rough example, compare *1964 USDA Hardiness Zone Map*, BILL'S GARDEN, http://www.garden.bsewall.com/topics/hardiness/zones/1964_Map_US.htm (last visited Apr. 6, 2014), with Agricultural Research Service, *2012 USDA Plant Hardiness Zone Map*, U.S. DEP'T OF AGRIC., <http://planthardiness.ars.usda.gov/PHZMWeb> (last visited Apr. 6, 2014). Another potential area for inclusion in a prediction market is the extent of the snowpack. For a discussion of snowpack shrinkage and its effects on the predation of animals that change coat color based on the length of the day rather than the temperature, *see* L. Scott Mills et al., *Camouflage Mismatch in Seasonal Coat Color Due to Decreased Snow Duration*, 110 PROC. NAT'L. ACAD. SCI. (Apr. 15, 2013) (noting that snowshoe hares are becoming vulnerable in the fall because their coats turn from brown to white before the snow cover

Third, the market should employ a mechanism that accurately captures the information from trading and signals this information through the contract price for the period before the outcome occurs.¹⁶⁸ Having a current price signal is particularly important for climate outcomes because, in many cases, the outcome will not occur for decades. In addition, the principal information conveyed by the market is traders' assessment of the likelihood of the outcome.¹⁶⁹ This is in contrast to other academic prediction markets like the IEM, in which participants receive feedback about the accuracy of their predictions with every election.

Other prediction markets have found solutions that may apply to climate predictions as well. For example, a continuous double auction (CDA) is a frequently used mechanism in financial and prediction markets. Both the IEM and Intrade have relied on this mechanism with some success. A CDA matches buyers with sellers in queue. This allows for traders to continually update their positions relative to their information. Continual updating is particularly important in a climate-change market considering the long-term nature of the contracts and the ongoing receipt of climate-change information. The market takes a passive role by employing a CDA mechanism. It matches buyers and sellers to facilitate activity but does not take on financial risk. Prediction-market scholars have asserted that an automated market maker mechanism—such as a dynamic parimutuel market or use of market scoring rules—may work better than CDA in markets where trade volume is low and the market is possibly illiquid.¹⁷⁰ These mechanisms may not work as well in a climate-change market, however, because they require the market to take an active role in pricing the contracts, which may damage the perception of the market as an unbiased aggregator of information. Furthermore, the CDA mechanism is generally recommended for simple markets, like the IEM or a climate-change market, in which the types of contracts traded do not outnumber the participating traders.¹⁷¹

begins, and concluding that snowpack average annual duration is expected to decrease substantially by midcentury).

168. Berg et al., *supra* note 161, at 748.

169. As of 2013, traders have few alternatives to trade options with long time horizons in carbon markets. See Rahim, *supra* note 124 (“The main financial instruments used today are short-term compared to climate change, and there aren’t enough traders to create a real market . . .”).

170. See Robin Hanson, *Combinatorial Information Market Design*, 5 INFO. SYS. FRONTIERS 107, 110–11, 117 (2004); David M. Pennock, *A Dynamic Pari-Mutuel Market for Hedging, Wagering, and Information Aggregation*, PROC. OF THE 5TH ACM CONF. ON ELECTRONIC COM. 170, 173 (2004); Yiling Chen & David M. Pennock, *Designing Markets for Prediction*, AI MAG., Dec. 2010, at 44–46.

171. Paul J. Healy et al., *Prediction Markets: Alternative Mechanisms for Complex Environments with Few Traders*, 56 MGMT. SCI. 1977, 1978 (2010) (“In simple settings with a large number of traders relative to the number of items being predicted, we suggest using the standard double auction mechanism.”).

Contract prices in prediction markets, like share prices in equity markets, may not be a rational representation of the true state of information at any given time.¹⁷² Traders do not always act rationally or in profit-maximizing ways.¹⁷³ Trader bias and price manipulation are of particular concern in a climate-change market, but the performance of the IEM presidential-prediction market provides some reason for optimism. Studies of the IEM's presidential markets have revealed that the average trader makes trades that favor his or her preferred candidate, but the more rational marginal traders are able to correct the price and profit from their corrections. Prediction markets have been shown to be remarkably robust to manipulation attempts,¹⁷⁴ perhaps because rational traders are able to spot manipulation, and prediction markets do not have short-selling barriers as traditional markets do.¹⁷⁵ Manipulation is particularly unsuccessful in the IEM, where a maximum trade of \$500 will only have a miniscule effect in a \$200,000 market.¹⁷⁶

Conversely, a large market with capitalization measured in billions of dollars also would be resistant to manipulation because it is difficult to conceive of a player who would risk enough capital to manipulate such a market. In addition, with billions at stake, if manipulation led to mispricing, savvy investors would aggressively seize arbitrage opportunities and attack the manipulators, similarly to Quantum Fund's famous short position on the pound in response to the Bank of England's attempts to manipulate exchange rates.¹⁷⁷ Such capitalization will not be possible in a betting market, but it could work in a reinsurance market. James Annan has proposed a climate futures market not for prediction, but to function

172. See Sanford J. Grossman & Joseph E. Stiglitz, *On the Impossibility of Informationally Efficient Markets*, 70 AM. ECON. REV. 393, 404–05 (1980); Wolfers & Zitzewitz, *supra* note 158, at 117.

173. See, e.g., Robert Forsythe et al., *Wishes, Expectations, and Actions: A Survey on Price Formation in Election Stock Markets*, 39 J. ECON. BEHAV. 83, 107–08 (1999).

174. See, e.g., Paul W. Rhode & Koleman S. Strumpf, *Manipulating Political Stock Markets: A Field Experiment and a Century of Observational Data* 37 (Working Paper, 2007).

175. *Id.* at 37; Berg et al., *supra* note 153, at 299.

176. BERG & REITZ, *supra* note 154, at 4–5; Levmore, *supra* note 81, at 602–03.

177. See Rod Cross & Douglas Strachan, *On George Soros and Economic Analysis*, 50 KYKLOS 561, 561–574 (1997); Sebastian Mallaby, 'Go for the Jugular', ATLANTIC MONTHLY, June 4, 2010, <http://www.theatlantic.com/business/archive/2010/06/go-for-the-jugular/57696>. On the issue of how a climate bond or prediction contract would need to be held (discussed in the following paragraph), although it would only need to be held until the market adjusted prices to reflect the science, as A. Gary Shilling famously noted, "[m]arkets can remain irrational a lot longer than you and I can remain solvent." A. Gary Shilling, *Scoreboard*, FORBES, Feb. 15, 1993, at 236; see also David Streitfeld, *Amazon's Prophet and Losses*, N.Y. TIMES (Dec. 11, 2013), <http://bits.blogs.nytimes.com/2013/12/11/amazons-prophet-and-losses> (noting that Paulo Santos has "lost and lost big" shorting Amazon even though "Amazon is more unprofitable now than when I started writing about it, will [sic] remain more unprofitable than when I started writing about it") (internal quotations omitted).

analogously to catastrophe bonds, enabling insurers and others with assets threatened by climate change to hedge their risk.¹⁷⁸ It might be worth considering whether such a climate bond market could simultaneously function to hedge risks and provide useful predictions.

A large and liquid climate bond market also could address the problem that bettors might not live to collect on bets regarding the climate in 2100. If expectations about the ultimate accuracy of climate scientists' predictions were priced into today's climate-bond prices, then investors who believe that today's market misestimates the accuracy of the scientific prediction (trusting it either too much or not enough) would not need to hold a climate bond until maturity (in 2100) to profit. Instead, they would only need to hold the bond until the market came to a better understanding of the science and adjusted bond prices accordingly. And, of course, if many investors correctly assessed the science, the cumulative impact of their actions would push prices quickly into alignment with the best estimates of future warming. Thus, a large and actively traded market for climate bonds could simultaneously provide hedging opportunities and credible nonpartisan predictions of future warming, although it may be difficult for the public to understand the implications of bond prices for the likelihood of climate outcomes.

4. Credibility

To be credible to doubters, the market should be transparent, robust to manipulation, privately governed, and unbiased (uninvolved in the resulting price).¹⁷⁹ A private climate-prediction market—one that is formed and operated by a for-profit or not-for-profit, non-governmental entity—is more likely to be established quickly and to provide a credible source of climate information for doubters than a government prediction market.¹⁸⁰ The government's principal foray into prediction markets, the Policy Analysis Market (PAM), is instructive.

178. See *supra* note 130 and accompanying text.

179. These guidelines are particularly important given research showing that people high in individualism (a trait more common among political conservatives than liberals) are less trusting of their fellow participants in cooperation games. See Paul A. M. Van Lange et al., *Are Conservatives Less Likely to be Prosocial Than Liberals? From Games to Ideology, Political Preferences and Voting*, 26 EUR. J. PERSONALITY 461, 462 (2011).

180. One way to assess the potential credibility of markets with this audience is to examine who participates in prediction markets. Early Iowa Presidential Market participants were more conservative than the general public. Forsythe et al., *supra* note 162, at 1146–47 tbl.2 (showing the traders' preferred candidates). This overrepresentation of conservatives in the IEM suggests that conservatives might be particularly willing to engage in a prediction market of climate futures as well.

The Defense Department started conceptualizing PAM during the Clinton administration and received funding in 2001, shortly after President George W. Bush took office.¹⁸¹ Information collection was PAM's primary objective, particularly regarding political instability in the Middle East,¹⁸² but the program generated substantial controversy and was quickly canceled by the secretary of defense.¹⁸³ Although partisan and strategic reasons explain some of the negative reaction to PAM,¹⁸⁴ mistrust of government-sponsored markets fueled some of the concern.¹⁸⁵ Confusion also arose over why the government was seeking the general public's input through a market when it had expert analysts,¹⁸⁶ suggesting that the independent capability of markets to aggregate information was not sufficiently persuasive to win political support for the program.¹⁸⁷ Given the PAM experience and the ability of climate doubters to block government development of a climate prediction market, the federal government is unlikely to develop such a market in the near term. The distrust of government among climate doubters also suggests that the results of a government prediction market may not be a credible source of information in any event.

5. Communication

In addition to the conditions necessary for a market to provide an accurate and credible assessment of the climate science, several conditions are important for the information generated by a climate prediction market to reach a large audience. The first is that the information generated must be comprehensible by nonexperts. Part of the problem with scientific information on climate change is that the information is not understandable to the average person. Even the

181. See Robin D. Hanson, *Designing Real Terrorism Futures*, 128 PUB. CHOICE 257, 258–59 (2006). For a discussion of intelligence prediction markets, see Puong Fei Yeh, *Using Prediction Markets to Enhance US Intelligence Capabilities*, 50 STUD. INTELLIGENCE 137 (2006); Carl Hulse, *Threats and Response: Plans and Criticisms; Pentagon Prepares a Futures Market on Terror Attacks*, N.Y. TIMES, July 29, 2003, <http://www.nytimes.com/2003/07/29/us/threats-responses-plans-criticisms-pentagon-prepares-futures-market-terror.html>.

182. See Robin Hanson, *The Policy Analysis Market: A Thwarted Experiment in the Use of Prediction Markets for Public Policy*, 2 INNOVATIONS 73, 77 (2007). PAM was under the umbrella of the Information Awareness Office and part of the FutureMAP project. See *id.* at 75, 77; Steven Pearlstein, *Misplacing Trust in the Markets*, WASH. POST, July 30, 2003, at E01.

183. Hanson, *supra* note 182, at 80.

184. See *id.* at 84.

185. See *id.* at 82–83; Floyd Norris, *Ideas & Trends; Betting on Terror: What Markets Can Reveal*, N.Y. TIMES, Aug. 3, 2003, <http://www.nytimes.com/2003/08/03/weekinreview/ideas-trends-betting-on-terror-what-markets-can-reveal.html>.

186. See Hanson, *supra* note 182, at 81–82 (citing Joseph E. Stiglitz, *Terrorism: There's No Futures in It*, L.A. TIMES, July 31, 2003, at B13); Hulse, *supra* note 181.

187. See Hanson, *supra* note 182, at 73.

Summary for Policymakers, which the IPCC includes with its climate periodic science assessments to inform politicians and government managers, can be difficult to understand and to translate into the pithy statements that dominate policy debates.¹⁸⁸ The general public must rely on secondary sources for climate change information, and secondary sources often have an agenda or misinterpret the information. A binary contract may be the most comprehensible because the contract's price is the market's probability that the event will occur.¹⁸⁹ For example, consider the IEM's winner-take-all market including a contract on a candidate that pays \$1.00 if the candidate wins and nothing if the candidate loses: If the contract is trading for \$0.75, this means the market is predicting a 75 percent probability that the candidate will win.¹⁹⁰ A vote-share contract is similar but offers more precise information. The same candidate's contract in the IEM's vote-share market pays proportionally to the percentage of the two-party vote the candidate receives, so "contracts for a candidate who receives 32.4% of the popular votes ... will be worth 32.4 cents each."¹⁹¹ A vote-share contract reflects the market's judgment not of the probability of a victory but of the most likely margin of victory or defeat: If a vote-share contract is trading at \$0.55, the market is predicting that the candidate will take 55 percent of the vote. Even the simplest contract is unlikely to be followed by a large audience, however, and so some secondary dissemination will be necessary.

A second condition necessary for communication to a wide audience is that the market price must be widely disseminated. If the market is viewed as credible by the media, the prices of climate predictions could be the subject of news accounts. These news accounts could have direct effects and could be further disseminated through social media. A risk is that the same media sources that play up the uncertainty of the climate science may ignore, ambiguate, or even turn the signals from a climate prediction market on their head. For example, one prediction that was traded on the Foresight Exchange was that "[b]y 2030, the greenhouse effect and other sources will have raised the average world sea level by 1

188. See Michael P. Vandenbergh & Jonathan A. Gilligan, *Macro-Risks: The Challenge for Rational Risk Regulation*, 21 DUKE ENVTL. L. & POL'Y F. 165 (2011) (discussing the difficulty of assessing sea-level increase from 2007 IPCC Summary for Policymakers).

189. Wolfers & Zitzewitz, *supra* note 158, at 109 n.3.

190. *2012 US Presidential Election Winner-Takes-All Market*, IOWA ELECTRONIC MARKETS, http://tippie.uiowa.edu/iem/markets/pr_pres12_wta.html (last visited May 16, 2014).

191. *2012 US Presidential Vote Share Market*, IOWA ELECTRONIC MARKETS, IEM PROSPECTUS PRES12_VS (2012), available at http://tippie.uiowa.edu/iem/markets/pr_pres12_vs.html (last visited May 16, 2014). It is important to note that because of their different structures, the two types of contract cannot be directly compared: An expected vote share greater than 50 percent does not imply 100 percent confidence that the candidate will win, but it is somewhat analogous to the point spread in sports betting.

meter from its 1994 level.” This is a sea-level rise that exceeds the upper limit of the IPCC’s range of estimates for 2100, much less 2030, so it is not a good test of the climate science. If this prediction sells for a very low price, the low price will shed little or no light on the accuracy of the science on sea-level rise or climate change generally. Skeptics could argue that the low price reflects doubt about the climate science, when all it reflects is that the one meter sea level rise by 2030 is far outside of the range predicted by climate scientists. This type of skewing of the reporting on market signals probably cannot be prevented, but choosing predictions that are based on peer-reviewed climate-science reports or studies may help prevent distortion. Press reports of market signals also will provide an opportunity to discuss the specific conclusions of the climate science and a basis to argue about the relevance of the market signals. In addition, if many media sources cover the climate prediction market signals, this information may reach moderate doubters, if not hard-core skeptics.

Perhaps most important, media accounts of the prices of climate predictions also could be used in political debates. Recent research suggests that an important source of climate-science information for the general public arises from media coverage of political elites.¹⁹² The ability to buy and sell a climate prediction may be surprisingly valuable because it would allow politicians not only to point to the price of a particular outcome but also because it would allow them to challenge opponents to put their money where their mouths are.¹⁹³

B. Challenges

Over the long term, climate outcomes will be influenced by the global emissions trajectory as well as the accuracy of the climate-science predictions, so in addition to the accuracy of the climate science, other considerations also will affect the current value of climate predictions. For example, the IPCC has projected that the mean temperature increase over preindustrial levels for the 2081–2100 period will be 3.7 °C if emissions in the interim follow Representative Concentration Pathway 8.5 (RCP8.5).¹⁹⁴ This is essentially the business-as-usual pathway. Although it is the pathway that most closely resembles the current

192. Brulle et al., *supra* note 11, at 170–71.

193. See Neil Irwin, *RIP Intrade: The Last, Best Hope for Pundit Accountability*, WASH. POST WONKBLOG (Mar. 11, 2013, 11:07 AM) <http://www.washingtonpost.com/blogs/wonkblog/wp/2013/03/11/rip-intrade-the-last-best-hope-for-pundit-accountability> (noting that although pundits offer vague predictions and are often not held accountable for their accuracy, “[o]n Intrade, by contrast, the traders who participate and collectively set market prices, are forced to choose—and put money where their mouths are”).

194. See IPCC 2013 REPORT, *supra* note 4, at 21.

emissions trajectory, if a global mitigation effort succeeds, emissions may more closely follow the track of one of the other RCPs, for which the IPCC projects mean increases of 2.2 °C or less. Given the lag time between emissions and climate effects, this is less of a concern for predictions over the next several decades. For predictions of outcomes in 2050 or 2100, the issue could be addressed by coupling a climate prediction with an emissions pathway. Alternatively, although the signaling value would be reduced somewhat by the omission of important emissions pathway variables, doubters will believe that the emissions pathway is irrelevant because of their confidence that the climate sensitivity is small. Those who trust mainstream climate science, on the other hand, will predict significant warming under any credible emissions scenario. Thus, despite uncertainties about the precise emissions trajectory, the prediction market would still provide a valuable source of information about the accuracy of the climate science.

A climate change prediction market also faces unusual challenges because the long-term nature of the investments creates large opportunity costs and thus potentially makes such markets very sensitive to investors' time discounting. Empirical studies have found that such opportunity costs cause long-term predictions markets to operate inefficiently.¹⁹⁵ But markets need not be absolutely efficient to provide useful and trustworthy information. If an option whose proper net-present value is \$100 happens to be mispriced at \$95 or \$105, it still provides useful information if traders can be reasonably confident that this imperfect price signals a value that is reliably well above \$50. A climate change prediction market has a reasonable prospect of being adequately efficient and producing sufficiently accurate forecasts if it is simple—that is, if it is designed to have only a few assets and an easily understood mechanism so that informed traders can spot and correct inaccuracies in the price.¹⁹⁶ Climate science itself is very uncertain about the exact amount of warming that will take place by 2100, even though it is confident that this warming will be substantial. We believe that additional uncertainties introduced by imperfections in climate prediction markets are likely to be small enough, relative to the scientific uncertainties, that the markets' results will be useful and relevant to the question of whether the planet will warm by a dangerous amount. In addition, as discussed above, the opportunity-cost problem might be alleviated if a large and actively traded market were established to simultaneously hedge climate risks and predict climate change. So long as the market

195. See Lionel Page & Robert T. Clemen, *Do Prediction Markets Produce Well-Calibrated Probability Forecasts?*, 123 *ECON. J.* 491, 510–12 (2013).

196. See Plott & Sunder, *supra* note 84, at 664. The IEM is designed this way. See Wolfers & Zitzewitz, *supra* note 158, at 122–24.

is liquid, investors could enter and leave at any time, instead of tying up their money until the bet matures.

A further challenge is traders' confidence that the market will remain operational and solvent long enough to complete trades when futures mature many decades hence, and that the funds held in escrow will realize a return sufficient to offset the traders' discounting rates due to opportunity costs, pure-time preference, and related considerations. Although the risk of insolvency must be taken seriously, it can be addressed reliably and inexpensively through reinsurance markets. The matter of determining what return on the investment is necessary to satisfy traders' time preferences, and what balance of risk (of insolvency) versus return would best please traders, is a technical question beyond the scope of this Article, but it is no different from any number of risk-versus-return optimization problems that investment markets handle daily. The existence of substantial, thriving markets for weather-future derivatives and proposals for analogous markets in global climate futures suggest that the risks of market manipulation and other imperfections can be managed adequately.

The potential for changing public attitudes toward global warming and the possibility of policy action by the government create large financial incentives to manipulate public opinion and belief. To this end, large sums are expended on advertising and lobbying. This suggests that climate markets may be subject to forceful and ingenious attempts at manipulation, perhaps more than election markets have been. Given the intensity of ideological and economic interest in climate outcomes, it is possible that a wealthy individual or corporation with an ideological or profit motive might attempt to manipulate the markets by spending \$1 million to get 2000 people to make \$500 trades. An individual with a financial interest in fossil fuels would have a personal profit motive to prevent greenhouse gas regulation, so the \$1 million may be a reasonable investment that environmentalists cannot counter effectively. At the same time, a renewable-energy entrepreneur might have the opposite incentive. Thus, such markets would need strong safeguards and careful monitoring to avoid manipulation by interested parties. These safeguards would be necessary to prevent manipulation, but also to prevent even the perception of manipulation. If the markets are to serve as trusted sources of information for those who doubt climate science, widespread perception that they can be manipulated by interested parties would undermine their value. Futures and securities markets are also susceptible to manipulation and consequently are highly regulated. Although these are genuine concerns, the IEM is subject to similar concerns and appears to have avoided sig-

nificant manipulation.¹⁹⁷ Furthermore, accumulated noise from irrational or manipulative trading would increase the ability of investors to profit from information.¹⁹⁸ Without noise, there is no arbitrage opportunity for the informed, rational trader. Therefore, noise can be essential in promoting investment in information and, by giving informed investors incentives to trade, can make a market more efficient.¹⁹⁹ The ongoing success of futures markets attests that even though cheating and manipulation occur, it is possible to control them sufficiently to allow the markets to function relatively well.

Bubbles are another potential concern. For example, prices can aggregate trader assessments and their psychological tendencies to act irrationally in evaluating types of information.²⁰⁰ Behavioral finance theory offers an explanation for bubbles and other long-term inefficiencies in the market.²⁰¹ In an efficient market, the market aggregates all information yet reflects only true information.²⁰² Behavioral scholars suggest that the market simply reflects whatever information traders put in it, including information that reflects cognitive errors.²⁰³ Prediction markets are not immune to these errors.²⁰⁴ Prediction markets experience bubbles just as traditional markets do, but studies show that these bubbles do not dominate the market or lead to grossly irrational pricing on average.²⁰⁵ A study on the IEM presidential prediction market shows that the average trader may be

197. The IEM has functioned successfully with little government regulatory oversight. See BERG & REITZ, *supra* note 154. For a nonexperimental market, appropriate regulatory supervision, analogous to that exercised over commodities futures markets, should be able to detect and prevent fraudulent attempts to manipulate markets.

198. See Grossman & Stiglitz, *supra* note 172, at 399–400.

199. See Sanford J. Grossman, *The Existence of Futures Markets, Noisy Rational Expectations and Informational Externalities*, 44 REV. ECON. STUD. 431, 443 (1977).

200. See Robert J. Shiller, *Human Behavior and the Efficiency of the Financial System 2–3* (Cowles Found., Discussion Paper No. 1172, 1998).

201. See ABRAMOWICZ, *supra* note 83, at 217.

202. See, e.g., Charles R. Plott, *Markets as Information Gathering Tools*, 67 S. ECON. J. 1, 11 (2000) (characterizing the market as knowing the true state).

203. For example, the tendency for people to avoid information that makes them doubt prior beliefs and assumptions is evident in markets. See Shiller, *supra* note 200, at 8. It follows that in a cognitive effort to avoid failure, investors hold off selling stocks that have not performed well, even if all the information tells them they should sell. This may explain why money flows into mutual funds performing well faster than it flows out of poorly performing funds. In a prediction market, it is conceivable that traders may not update their position in the market even though their information has changed. This may be an impediment to incorporating private information. The psychological tendency for overconfidence also may play a role in market prices. See ABRAMOWICZ, *supra* note 83, at 68; Shiller, *supra* note 200, at 13–17. Market models have shown how investors' overconfidence combines with their limited attention spans to create amplification of any existing noise in the market. See Lin Peng & Wei Xiong, *Investor Attention, Overconfidence, and Category Learning*, 80 J. FIN. ECON. 563 (2006).

204. Wolfers & Zitzewitz, *supra* note 158, at 117–18.

205. See Plott & Sunder, *supra* note 84, at 686; Wolfers & Zitzewitz, *supra* note 158, at 119.

influenced by his or her political preferences, but these trades do not affect overall accuracy because of rational and informed marginal traders.²⁰⁶ A climate change market may work the same way: Although many traders may be ideologically motivated, the market can still incorporate information accurately.

The prospect of informed traders recognizing errors in a price and being able to profit from errors is critical to efficient markets.²⁰⁷ One key to this profit is a lack of barriers to short selling. In the stock market, informed traders may face barriers to short selling overvalued stocks that are not present in buying undervalued stocks.²⁰⁸ For example, in buying one could lose only the amount paid, but in short selling there is no limit to the possible loss.²⁰⁹ This prevents informed traders from correcting a price that is too high.²¹⁰ Especially when the timing is uncertain, investors may not be willing or able to face the risks involved with shorting, even if they are certain the stock is overvalued.²¹¹ Economists are divided on how much the added risks of short selling affect the market.²¹² Ideally, an informed trader would be able to offset cognitive errors in price by selling short. Most prediction markets, however, do not face the obstacles that traditional markets do in short selling and are designed so that marginal traders can profit from buying and selling alike.²¹³

Another potential obstacle to efficient prediction markets is the level and type of participation. If few people participate in a prediction market, trades will draw on a limited and possibly biased reservoir of information. For instance, if participants were predominantly climate skeptics, the market could significantly underpredict warming, and if participants were predominantly climate alarmists, the market could significantly overpredict warming. Past prediction market bets on climate change, such as an Intrade contract on the 2010 annual global mean temperature, have not attracted large numbers of participants, so this concern has

206. Forsythe et al., *supra* note 162, at 1157–61.

207. See Shyam Sunder, *Market for Information: Experimental Evidence*, 60 *ECONOMETRICA* 667, 691 (1992) (concluding that convergence to the wrong price might have occurred because of restrictions on short selling).

208. See ABRAMOWICZ, *supra* note 83, at 221–22 (citing J. Bradford De Long et al., *Noise Trader Risk in Financial Markets*, 98 *J. POL. ECON* 703 (1990)).

209. See PAUL WILMOTT ET AL., *THE MATHEMATICS OF FINANCIAL DERIVATIVES: A STUDENT INTRODUCTION* 12 (1995) (noting that short positions are equivalent to writing call options and thus entail “the possibility of arbitrarily large loss”); Robert J. Shiller, *From Efficient Markets Theory to Behavioral Finance*, 17 *J. ECON. PERSP.* 83, 100 (2003).

210. See Shiller, *supra* note 209, at 99.

211. See ABRAMOWICZ, *supra* note 83, at 222; Shilling, *supra* note 177.

212. See Shiller, *supra* note 209, at 97–98.

213. See ABRAMOWICZ, *supra* note 83, at 219–25.

some empirical basis.²¹⁴ The controversy in the public mind about climate change consistently generates significant participation in other spheres of activity, however, suggesting that a well-designed and promoted market could attract many participants. Both liberal and conservative media regularly run stories and opinion pieces about climate change. Voters care sufficiently about climate change that Bob Inglis's (R-SC) loss in the 2010 Congressional Primary may have been due in part to his "heresy" of declaring that human activity was changing the climate.²¹⁵ The perception that voters care strongly about a candidate's position on climate science also may have led Jon Huntsman to retreat from his bold statement that he trusted scientists about climate change.²¹⁶ If enough voters are sufficiently passionate about climate change to defeat an otherwise strong candidate and to cause another to walk back a position, then a well-publicized prediction market could well draw a large number of participants. If the market deviates from the assessments of experts, well-informed individuals may enter the market to profit from the mispricing. Only an empirical trial can determine whether such a market could attract enough traders to function well, but the public seems sufficiently interested in arguments about climate science to make it at least plausible that such a market could succeed.

In sum, the theoretical and empirical literature provides some basis to conclude that a well-designed prediction market will accurately reflect information, even if climate doubters' concerns about the exclusion of inconvenient information by climate scientists are well-founded. Long time spans, information costs, cognitive biases, lack of participants, and other phenomena could limit the

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214. This Intrade contract, called Climate Change Prediction: Al Gore Versus Prof. Scott Armstrong, started in 2008 and was based on the relative accuracy of a prediction by climate skeptic Scott Armstrong (that there would be no change in global annual temperature as compared to 2007) and the warming predicted by the 1992 IPCC report (which was labeled the "Al Gore" prediction). Armstrong had previously challenged Gore to a climate bet, which Gore declined. The expiry was global annual mean temperature for 2010. The contract had a total of 2288 trades over twenty months (May 2009–Jan 2011). INTRADE, *Climate Change Prediction: Al Gore Versus Prof. Scott Armstrong*, http://www.intrade.com/jsp/intrade/common/c_cd.jsp?conDetailID=680459&z=1270421180739# (last visited Apr. 6, 2014).
215. See Robert E. Gropp, *New Congress, Old Climate Rhetoric?*, 61 BIOSCIENCE 106 (2011); David Corn, *Confessions of a Tea Party Casualty*, MOTHER JONES (Aug. 3, 2010), <http://www.motherjones.com/politics/2010/08/bob-inglis-tea-party-casualty>; Evan Lehmann, *Republicans Learn the Perils of Being Politically Incorrect on Climate Change*, CLIMATE WIRE (Nov. 22, 2010), available at <http://www.nytimes.com/cwire/2010/11/22/22climatewire-republicans-learn-the-perils-of-being-politic-3326.html?pagewanted=all>; Elizabeth McGowan, *Outgoing Rep. Bob Inglis Still Touting Revenue Neutral Carbon Tax*, REUTERS (Dec. 8, 2010, 11:22 AM), <http://www.reuters.com/article/2010/12/08/idUS286690080020101208>.
216. See Stephen Stromberg, Op-Ed., *Huntsman Sells Out on Climate Change?*, WASH. POST, Dec. 7, 2011, http://www.washingtonpost.com/blogs/post-partisan/post/jon-huntsman-confuses-on-climate-change/2011/12/07/gIQAwX8scO_blog.html.

extent to which a market price accurately reflects all relevant climate information, but a well-functioning market should reflect information that is relevant and material to the likelihood that a traded climate outcome will occur. Even if these factors cause the market to deviate from perfect efficiency, the market should be efficient enough to produce trustworthy information about the accuracy of mainstream climate science. In addition, there is reason to believe that a market could do so even if that information is not from conventional sources or is not consistent with conventional wisdom among climate scientists.

IV. LONG-TERM INITIATIVES

In the long run, if the climate market can transition from a limited experimental climate prediction market to a more robust commercial climate futures market, the prices of climate futures could be much more widely disseminated. For example, the market value of climate predictions could be included in routine daily financial tables in print and electronic media along with the prices of stocks, bonds, and other financial instruments.²¹⁷ These numbers also could become the subject of daily reporting, much as S&P 500 index figures and projected quarterly employment and Gross Domestic Product (GDP) figures are reported today. This daily information flow may enable the value of climate predictions to become a common, widely discussed feature of newspapers, news blogs, financial news television and radio shows, and social media.

A. Commercial Options Markets

The recent history of climate and other markets suggests that movement from a small experimental market to a large commercial market may take time and require statutory or regulatory changes. For example, from 2007 until 2012 Intrade and its affiliate, the Trade Exchange Network (TEN), operated a predic-

217. Although a play-money market may be another viable option for a climate change market, it is unlikely to generate widespread media attention or to have as much credibility with doubters as a real-money market. Play-money markets may not have as much impact as real-money markets, but research indicates that their insights can be valuable and that they may be just as accurate as real-money markets. See Bell, *supra* note 12, at 47 (noting that the principle of rewarding participants for developing truthful beliefs applies to play-money markets just as it would in a real-money market); Elizabeth Dwoskin, *Intrade, Where Politics Meets the Market*, BLOOMBERG BUSINESSWEEK (Feb. 23, 2012), <http://www.businessweek.com/articles/2012-02-23/intrade-where-politics-meets-the-market#p2> ("Intraders brag about their insights, but not their earnings."). Some have argued that BitCoin, an electronic currency, may be a way for real-money prediction markets to operate in the United States without regulatory obstacles. See Jerry Brito, *The Top 3 Things I Learned at the Bitcoin Conference*, REASON.COM (May 20, 2013), <http://reason.com/archives/2013/05/20/the-top-3-things-i-learned-at-the-bitcoi>.

tion market that offered U.S. customers binary options contracts. These contracts allowed investors to bet on whether some event would take place, for example whether the price of gold or certain currencies would reach a specified level by a set date. In November 2012, the CFTC found Intrade and TEN to be in violation of the Commodity Exchange Act. Intrade and TEN were sanctioned for offering commodity options to U.S. customers off-exchange and without authorization from the CFTC.²¹⁸ Intrade's allegedly illegal practices included offering contracts on commodities such as gold and oil; currencies such as the Yen and Euro; macroeconomic indicators such as the employment rate, GDP, and the number of banks that will fail; and foreign military affairs such as war or action against North Korea.²¹⁹ In 2005, TEN had similarly fallen afoul of the Commodity Exchange Act for offering off-exchange commodity options.²²⁰ Subsequently, it attempted, unsuccessfully, to operate as an Exempt Board of Trade (EBOT), a largely unregulated trading platform that allowed eligible traders to transact in excluded commodities.²²¹ Following the passage of the Dodd-Frank Act in 2010, this category of unregulated market no longer exists.²²²

Intrade is no longer in business, but it was the most popular prediction market to date.²²³ It was widely discussed in the media; the New York Times alone mentioned it 68 times in 2012.²²⁴ Intrade also generated remarkably accurate predictions in some instances. In 2008, it predicted Obama winning the election with 364 electoral votes, only 1 vote shy of the actual number.²²⁵ It is unclear whether a company such as Intrade would be able to operate in the United States if it cooperated with the CFTC.

218. Perhaps after Nadex pointed out the inconsistency of allowing Intrade to host political markets free of regulation, the CFTC could no longer ignore it. See Letter from Timothy G. McDermott, Gen. Counsel, Nadex, to David Stawick, Sec'y of Comm'n, CFTC 2 (Feb. 16, 2012), available at <http://www.cftc.gov/stellent/groups/public/@rulesandproducts/documents/ifdocs/nadextr021612.pdf> (interpreting 40.11(a)(1) to be a ban on certain underlying events, not on the trading of the events); Complaint at 4-9, U.S. Commodity Futures Trading Commission v. Trade Exchange Network Ltd., No. 1:12-cv-01902 (D.C. Cir. Nov. 26, 2012) [hereinafter CFTC TEN Complaint].

219. See CFTC TEN Complaint, *supra* note 218, at 8.

220. See *In re Trade Exchange Network*, No. 05-14, 2005 WL 2428319, at *4-5.

221. See CFTC TEN Complaint, *supra* note 218, at 15.

222. The Dodd-Frank Wall Street Reform and Consumer Protection Act, Pub. L. No. 111-203 § 734, 124 Stat. 1376, 1718 (2010); CFTC Order Instituting Proceedings and Imposing Remedial Sanctions Against the Trade Exchange Network, available at <http://www.cftc.gov/files/enf/05orders/enfradeexchangenetworkorder.pdf>.

223. See Goldberg, *supra* note 129, at 425; see also Brito, *supra* note 217 (calling Intrade a "darling of academic economists and political scientists").

224. *Prediction Markets: Don't Bet on It*, ECONOMIST, Dec. 1, 2012, <http://www.economist.com/news/finance-and-economics/21567382-intrade-retreats-american-regulators-dont-bet-it>.

225. Dwoskin, *supra* note 217.

B. Creating Regulated Markets

An additional option for a climate prediction market would be for the market to become a fully regulated exchange or designated contract market (DCM) that operates in compliance with CFTC rules. A regulated exchange would be subject to the CFTC's full panoply of designation requirements and its antifraud and antimanipulation authority.²²⁶ Although these types of markets have high regulatory costs, they have the advantage of ensuring that a broad range of retail and more sophisticated investors can participate. Regulated exchanges also can seek to trade a wide range of products. Authorization under the CFTC, then, can open the door to prediction markets that include many types of participants and that trade products reflecting a diversity of climate-change challenges, bringing into relief views and prevailing opinions on many topics.

Although an ambitious undertaking, organizing a regulated climate prediction market offers considerable potential advantages. Exchanges provide investors with a range of economic and market functions. These include: (1) price discovery, (2) hedging of economic risks, and (3) speculative trading in listed assets. For example, using an exchange-traded derivative, a farmer can protect herself and hedge her risks by locking in the price at which she will sell a bushel of wheat in a year's time. Alternatively, a speculator might enter into the same contract depending on her view of how wheat prices are likely to fluctuate—but without owning any wheat herself. In these cases, the trading, alongside that of other participants, generates price discovery of what the wheat is likely to be worth in a year's time.²²⁷ The effects of these different trading functions in prediction markets are not entirely clear.²²⁸ For example, if a climate-change prediction market is used to hedge risks, the prices at which its contracts trade may better reflect the costs of insuring against certain events rather than the likelihood of these events occurring. Although the two measures may be closely linked, differentiating the prediction value from the economic value of traded contracts is likely to be challenging. As an illustration, the accuracy of the IEM may be due

226. For an overview, see *Trading Organizations*, U.S. COMMODITY FUTURES TRADING COMMISSION, <http://www.cftc.gov/industryoversight/tradingorganizations/index.htm> (last visited Apr. 6, 2014).

227. See *Weather Futures and Options*, CME GROUP (June 27, 2013), http://www.cmegroup.com/trading/weather/files/WT-104_WeatherFC_SR.PDF (explaining how businesses can hedge risk associated with adverse weather events); *Why Nadex?*, NADEX (October 13, 2013), <http://www.nadex.com/why-nadex.html> (describing a new way of trading the financial markets).

228. See Justin Wolfers & Eric Zitzewitz, *Interpreting Prediction Market Prices as Probabilities* (IZA, Discussion Paper No. 2092, 2006); see also Bell, *supra* note 12, at 49–51 (explaining that hedging may only be a tertiary purpose of prediction markets).

in part to a majority of risk-neutral traders and the \$500 investment limit, which prevents the market from becoming a viable hedging tool.²²⁹

Many regulated markets trade exotic products. Nadex has traded binary options on macroeconomic indicators since 2004, and the Chicago Mercantile Exchange has offered a variety of weather derivatives since 1999.²³⁰ These exchanges have the capacity to comply with the costly requirements of a contract-market designation.²³¹ Nevertheless, as a practical matter, for a climate-change prediction market, obtaining authorization is likely to pose considerable challenges in the near term. Although the CFTC has textual flexibility to decide which contracts may be traded, such authority can be restrictively exercised. When contracts fail to satisfy an economic-purpose test, notably as contracts that are not useful for hedging or in the public interest, they are likely to be prohibited.²³² For example, contracts may allow speculation on assassination risks, terrorism, or natural disasters, falling afoul of the CFTC's public-interest requirements. Prediction markets may involve trading on events that breach state or federal law, again inviting suspicion from the CFTC.²³³ New contracts also can create insider-trading concerns, but closing off a climate prediction market to climate experts and insiders would defeat its key, informative purpose.²³⁴

The CFTC's recent interpretations suggest deep suspicion of prediction markets and speculative instruments. For example, the CFTC recently decided not to approve designated contract markets in presidential-election futures.²³⁵ Similarly, in its effort to start a new political-futures market, Nadex failed to persuade the CFTC that the social and economic benefits of the market would outweigh the potential drawbacks of upsetting Congress, encroaching on state laws, and risking monetary manipulation in presidential elections. The Hollywood Stock Exchange failed in a similar attempt related to box-office futures. Although its application for a designated contract market in future box-office re-

229. See Berg et al., *supra* note 153, at 287 n.3.

230. See *Trading Organization Products*, U.S. COMMODITY FUTURES TRADING COMMISSION, <http://sirt.cftc.gov/sirt/sirt.aspx?Topic=TradingOrganizationProducts&implicit=true&Status=Approved&CustomColumnDisplay=TTTTTTTTTT> (last visited June 27, 2013) (searching all contracts under the subcategory "weather").

231. See, e.g., Automated Trade Surveillance System, 17 C.F.R. § 38.156.

232. See Self-Certification by N. Am. Derivatives Exch., Inc., *supra* note 136.

233. See *id.*

234. See *Hearing to Review Proposals to Establish Exchanges Trading "Movie Futures": Hearing Before the Subcomm. on Gen. Farm Commodities and Risk Mgmt. of the H. Comm. on Agric.*, 111th Cong. 10, 14-15 (2010) [hereinafter *Movie Futures Hearing*] (statement of Dan M. Berkovitz, Gen. Counsel, CFTC), available at <http://agriculture.house.gov/sites/repUBLICans.agriculture.house.gov/files/testimony/111/111-49.pdf>.

235. See 17 C.F.R. § 40.11 (2012); Self-Certification by N. Am. Derivatives Exch., Inc., *supra* note 136.

ceipts was approved by a divided CFTC vote, weeks later Congress expressed its disapproval of event contracts by explicitly banning the trading of future box-office receipts.²³⁶

Nevertheless, the CFTC does have substantial legal, if not political, discretion to determine public interest.²³⁷ A climate-change prediction market could have social and economic benefits that dwarf those of box-office futures or political event markets. If early action to address the potential harms of climate change may reduce mitigation costs by trillions of dollars, as leading economists have argued,²³⁸ providing accurate information about the climate science that informs private and public responses could have obvious benefits. Companies could use the market to make more informed decisions about investments in low-carbon technologies, and coastal cities could better plan adaptation efforts. Policymakers at the national and subnational levels could better assess the appropriate investments in a wide range of energy, climate, infrastructure, and other projects and policies. With these benefits in mind,²³⁹ at a minimum it is hard to argue that a climate-change market is contrary to public interest. These benefits likely outweigh possible concerns about gambling and manipulation, making their approval in the public's interest, although it may take time to overcome legislative and regulatory hurdles.²⁴⁰

236. See Dodd-Frank Wall Street Reform and Consumer Protection Act § 721(e), 7 U.S.C. § 13-1 (2012); *Movie Futures Hearing*, *supra* note 234, at 19.

237. See *Prediction Markets: Don't Bet on It*, *supra* note 220.

238. See, e.g., William D. Nordhaus, *Why the Global Warming Skeptics Are Wrong*, N.Y. REV. BOOKS, Mar. 22, 2012, at 1 (estimating that the cost of a fifty-year delay in reducing CO₂ emissions is \$4.1 trillion).

239. See Silver, *supra* note 12.

240. See SUROWIECKI, *supra* note 149, at 21 (“[G]iven the right conditions and the right problems, a decision market’s fundamental characteristics—diversity, independence, and decentralization—are guaranteed to make for good group decisions.”). In 2008, the rising interest and scholarship in prediction markets prompted the CFTC to solicit comments relating to regulation of event contracts. See Concept Release, *supra* note 145, at 25669. The regulation, jurisdiction, and legality of event contracts had been a gray area for some time. See *id.* at 25671–72; Letter from John Delany, CEO, Intrade, to CFTC 2 (July 4, 2008), available at <http://www.cftc.gov/ucm/groups/public/@lrfederalregister/documents/frcomment/08-004c014.pdf> (“While U.S. institutions and society benefit from Intrade’s services it is perversely unclear as to whether Intrade . . . [is] considered *persona gratis* by the United States.”). The comments were supportive of event contracts, expressing the view that they were innovative tools promoting the public’s interest. See, e.g., Letter from IEM Board of Directors, University of Iowa, to Office of the Sec’y, CFTC (July 7, 2008), available at <http://www.cftc.gov/ucm/groups/public/@lrfederalregister/documents/frcomment/08-004c014.pdf>; Letter from Greg Zeran, Counsel and Head of Global Public Policy, International Swaps and Derivatives Association, to Office of the Sec’y, CFTC (July 1, 2008), available at <http://www.cftc.gov/ucm/groups/public/@lrfederalregister/documents/frcomment/08-004c010.pdf>; see also *Federal Register Comment File: 08-004*, U.S. COMMODITY FUTURES TRADING COMMISSION (last updated May 7, 2008), <http://www.cftc.gov/LawRegulation/PublicComments/08-004> (providing links to comments responding to the concept release for event

CONCLUSION

A deep disconnect exists between the views of climate scientists and one half of the American population, and sound national and international energy policy is difficult to design in the face of this disconnect. Recent experience and multiple studies suggest that more science and improved science communication are necessary but not sufficient to close this gap. If the problem is not the existence of climate science but the willingness of many to update their beliefs, the solution should address the reasons why people resist doing so. One of those reasons is the source of the information: For many conservatives and some moderates, government-funded or generated reports on climate science lack credibility. These individuals tend to place greater stock in private markets as policy instruments. It is reasonable to believe that they also find markets to be more credible sources of information than government, although surprisingly little research has been done on this issue.

This Article proposes the creation of a private prediction market to assess and communicate the implications of climate science. Private markets have the potential to respond to two of the limitations of government climate-science reports: the argument that information has been inappropriately excluded from the climate consensus, and the lack of trust in climate-science reports as a source of climate information. Market information also can be disseminated widely. At some point, commodities and securities regulatory agencies may view the climate-science disconnect and the resulting government inaction on carbon mitigation, as a bigger risk to investors and the economy than the risks of a robust climate-futures market. At that point, it may be possible to create a climate-futures market that will enable the general public to open a newspaper (or a tablet or cell phone) and check on the daily status of climate-science predictions in much the same way one would check the S&P 500 or the Dow. That day is not near. These markets pose genuine risks, and agency caution and negative reactions by opponents of government carbon mitigation can be expected to slow the policy, regulatory, and legislative actions that would make a climate-futures market possible.

contracts). Despite the positive response, the development of a regulatory plan for event contracts ended with the concept release. See Jill E. Sommers, Dissent of Commissioner Jill E. Sommers from Approval of Media Derivatives Exchange's Opening Weekend Motion Picture Revenue Futures and Binary Option Contracts, (June 14, 2010), available at <http://www.cftc.gov/ucm/groups/public/@otherif/documents/ifdocs/mdexdissentingsommers061410.pdf> ("Unfortunately, the Commission has not yet acted to promulgate definitions or guidance for these markets . . ."). The financial crisis of 2008 became a more pressing issue for regulatory bodies, and afterwards the climate had chilled for innovative financial products.

In the near term, the more realistic option is the creation of a private prediction market that is limited in scope but provides accurate, credible, and widely communicated signals about the status of the climate science. A private prediction market or climate-futures market could be a surprisingly important way to assess the likelihood of the climate threat in a way that is accurate and not easily dismissed across the political spectrum. The potential value of a climate prediction market suggests that this is an area worthy of substantial attention not only by scholars, but also by philanthropic organizations, corporations, and advocacy groups.