

## CLIMATE CHANGE AND THE TRANSFORMATION OF RISK: INSURANCE MATTERS

Sean B. Hecht<sup>\*</sup>

*Climate change will increase risks significantly in many areas of society, and also will make many risks more uncertain and harder to measure. If our society is to survive climate change without significant human costs, we must develop robust institutions and practices to manage these risks. The insurance industry is our society's primary financial risk manager and needs to play a leading role in developing these institutions and practices. But climate change poses an unprecedented challenge to the insurance industry, because factors such as increasing uncertainty and the potential for highly correlated losses will make it difficult to insure against climate change-related risks and will strain capital markets' ability to compensate those who are affected. If the industry rises to the challenge, it stands to profit while facilitating our most successful responses to climate change-related threats around the world. If not, insurers will suffer along with everyone else. A report issued recently by a major financial services firm identified climate change as the number one "strategic threat" facing the insurance industry, noting that it is a "long-term issue with broad-reaching implications that will significantly affect the industry." To date, however, there has been relatively little effort to examine what supply- and demand-side barriers may be impeding development of insurance products that address climate change risk effectively. In this context, this Article examines the incentives that insurance products provide to influence the climate change-mitigating and adaptive capacity-building behavior of policyholders and other actors. It also looks at the reasons that insurers might or might not choose to provide those products and the reasons individuals and businesses may or may not choose to purchase those products. Finally, it examines the extent to which the insurance industry's products are likely to play a significant and effective role in affecting private actors' responses to climate change. The Article concludes that although it is not yet clear whether and how the insurance industry will be able to address climate change in a way that systematically creates solutions, the industry's future—and perhaps the rest of ours as well—may rest on the success or failure of its adaptation to a world with a changing climate.*

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<sup>\*</sup> Executive Director, UCLA Environmental Law Center, UCLA School of Law. I am grateful to Dan Farber, Wesley Gorman, Shi-Ling Hsu, Evan Mills, Cliff Rechtschaffen, Michael Vandenberg, and Rebecca Weiker for their helpful comments. Angela Mo and Kiran Prasad provided excellent research assistance. This Article also benefited from my conversations with Tom Ankersen. Finally, the Evan Frankel Foundation's support has played an important role in making this Article possible.

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## INTRODUCTION

The insurance industry is poised to make important contributions to address both the causes and impacts of our changing climate. Climate change poses risks that are unprecedented in the short timespan of industrialized society; some of the risks are startlingly uncertain in nature

and degree and have financial consequences to businesses and individuals. Because insurers play a central role in helping our global economy to manage risk and to make business and personal financial ventures viable, their participation in solving the climate change problem is essential. Moreover, climate change poses a risk to the long-term stability of the insurance industry itself, because of the uncertainties that climate change introduces into risk management. If insurers do not rise to the challenge of climate change, there could be a serious financial and social crisis on a global scale. Global governance institutions will have to devise other methods of managing the risks posed by climate change.

Some insurance industry leaders have noted that the industry has a significant financial stake in climate change, and some have asserted that the insurance sector can and should play an active role in solving our society's climate change-related problems.<sup>1</sup> This awareness has encouraged significant recent activity among insurance companies to attempt to assess and to react to climate change.<sup>2</sup> Trevor Maynard, Manager of Emerging Risks for the massive surplus insurer Lloyd's of London, has stated that "[c]limate change is already affecting the global insurance industry,"<sup>3</sup> and has argued that "[a]ll aspects of an insurer's balance sheet, its liabilities, capital requirements and assets may be affected."<sup>4</sup> And a report issued recently by the major financial services firm Ernst and Young identified climate change as the "top insurance risk in 2008," noting that it is a "long-term issue with broad-reaching implications that will significantly impact the industry."<sup>5</sup>

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1. See CLIMATEWISE, REDUCING THE RISK FOR TOMORROW 10–12 (2007) (describing a commitment to take action on climate change signed onto by a coalition of the Association of British Insurers and sixteen major international insurance companies and highlighting the importance of insurance industry activities to help to address climate change), available at <http://www.climatewise.org.uk/media/666/climate%20wise%20for%20web.pdf>; Trevor Maynard, *Climate Change: Impacts on Insurers and How They Can Help With Adaptation and Mitigation*, 33 GENEVA PAPERS 140 (2008).

2. The Article proceeds from the assumption that anthropogenic global climate change is occurring on a significant scale, as has been well documented in the scientific literature. See generally INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS (2007), available at <http://www.ipcc.ch/ipccreports/ar4-wg1.htm>. See discussion *infra* Part II, about specific climate change-related phenomena that are anticipated to affect the insurance industry. See also Naomi Oreskes, *The Scientific Consensus on Climate Change: How Do We Know We're Not Wrong?*, in CLIMATE CHANGE 65, 65–99 (Joseph F.C. DiMento & Pamela Doughman eds., 2007) (discussing the state of scientific knowledge about climate change).

3. Maynard, *supra* note 1, at 140.

4. *Id.* at 145.

5. ERNST & YOUNG, STRATEGIC BUSINESS RISK: INSURANCE 2008, at 4 (2008), available at [http://www.ey.com/Global/assets.nsf/International/Industry\\_Insurance\\_StrategicBusinessRisk\\_2008/\\$file/Industry\\_Insurance\\_StrategicBusinessRisk\\_2008.pdf](http://www.ey.com/Global/assets.nsf/International/Industry_Insurance_StrategicBusinessRisk_2008/$file/Industry_Insurance_StrategicBusinessRisk_2008.pdf).

Scholars interested in risk management have noticed, and in some case have influenced, this trend, as have researchers seeking mechanisms to facilitate mitigation of greenhouse gas emissions and adaptation to the inevitable impacts of climate change.<sup>6</sup> The insurance industry's role will go far beyond simply compensating climate change's victims for their losses. Insurers' products will likely affect incentives across the globe for businesses and individuals to address climate change. As Mr. Maynard of Lloyd's has noted, "[w]e cannot insure our way out of the problem. . . . The insurance industry can actively play its part in mitigation and encouraging others to do so; it can also be a force to encourage appropriate adaptation."<sup>7</sup>

To date, however, there has been relatively little effort to examine the relationship between climate change and the way that insurance products affect the behavior of insurers and consumers.<sup>8</sup> This Article examines the incentives that insurance products provide to influence the behavior of policyholders and other actors in mitigating and adapting to climate change risks. It also looks at the reasons that insurers may or may not choose to provide those products and the reasons individuals and businesses may or may not choose to purchase those products. Finally, the Article examines how effective the insurance industry's products are likely to be in affecting private actors' responses to climate change in light of the observed and predicted behavior of both consumers and insurers.<sup>9</sup>

In Part I, I describe the insurance industry's role in managing risk for individuals and businesses and explain why it is essential to our world economy. In Part II, I show that climate change is having significant

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6. See, e.g., Howard C. Kunreuther & Erwann O. Michel-Kerjan, *Climate Change, Insurability of Large-Scale Disasters, and the Emerging Liability Challenge*, 155 U. PA. L. REV. 1795 (2007); Evan Mills, *Insurance in a Climate of Change*, 309 SCIENCE 1040 (2005).

7. Maynard, *supra* note 1, at 142.

8. Two recent articles that do begin to address these questions are Kunreuther & Michel-Kerjan, *supra* note 6, and Michael G. Faure, *Insurability of Damage Caused by Climate Change: A Commentary*, 155 U. PA. L. REV. 1875 (2007).

9. This Article seeks to explain the role private insurers play, and might play, in addressing climate change as market actors in their core business. Consequently, I focus on the insurance industry's products, and not on other ways in which the industry is addressing, or may address, climate change. These other efforts by insurers—such as conducting and sponsoring research, lobbying, investing, regulating the industry's own carbon emissions, educating consumers, offering risk assessment and risk management services that do not themselves involve taking on risk of loss, and participating in public policy formulation—can contribute importantly to solving societal problems relating to our changing climate. In many cases these efforts are synergistic with innovative insurance product development. For an overview of insurers' efforts to deal with climate change through a variety of mechanisms, see EVAN MILLS, *FROM RISK TO OPPORTUNITY: 2007: INSURER RESPONSES TO CLIMATE CHANGE* 14 (2007), available at <http://eetd.lbl.gov/insurance/opportunities/Risk-to-Opportunity-2007.pdf>.

impacts on insured risks. These impacts will negatively affect insurability and insurers' willingness and ability to supply insurance.

In Part III, I examine the potential for the insurance industry to influence private responses to climate change through the industry's products. I analyze the factors that affect both insurers' supply and consumers' demand for insurance products, and identify some significant theoretical and practical barriers to adoption of products that might influence behavior that will either mitigate greenhouse gas emissions or facilitate adaptation to climate change.

In Part IV, I analyze the industry's future through a discussion of the attributes of some specific insurance products that may affect climate change-related behavior of other private actors. I conclude that while opportunities exist for insurers to facilitate mitigation of greenhouse gases and adaptation to the unavoidable impacts of climate change through their products, there are significant barriers both to insurers' willingness to offer many of these products and to consumers' willingness to pay for them, and not all products that appear to be climate-friendly will necessarily accomplish those goals in practice.

In Part V, I examine the influence that governmental and nongovernmental third parties, such as regulators and rating agencies, may have on insurer behavior in this context. And finally, in Part VI, I draw on recent research framing private contracting as a form of environmental governance to examine whether the insurance industry may become a successful and legitimate quasi-regulatory force to address climate change issues internationally.

I conclude that while the insurance industry will be deeply affected by our changing climate, it is not yet clear whether and how it will be able to address climate change in a way that systematically creates solutions. The insurance industry is one of the primary buffers our society has to address the social costs of risk. If the industry were unable to address climate change-related risks effectively, we would face an international crisis. Currently insurable risks would become uninsurable, and individuals and businesses will face unbearable risks. If that happens, alternative institutions will have to be developed to assist with risk management, likely at a great cost, in order for our society to mitigate and to cope with climate change.

## I. THE INSURANCE INDUSTRY

The insurance industry plays a crucial role in spreading risk, enabling our global economy to function effectively. Understanding the interplay between climate change and the insurance industry requires a basic understanding of the insurance industry's financial power and the concept of insurability.

### A. The Insurance Industry's Risk-Bearing Role

Insurers are able to bear risks that other businesses and individuals are unable to bear, by aggregating those risks to make the insurer's overall risk predictable. Policyholders pay a relatively small, certain amount (called a premium) in order to avoid the risk of a larger payout later. This enables policyholders to use their capital rather than hold it in reserve in case a risk materializes.<sup>10</sup>

Insurance coverage thus satisfies the central needs of businesses and individuals to minimize the risk that stochastic events might have on their capital base, and to ensure that enough capital is liquid to allow them to make investments that facilitate the development of products and services. Insurers also provide capital to companies through their own considerable investments and through other products that attract capital from third party investors. Without these services, our national and international economies would not be able to function as they currently do.

The insurance industry is extremely large and influential. In 2006, U.S. property and casualty insurers held \$1.483 trillion in assets.<sup>11</sup> Eighty-three percent, or \$1.229 trillion, were cash and invested assets.<sup>12</sup> In the U.S. alone, property and casualty insurance premiums written in 2006 totaled \$448.94 billion,<sup>13</sup> while overall premiums in all insurance lines internationally totaled \$3.72 trillion.<sup>14</sup>

### B. Insurability

The fact that individuals and businesses face risks is good for insurers: without these risks, they would have no revenue, since bearing risk is the core business of insurance. The fact that a phenomenon such as climate change might increase the risk of losses across our society does not in itself bode ill for insurers. On the contrary, to the extent that the increased risk is insurable and potential policyholders are motivated to purchase insurance, increased risk should be good for insurers, presenting new business opportunities. To the extent that risks are not insurable, however, insurers are generally unable either to produce revenue from those risks or to assist other actors with spreading the risks to preserve their capital and liquidity.

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10. Kunreuther & Michel-Kerjan, *supra* note 6, at 1811–12.

11. INS. INFO. INST., *Introduction to A FIRM FOUNDATION: HOW INSURANCE SUPPORTS THE ECONOMY 3* (2008), available at <http://www.iii.org/economics/pdf>.

12. *Id.*

13. *Contribution to the National Economy*, in INS. INFO. INST., *supra* note 11, at 5.

14. INS. INFO. INST., *World Overview*, in INTERNATIONAL INSURANCE FACT BOOK: 2008–2009 (2008), available at <http://www.iii.org/international/overview> (last visited June 16, 2008).

In order for a risk to be insurable, it must meet certain criteria. The largest possible loss should not affect the insurer's solvency, meaning that the insurer's assets or access to other capital must be sufficient to cover its commitments in the face of that large loss. The average loss should be determinable and quantifiable, so that the insurer can determine a price that enables it to earn relatively predictable profits on its underwriting. Risks should be independent rather than correlated,<sup>15</sup> so that the insurer can diversify risks effectively. Risks should be well-distributed. The pool of insureds should not be skewed toward those with higher risk than indicated by information available to the insurer (adverse selection), and the insurance contract should not motivate policyholders to fail to take self-protective measures (moral hazard), as either of these conditions will make it impossible for the insurer to price risks at a rate that generates net revenues. And finally, there must actually be a market in which supply and demand yield a price point for any given level of insurance against any given risk.<sup>16</sup>

Risk level does not necessarily affect insurability. At any level of risk, insurers could make a profit by setting the ratio of premiums to expected covered losses at a level that nets them a return on their capital, assuming there is a market for the insurance and that the insurer has access to capital

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15. For a useful discussion of the meaning of correlated risks, see Michelle E. Boardman, *Known Unknowns: The Illusion of Terrorism Insurance*, 93 GEO. L.J. 783, 820–21 (2005). As Boardman notes: "The risk your Los Angeles home will be destroyed by an earthquake is correlated with whether your neighbor's will be, not because your loss causes your neighbor's in any way, but because both losses come from a single cause—an earthquake. Natural disasters are highly correlated, and difficult to 'uncorrelate' because those who are not at high risk do not seek to transfer their risk. An insurer covering earthquake risk in California, for example, cannot spread the concentrated California risk with policyholders in Iowa because Iowans will not bother with earthquake coverage." *Id.*

16. Arthur Charpentier, *Insurability of Climate Risks*, 33 GENEVA PAPERS 91, 95 (2008); see also BARUCH BERLINER, *LIMITS OF INSURABILITY OF RISKS* 3–4 (1982) (articulating a related but slightly different set of the relevant factors); Kunreuther & Michel-Kerjan, *supra* note 6, at 1820–26 (discussing insurability criteria specifically in the context of climate change). Trevor Maynard has stated that: "Insurers pool risk. They work on the premise that insurable risks can be:

- quantifiable (i.e. that the risk is largely constant over the period of insurance and well understood);
- diversifiable (that one type of risk can be offset against another, for example that household and motor books are largely independent);
- fortuitous (may or may not happen);
- economically priced (the policyholder can afford to pay)."

Maynard, *supra* note 1, at 141. *But see* Dwight M. Jaffee & Thomas Russell, *Catastrophe Insurance, Capital Markets, and Uninsurable Risks*, 64 J. RISK & INS. 205 (1997) (arguing from the premise that the prospect of large single losses affecting an insurer's solvency is not an "insurability" issue, but rather a short-term challenge for an insurer that can be solved through mechanisms to make capital available to insurers to address cash flow problems); Boardman, *supra* note 15 (noting that a risk with no price point can be considered "insurable, but at a price the public does not wish to pay").

adequate to pay claims.<sup>17</sup> Nonetheless, insurers are uncertainty averse and keenly concerned about the possibility of losses so large as to threaten their solvency.<sup>18</sup> Regulators and rating agencies are also concerned about losses of this magnitude.<sup>19</sup> The consequences to an insurer of inaccurately predicting insured losses relative to the capital the company has reserved to pay claims can be dire.

These problems cannot always be solved simply by setting high premiums. A single year of extremely large covered losses may be high enough to render an insurer insolvent. The fact that premiums could theoretically recover these losses over time does not solve the insurability problem created by this risk.<sup>20</sup> And, in regulated insurance markets where insurers are not able to raise premiums at will, and in markets where it is unclear that policyholders would be willing to purchase insurance at higher premium levels, insurers cannot price their products in a way that reflects risks accurately.<sup>21</sup>

More fundamentally, some types of risk challenge core principles of insurability. A given level of overall risk from a particular class of insured loss may be perfectly acceptable if losses are likely to be well distributed and independent. But concentration or correlation of losses makes it more likely that an insurer will not be able to earn a profit through insuring the risk, or

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17. See Jaffee & Russell, *supra* note 16; see also Boardman, *supra* note 15 (arguing that neither large single losses nor the lack of a market, respectively, are really “insurability” questions). Nonetheless, insurers’ core underwriting business, as measured by insurers’ combined ratio—the ratio of underwriting losses and expenses to earned premiums—is often unprofitable. See, e.g., Robert P. Hartwig, President, Ins. Info. Inst., Special Report: Earlybird Forecast 2008 (Dec. 17, 2007), <http://www.iii.org/media/industry/financials/earlybird2008> (predicting industry-wide combined ratios of 93.8 in 2007 and 97.3 in 2008, but noting that combined ratios from 1997 through 2001 ranged from 102 to 116, where a number greater than 100 indicates net underwriting losses). Insurers also earn revenue by investing the considerable assets they hold.

18. Kunreuther & Michel-Kerjan, *supra* note 6, at 1822–23; see also Howard Kunreuther, *Mitigating Disaster Losses Through Insurance*, 12 J. RISK & UNCERTAINTY 171, 178 (1996).

19. Kunreuther & Michel-Kerjan, *supra* note 6, at 1829–30 (noting rating agencies’ application of a more stringent test to rate insurers’ financial condition in light of potential catastrophe); Nat’l Ass’n of Ins. Comm’rs, Current Issues: Natural Catastrophe Response, [http://www.naic.org/topics/topic\\_catastrophe.htm](http://www.naic.org/topics/topic_catastrophe.htm) (last visited July 15, 2008) (arguing that “future mega catastrophes could be even worse [than the 2004 and 2005 hurricane seasons], and a reactive response will not suffice”).

20. Jaffee and Russell do not, however, view this mismatch as an “insurability” issue. They instead view the challenge of providing sufficient capital to allow the industry to insure otherwise insurable losses as a distinct and separate phenomenon. Jaffee & Russell, *supra* note 16, at 205–07. Berliner, on the other hand, sees “maximum possible loss” as a critical component of insurability of catastrophes. BERLINER, *supra* note 16, at 110–12.

21. Michelle Boardman describes the phenomenon in this way: “While insurers might label such a risk ‘uninsurable,’ it is more precise to recognize that the risk is insurable, but at a price the public does not wish to pay. Or the price might be potentially palatable to the public, but rejected in favor of anticipated ‘free’ government relief. In short, there is no market for it.” Boardman, *supra* note 15, at 814.



even will suffer unsustainable losses within a single year. As Michelle Boardman has noted, “[a]n insurer must first answer how much it should set aside in reserve to meet all expected losses, and so how much it should charge for a given risk,” and then must answer the question “how much does the company need to have on hand to remain solvent in the worst of times?”<sup>22</sup>

Moreover, uncertainty, or ambiguity of risk—the inability to assess and quantify probabilities of predicted losses with sufficient precision<sup>23</sup>—makes risks uninsurable or insurable only at a very high cost, especially where that uncertainty relates to risks that are high in magnitude and thus might threaten insurers’ solvency. Insurers are risk-neutral, but uncertainty averse,<sup>24</sup> and typically will charge a risk premium, a higher charge than the risks otherwise would warrant, to insure risks characterized by significant uncertainty.<sup>25</sup> In extreme cases, uncertainty will render a risk uninsurable by rendering risks unquantifiable, concentrated, and unable to be priced at a level palatable to consumers.<sup>26</sup>

Certain larger insurers, often insurers who are not admitted<sup>27</sup> in regulatory environments and thus operate subject to minimal regulation, are more likely to insure these risks than typical retail insurance companies. These larger companies are able to charge higher premiums for insuring these risks.

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22. See Boardman, *supra* note 15, at 812.

23. Kunreuther & Michel-Kerjan, *supra* note 6, at 1813.

24. Kunreuther & Michel-Kerjan, *supra* note 6, at 1822–23; see WHARTON RISK MGMT. & DECISION PROCESSES CTR., MANAGING LARGE-SCALE RISKS IN A NEW ERA OF CATASTROPHES 146–47 (2008), available at [http://opim.wharton.upenn.edu/risk/library/Wharton\\_LargeScaleRisks\\_FullReport\\_2008.pdf](http://opim.wharton.upenn.edu/risk/library/Wharton_LargeScaleRisks_FullReport_2008.pdf) (describing empirical research results showing ambiguity aversion in underwriting); Kunreuther, *supra* note 18, at 178.

25. See Faure, *supra* note 8, at 1889–90; Howard R. Kunreuther, R. Hogarth & J. Meszaros, *Insurer Ambiguity and Market Failure*, 7 J. RISK & UNCERTAINTY 71, 72 (1993).

26. See Boardman, *supra* note 15, at 814 (discussing how uncertainty has rendered terrorism risk uninsurable).

27. An “admitted policy is issued by an insurance company that is licensed in the country in which the insured and/or the risk is domiciled,” while a “non-admitted policy is issued by an insurance company in a country in which it is not licensed and/or a country outside of the risk domicile.” Donna Pfluger-Murray & Jason Taylor, *Global Implications of Admitted, Non-Admitted and Self-Insurance*, RISK MGMT. MAG., Oct. 2005, at 54. Admitted carriers are subject to significant regulatory constraints not placed on nonadmitted carriers, and also take part in state-run insurance guarantee programs that assist policyholders in case of insurer insolvency. They also share in the profits and losses of residual market mechanisms that guarantee coverage for extremely high risks, such as “FAIRplan” insurance for homeowners in areas especially prone to losses. Ins. Info. Inst., *Residual Markets*, <http://www.iii.org/media/hottopics/insurance/residual> (last visited Mar. 27, 2008). Most insurance coverage in the U.S. is written by admitted insurers; nonetheless, nonadmitted carriers, mostly based in Europe, write a significant amount of insurance in the United States, especially where regulatory or internal underwriting constraints prevent admitted insurers from taking on certain types of risk. Nonadmitted insurers are still subject to solvency regulation in the U.S. states in which they operate. Ins. Info. Inst., *Commercial Insurance, How It Functions*, <http://www.iii.org/commerciallines/howitfunctions/regulation> (last visited Mar. 27, 2008).

Admitted insurers' ability to charge risk premiums and ability to risk significant amounts of their capital on relatively speculative coverage are both generally tightly circumscribed by regulators.<sup>28</sup> As discussed in Part II.B.3, reinsurance and other risk-spreading instruments can enable insurers to transfer a portion of these risks to other financial institutions, making the insurability problem less severe. But these instruments have been limited in their application, and so far, they have not solved the insurability problems associated with catastrophic risks.

As noted by Trevor Maynard of Lloyd's, insurers "cannot insure our way out of the problem," because "[r]einsurers and alternative capital market providers will not accept risk on terms that are not commercially viable."<sup>29</sup>

## II. CLIMATE CHANGE'S IMPACTS ON THE INSURANCE INDUSTRY

Climate change will affect, and in some cases is already affecting, most major types of insurance products. First, insurers will feel the impact of climate change on property and casualty insurance, where the insurer bears the risk of a loss suffered directly by the policyholder. These property and casualty claims include not only damage to insured property as a direct result of weather, but also claims for business interruptions and other consequences of weather-induced events. Second, health and life insurers will face increasing costs. Third, insurers will face claims based on liability insurance, where the insurer pays for legal claims brought by third parties against the policyholder. Depending on the risk involved, all these types of insurance may be particularly affected by climate change-related losses or present unique opportunities to encourage the mitigation of such losses. And insurers will face challenges to insurability that may deeply impact the industry's ability to spread risk. This Part will discuss the impact that climate change is likely to have on both loss trends and insurability.

The direct risks to insurers from climate change are primarily catastrophe related. Catastrophes are the single largest threat to insurer solvency. Catastrophes, defined by the American Academy of Actuaries as "infrequent events that cause severe loss, injury or property damage to a large population of exposures,"<sup>30</sup> pose a unique, complex, and significant

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28. This is discussed more fully *infra* Part V.

29. Maynard, *supra* note 1, at 142.

30. AM. ACAD. OF ACTUARIES CATASTROPHE MGMT. WORK GROUP, CATASTROPHE EXPOSURES AND INSURANCE INDUSTRY CATASTROPHE MANAGEMENT PRACTICES (2001), available at [http://www.actuary.org/pdf/casualty/catastrophe\\_061001.pdf](http://www.actuary.org/pdf/casualty/catastrophe_061001.pdf). The word catastrophe has been defined in various ways in the insurance context, but most commentators and industry experts appear to know it

set of risks to insurer solvency. Catastrophes—particularly catastrophes that are stochastic in nature, such as severe weather events, earthquakes, or terrorism—pose challenges of risk magnitude, uncertainty, and correlation, “complicat[ing] the fundamental actuarial and pricing processes that underlie well-functioning insurance markets.”<sup>31</sup> Weather-related catastrophes have disrupted insurance markets in the past—for example, after Hurricane Andrew in 1992, and after the 2005 hurricane season in the Gulf of Mexico—and are likely to do so again in the future.<sup>32</sup> According to a 2007 Congressional Research Service report, “[m]ost insurance market analysts note that there is no state in the Union that is not subject to catastrophe exposure, and the current state of affairs suggests that the exposures are far greater than the insurance industry is now currently prepared to handle.”<sup>33</sup> And there is significant evidence that climate change will increase both the risks borne by insurers from catastrophic events and the uncertainties associated with these risks.<sup>34</sup> These risks include both first-party risk (the risk of loss by an insured) and third-party risk (the risk that an insured’s actions will result in losses to others). In addition, climate change may significantly affect risks and uncertainties from other, noncatastrophic insured losses.<sup>35</sup>

#### A. Climate Change and Insurance Losses

Insurers’ underwriting is affected directly by the risks to which their policyholders are exposed. The insurance industry recognizes that “[f]or many industries, [weather] is the greatest risk to earnings: a risk that cannot be

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when they see it. See Charpentier, *supra* note 16, at 95 (“Defining a *catastrophe* is quite difficult, but as mentioned, for example, in Kunreuther, a key concept is the geographic area, and an induced strong correlation among the losses in their portfolio (thousands of policies hit, for several lines of business—property, car insurance, life insurance for casualties, business interruption, etc.)” (citations omitted)). The U.S. property insurance industry considers an event a catastrophe when “claims are expected to reach a certain dollar threshold, currently set at \$25 million, and more than a certain number of policyholders and insurance companies are affected.” Ins. Info. Inst., *Catastrophes: Insurance Issues* (June 2008), <http://www.iii.org/media/hottopics/insurance/catastrophes>.

31. Mills, *supra* note 6, at 1042.

32. U.S. GOV’T ACCOUNTABILITY OFFICE, *CATASTROPHE RISK: U.S. AND EUROPEAN APPROACHES TO INSURE NATURAL CATASTROPHE AND TERRORISM RISKS* 9–11, 24 (2005), available at <http://www.gao.gov/new.items/d05199.pdf>; RAWLE O. KING, *HURRICANE KATRINA: INSURANCE LOSSES AND NATIONAL CAPACITIES FOR FINANCING DISASTER RISKS* 3–9 (2005), available at <http://www.au.af.mil/au/awc/awcgate/crs/rl33086.pdf>.

33. *Id.*

34. See Mills, *supra* note 6.

35. See generally Mills, *supra* note 6, and Kunreuther & Michel-Kerjan, *supra* note 6, for a discussion of these impacts, which are more fully discussed *infra* Part II.A.

prevented, avoided or isolated.”<sup>36</sup> Swiss Re, a surplus insurer that has been aggressive in identifying climate change as a major risk to businesses internationally, has noted that “[v]ariable weather affects supply and demand in almost every industry: evidently in such sectors as energy or agriculture; more subtly, but still significantly, in others, for example retail, clothing, or entertainment.”<sup>37</sup> According to a researcher for leading surplus insurer Lloyd’s of London, “[c]limate change is already affecting the global insurance industry. There are clear trends in past climate data that have translated into trends in insurance claims,” including rising sea levels and consequent storm surges and longer and more frequent forest fires.<sup>38</sup> Since an estimated \$3 trillion of the U.S.’s \$11 trillion economy is directly affected by weather,<sup>39</sup> it is essential that the insurance industry retain the capacity to buffer businesses’ exposure to weather-related losses.

Not all scientists agree on the extent to which climate change is responsible for recent extreme weather trends. For example, some researchers have concluded that climate change has already caused tropical cyclones (hurricanes and typhoons) to increase in severity.<sup>40</sup> Other researchers are skeptical of

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36. Swiss Re, Financial Solutions for Weather Risks, [http://www.swissre.com/pws/about%20us/knowledge\\_expertise/top%20topics/financial%20solutions%20for%20weather%20risks.html](http://www.swissre.com/pws/about%20us/knowledge_expertise/top%20topics/financial%20solutions%20for%20weather%20risks.html) (last visited July 15, 2008). For statistics on weather-related losses suffered by the U.S. economy, see NAT’L OCEANIC AND ATMOSPHERIC ADMIN., ECONOMIC STATISTICS FOR NOAA 9–20 (5th ed. 2006), available at [http://www.economics.noaa.gov/library/documents/economic\\_statistics\\_and\\_methodology/NOAAEconomicStatistics-May2006.pdf](http://www.economics.noaa.gov/library/documents/economic_statistics_and_methodology/NOAAEconomicStatistics-May2006.pdf).

37. Swiss Re, *supra* note 36.

38. Maynard, *supra* note 1, at 140.

39. Swiss Re, *supra* note 36 (referring to a U.S. Department of Commerce statistic). The National Oceanic and Atmospheric Administration, an agency within the U.S. Department of Commerce, states that weather- and climate-sensitive industries directly and indirectly account for about one-third of the U.S.’s GDP (about \$4 trillion in 2005 dollars) and indirectly account for about one-tenth of the GDP. See NAT’L OCEANIC AND ATMOSPHERIC ADMIN., *supra* note 36, at 9.

40. Kerry Emanuel, *Increasing Destructiveness of Tropical Cyclones Over the Past 30 Years*, 436 NATURE 686, 686 (2005); Mark A. Saunders & Adam S. Lea, *Large Contribution of Sea Surface Warming to Recent Increase in Atlantic Hurricane Activity*, 451 NATURE 557 (2008). But see sources cited *infra* note 41, for contrary points of view.

any trend in these storms.<sup>41</sup> With respect to other impacts of climate change, such as heat waves, droughts, and floods, there is a higher level of agreement.<sup>42</sup>

Looking broadly at the potential for increased catastrophic events from extreme weather, most scientists believe that climate change is more probably than not already affecting weather severity in several significant ways,<sup>43</sup> and that whether or not climate change can be seen as causing increased risk so far, such a trend will emerge in the future.<sup>44</sup>

Extreme weather trends will deeply affect the insurance industry. Swiss Re has noted that “extreme events [are] expected to increase both in frequency and severity due to climate change.”<sup>45</sup> The Association of British

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41. See Johnny C.L. Chan, *Comment on “Changes in Tropical Cyclone Number, Duration, and Intensity in a Warming Environment,”* 311 *SCIENCE* 1713b (2006); Christopher W. Landsea, *Hurricanes and Global Warming*, 438 *NATURE* E11, E11–E12 (2005); Roger Pielke, Jr., *Are There Trends in Hurricane Destruction?*, 438 *NATURE* E11 (2005); Chunzai Wang & Sang-Ki Lee, *Global Warming and United States Landfalling Hurricanes*, 35 *GEOPHYSICAL RES. LETTERS* L02708 (2008). *But see* Emanuel, *supra* note 40, at 686; Saunders & Lea, *supra* note 40, at 557–560. Science journalist Chris Mooney has written a fascinating and provocative book chronicling the professional and scientific dispute over the relationship between climate change and trends in tropical cyclone number, duration, and severity. See CHRIS MOONEY, *STORM WORLD: HURRICANES, POLITICS, AND THE BATTLE OVER GLOBAL WARMING* (2007).

42. See Laurence S. Kalkstein et al., *The 2003 European Summer Heat Wave and Analog Studies for U.S. Cities*, in *THE CTR. FOR HEALTH & THE GLOBAL ENV'T, CLIMATE CHANGE FUTURES: HEALTH, ECOLOGICAL AND ECONOMIC DIMENSIONS* 53 (2005), available at [http://www.climatechangeandfutures.org/pdf/CCF\\_Report\\_Final\\_10.27.pdf](http://www.climatechangeandfutures.org/pdf/CCF_Report_Final_10.27.pdf) [hereinafter *CLIMATE CHANGE FUTURES*] (citing studies that have concluded that global warming is related to more intense and prolonged heat waves than in the past); Nat'l Climatic Data Ctr., Nat'l Oceanic and Atmospheric Admin., *Significant Climate Anomalies and Events in 2007* (2007), <http://www.ncdc.noaa.gov/img/climate/research/2007/ann/significant-extremes2007.gif> (providing a map of extreme weather events throughout the world that may be linked to global temperature increases). *But see* Nat'l Climatic Data Ctr., Nat'l Oceanic and Atmospheric Admin., *Global Warming: Frequently Asked Questions*, <http://www.ncdc.noaa.gov/oa/climate/globalwarming.html> (last visited Apr. 7, 2008) (recognizing “clear evidence” of regional trends toward climate variability and extremes on regional scales, but noting that there is little evidence of such trends on a global scale).

43. See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 2, at 5–9.

44. *Id.* at 13. Cf. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *CLIMATE CHANGE 2007: IMPACTS, ADAPTATION AND VULNERABILITY* 9–11 (2007), available at <http://www.ipcc.ch/ipccreports/ar4-wg2.htm> (“Recent climate changes and climate variations are beginning to have effects on many other natural and human systems [i.e., coastal and glacier lake floods, longer dry seasons, uncertain rainfall]. However, based on the published literature, the impacts have not yet become established trends. . . . Drought-affected areas will likely increase in extent. Heavy precipitation events, which are very likely to increase in frequency, will augment flood risk.”). Nonetheless, according to the report, “[g]iven that the strong rise in global temperatures only began in the 1970s, it is difficult to demonstrate statistically a change in the occurrence of extreme floods and storms (with return periods of 20 years or more) simply from the recent historical record.” *Id.* at 109 (citation omitted). The report cited inconclusive evidence on river flooding and Northeast Atlantic extra-tropical cyclones, but did note that increased sea surface temperatures have been blamed for recent increased storm activity and intensity in the Atlantic. See *id.*

45. Swiss Re, *Products and Services*, [http://www.swissre.com/pws/about%20us/knowledge\\_expertise/top%20topics/products%20and%20services.html](http://www.swissre.com/pws/about%20us/knowledge_expertise/top%20topics/products%20and%20services.html) (last visited May 10, 2008).

Insurers also believe that climate change has caused extreme weather trends, noting that “climate change is making it likely that storm surges will occur more frequently, and that they will be more destructive when they do.”<sup>46</sup> And Lloyd’s of London has expressed concerns about the effects of climate change on weather volatility, and on the implications that uncertainties surrounding these effects may have on insurability.<sup>47</sup> Accordingly, some insurers have developed products to meet the “increasing demand for protection against adverse weather” and weather volatility due to climate change.<sup>48</sup>

Unexpected catastrophe losses have already rocked the sector. Researchers Howard Kunreuther and Erwann Michel-Kerjan note that some insurers were taken by surprise at the size of losses from Hurricane Andrew and the Northridge earthquake in 1992 and 1994, respectively. “[F]ollowing Hurricane Andrew, many insurers only marketed coverage against wind damage in Florida because they were required to do so and state insurance

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AIG also believes that climate change is affecting weather patterns and is responsible for “more intense hurricanes.” AIG, AIG’s Policy and Programs on Environment and Climate Change 6 (2008), [http://media.corporate-ir.net/media\\_files/irol/76/76115/reports/AIG\\_climate\\_change\\_policy\\_updated\\_0607.pdf](http://media.corporate-ir.net/media_files/irol/76/76115/reports/AIG_climate_change_policy_updated_0607.pdf) (noting among its climate change initiatives its participation in a research project to “develop a model for coastal community resilience in light of more intense hurricanes”); *see also* AIG, Climate Change Basics, <http://phx.corporate-ir.net/phoenix.zhtml?c=76115&p=irol-govresponsclimatebasics> (last visited May 10, 2008) [hereinafter AIG, Climate Change Basics] (“The [greenhouse] warming affects global and regional climate patterns . . .”).

46. ASS’N OF BRITISH INSURERS, COASTAL FLOOD RISK—THINKING FOR TOMORROW, ACTING TODAY 2, 4 (2006), available at [http://www.climatewise.org.uk/media/613/abi\\_coastal\\_flooding\\_report.pdf](http://www.climatewise.org.uk/media/613/abi_coastal_flooding_report.pdf).

47. *See* LLOYD’S OF LONDON, CLIMATE CHANGE: ADAPT OR BUST 3 (2006), available at <http://www.lloyds.com/NR/rdonlyres/38782611-5ED3-4FDC-85A4-5DEA88A2DA00/FINAL360climatechangereport.pdf> (“Until recently, world opinion has been divided: are current weather trends the result of long-term climate change or not? And what role, if any, has climate change played in the recent spate of weather-related catastrophes? . . . However, a growing body of expert opinion now agrees that the climate is changing—and that human activity is playing a major role. Most worryingly, the latest science suggests that future climate change may take place quicker than previously anticipated.”); *id.* at 18–19, 21 (noting that long-term climate patterns have historically been volatile and stating, “We do not subscribe to scare stories, and we do not know how the climate will react to the highly elevated CO<sub>2</sub> levels,” and “We don’t know exactly what impact climate change will have.”); Lloyd’s of London, Climate Change, [http://www.lloyds.com/News\\_Centre/360\\_risk\\_project/The\\_debate\\_on\\_climate\\_change](http://www.lloyds.com/News_Centre/360_risk_project/The_debate_on_climate_change) (last visited May 10, 2008) (“The frequency and magnitude of catastrophes—especially weather related catastrophes—has increased significantly in recent years. Climate change is expected to exacerbate this further, and by 2050 mega-catastrophes like Hurricane Katrina, which used to occur every 100 years, are predicted to happen every 25.”); Lloyd’s of London, Lloyd’s Urges Insurers to Take Climate Change Seriously or Risk Being Swept Away, [http://www.lloyds.com/News\\_Centre/Features\\_from\\_Lloyds/Climate\\_change\\_adapt\\_or\\_bust.htm](http://www.lloyds.com/News_Centre/Features_from_Lloyds/Climate_change_adapt_or_bust.htm) (last visited May 10, 2008) (“[C]urrent sea levels are higher in the Gulf of Mexico than in the past and with sea temperatures rising, the industry must prepare for increased windstorm activity. . . . Over the past few years, insurers have battled with record hurricane seasons, a trend that is expected to continue.”).

48. *See, e.g.,* Swiss Re, *supra* note 45.

pools were formed to limit their risk. In California, insurers refused to renew homeowners' earthquake policies after the 1994 Northridge earthquake, and in their place the California Earthquake Authority was formed by the state in 1996 with funds from insurers and reinsurers."<sup>49</sup> In 2003, natural catastrophes worldwide caused \$15 billion in insured losses (\$8 billion of which were caused by storms).<sup>50</sup> In 2005, Hurricane Katrina and other weather catastrophes caused insured losses of almost \$80 billion worldwide,<sup>51</sup> causing some companies' payouts to exceed insurance premiums.<sup>52</sup> According to a recent report, "Louisiana property insurer losses following Hurricane Katrina were \$3 billion more than all premiums collected in the state for the preceding 22 years [and] Lloyd's posted . . . a loss of \$180 million in 2005 which equates to \$1.12 paid out for ever[y] \$1.00 in premium revenues, thanks largely to hurricane losses."<sup>53</sup>

Whether or not current weather patterns already reflect climate change's impacts, insured losses from catastrophic weather events are increasing and are expected to continue to increase. According to a recent study, socioeconomic factors, including the "degree of urbanization and value at risk," "directly influence the level of economic losses due to weather-related events."<sup>54</sup> These factors, in synergy with changing weather patterns, are likely to affect the insurance industry's covered losses significantly over time.<sup>55</sup> And aside from extreme weather events, other adverse effects of climate change should concern the insurance industry because of their potential costs.<sup>56</sup> As insurers' costs rise, the premium levels necessary for an

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49. Kunreuther & Michel-Kerjan, *supra* note 6, at 1821.

50. NAT'L OCEANIC AND ATMOSPHERIC ADMIN., *supra* note 36.

51. EVAN MILLS & EUGENE LECOMTE, FROM RISK TO OPPORTUNITY: HOW INSURERS CAN PROACTIVELY AND PROFITABLY MANAGE CLIMATE CHANGE 4 (2006), available at [http://eetd.lbl.gov/emills/PUBS/PDF/Ceres\\_Insurance\\_Climate\\_Report\\_090106.pdf](http://eetd.lbl.gov/emills/PUBS/PDF/Ceres_Insurance_Climate_Report_090106.pdf).

52. See *id.* at 7.

53. *Id.* These losses do not include flood losses insured under the federal National Flood Insurance Program (NFIP), which encompasses many homeowners' insured claims of property damage relating to Katrina. See U.S. Dep't Homeland Security, What Government Is Doing, [http://www.dhs.gov/xprepresp/programs/gc\\_1157649340100.shtm](http://www.dhs.gov/xprepresp/programs/gc_1157649340100.shtm) (last visited May 10, 2008) (stating that more than \$16.1 billion has been paid out to more than 205,000 policyholders from the NFIP since the 2005 hurricane season).

54. Kunreuther & Michel-Kerjan, *supra* note 6, at 1805–07; see also Barclay G. Jones & William A. Kandel, *Population Growth, Urbanization, and Disaster Risk and Vulnerability in Metropolitan Areas: A Conceptual Framework*, in 168 WORLD BANK DISCUSSION PAPERS: ENVIRONMENTAL MANAGEMENT AND URBAN VULNERABILITY 51, 68–70 (Alcira Kreimer & Mohan Munasinghe eds., 1992) (arguing persuasively that urbanization and related activities will make disaster losses much worse in the future).

55. See Mills, *supra* note 6; Kunreuther & Michel-Kerjan, *supra* note 6.

56. See generally Mills, *supra* note 6; Kunreuther & Michel-Kerjan, *supra* note 6, for discussion of these impacts.

insurer to make a profit rise, shrinking the potential market for the insurance. If costs are high enough, there will be no price point that satisfies both the insurer and the consumer, and there will be no market for the insurance, rendering the risk effectively uninsurable.<sup>57</sup>

Climate change-related risks are likely to affect all major insurance types: property/casualty, health, life, and liability. Property and casualty insurance lines are likely to be affected by climate change, even aside from extreme weather. For example, coastal and sea-level property losses due to flooding from a higher sea level are expected. According to the Intergovernmental Panel on Climate Change, “[m]any millions more people are projected to be flooded every year due to sea-level rise by the 2080s.”<sup>58</sup> A report commissioned by the Association of British Insurers predicts that if no action to mitigate climate change is taken, the annual losses from coastal flooding in England and Wales “could increase by between £1.0 billion and £13.5 billion by the end of the century.”<sup>59</sup> In addition, property-damaging wildfires may increase in number and in intensity, in part because of climate change-related droughts, changes in wind and vegetation patterns, lightning strike increases, and reduced moisture content in vegetation.<sup>60</sup> As an example of wildfires’ potential cost to the insurance industry, one 1991 wildfire that reached the urban Oakland and Berkeley areas in northern California caused \$2.4 billion in insured losses, including the loss of 3,400 buildings and 2,000 cars.<sup>61</sup> Swiss Re and Lloyd’s of London believe that climate change may have increased the magnitude of losses from the Oakland-Berkeley fire and other wildfires.<sup>62</sup>

Regardless of whether current patterns in severe weather events can be attributed directly to climate change, climate change is expected to create regional shocks and other changes to the agricultural sector over

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57. See Boardman, *supra* note 15, at 814.

58. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 44, at 12; see also AIG, *Climate Change Basics*, *supra* note 45 (“The [greenhouse] warming affects global and regional climate patterns, water supply, and sea level. Models and simulations reveal impacts, some of which are evidenced already, such as melting of permafrost and ice caps; [and] rises in sea level . . .”).

59. ASS’N OF BRITISH INSURERS, *supra* note 46, at 6.

60. Paul Epstein et al., *Forests: Drought, Beetles and Wildfires*, in CLIMATE CHANGE FUTURES, *supra* note 42, at 65, 67; A.L. Westerling et al., *Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity*, 313 SCIENCE 940, 941–42 (2006).

61. Paul Epstein et al., *supra* note 60, at 67 (noting that between 1985 and 1994, U.S. wildfires resulted in an average insured cost of about \$300 million per year and the total destruction of more than 9,000 homes).

62. *Id.*



time.<sup>63</sup> Insurance already plays a central role assisting farmers in dealing with production risks from weather variation and crop disease, ecological risks, and regulatory risks.<sup>64</sup> It will play an ever more crucial role as climate change exacerbates these risks.<sup>65</sup>

Unusual temperature variations (heat or cold), increased pests and plant diseases, droughts, and floods resulting from climate change are also likely to spur agricultural losses in many regions of the globe.<sup>66</sup> One case study (part of a report sponsored by Swiss Re and the United Nations Development Programme) found that costly declines in soybean production have been linked to unusual weather events, such as an outbreak in aphids and charcoal rot (a fungal disease) following abnormally dry weather, and the introduction of soybean rust into the U.S. because of Hurricane Ivan.<sup>67</sup>

Climate change will also affect health and life insurance. Increases in infectious and respiratory diseases, heat stress, pollution, and malnutrition-related disorders are linked to climate change.<sup>68</sup> For instance, climate warming may increase the spread of malaria—a disease that kills over 3,000 children each day—by creating more favorable mosquito breeding, maturation, and living conditions.<sup>69</sup> European and U.S. outbreaks of West Nile

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63. See PRADEEP KURUKULASURIYA & SHANE ROSENTHAL, CLIMATE CHANGE AND AGRICULTURE: A REVIEW OF IMPACTS AND ADAPTATIONS 1–5 (2003), available at [http://www.undp.org/gef/adaptation/docs/EDP\\_91-W.pdf](http://www.undp.org/gef/adaptation/docs/EDP_91-W.pdf); Jerry R. Skees, *A Role for Capital Markets in Natural Disasters: A Piece of the Food Security Puzzle*, 25 FOOD POL'Y 365, 365–66 (2000).

64. KURUKULASURIYA & ROSENTHAL, *supra* note 63, at 38–41.

65. *Id.*

66. See Cynthia Rosenzweig et al., *Agriculture: Climate Change, Crop Pests and Diseases*, in CLIMATE CHANGE FUTURES, *supra* note 42, at 70–72; William Easterling & Pramod Aggarwal, *Food, Fibre and Forest Products*, in INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 44, at 273, 276, 296–303; cf. Skees, *supra* note 63 (discussing various means of protecting developing nations against food shocks associated with natural disasters); see also Kalkstein et al., *Extreme Weather Events: Heat Waves*, in CLIMATE CHANGE FUTURES, *supra* note 42, at 53, 55 (2005) (noting that the 2003 European heat wave caused a loss of livestock, wilted crops, and carbon loss in soils, and was linked to fires that burned agricultural land).

67. Rosenzweig et al., *supra* note 66, at 70, 74.

68. See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 58, at 12. That climate change is likely to have serious health consequences is accepted by at least some major insurers. AIG, *Climate Change Basics*, *supra* note 45 (“Models and simulations reveal impacts, some of which are evidenced already, such as . . . increases in disease and pests.”). Cf. CLIMATE CHANGE FUTURES, *supra* note 42, at 32–52 (presenting case studies and discussing projected increases in infectious and respiratory diseases caused directly or indirectly by climate change). *But see* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 44, at 107–09 (cautioning that the relationship between climate change and health changes is sometimes overstated and that nonclimatic factors, such as social factors or reporting changes, may be responsible).

69. Kristie L. Ebi et al., *Malaria*, in CLIMATE CHANGE FUTURES, *supra* note 42, at 32 (noting that droughts, flooding, and heavy rains can also indirectly affect malaria distribution). *But see* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note, at 12 (noting that “[c]limate change is expected to have some mixed effects, such as a decrease or increase in the range and transmission potential of malaria in Africa”).

virus—which can cause death and neurological impairment if it develops into encephalitis and meningitis<sup>70</sup>—have coincided with droughts and heat waves, which can accelerate the virus’s maturation within mosquitoes, reduce mosquito predators, and increase the “viral load” in birds and mosquitoes.<sup>71</sup> Climate change will also affect the spread of Lyme disease—which, if untreated, can permanently affect the nervous system, musculoskeletal system, and the heart—because the climate largely regulates the populations of deer ticks, which transmit the bacteria that causes Lyme disease.<sup>72</sup> Furthermore, the worsened air quality related to climate change may increase the symptoms and mortality of sufferers of asthma, allergies, and other respiratory conditions.<sup>73</sup> The ways that climate change can affect respiratory health include: increased pollen allergens due to increased carbon dioxide and temperatures, increased particulate and smog pollution from drought-driven wildfires, mold growth in homes due to floods, and ozone pollution during heat waves.<sup>74</sup> Heat waves linked to climate change may also worsen cardiovascular health<sup>75</sup> and are associated with excessive deaths from dehydration, heat stroke, and other causes, mainly among children, the elderly, and people of low socioeconomic status.<sup>76</sup> During the 2003 heat wave in Europe, which was unprecedented in magnitude and duration,<sup>77</sup> one Paris health facility—with core temperatures of at least 105°F—counted 2,814 deaths between August 8 and 19, 81 percent of which were persons older than 75.<sup>78</sup> Although it has already

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70. Paul Epstein & Douglas Causey, *West Nile Virus: A Disease of Wildlife and a Force of Global Change*, in CLIMATE CHANGE FUTURES, *supra* note 42, at 41–43; Centers for Disease Control and Prevention, *West Nile Virus: Questions and Answers* (2007), <http://www.cdc.gov/ncidod/dvbid/westnile/qa/cases.htm>.

71. See Epstein & Causey, *supra* note 70, at 42.

72. See John Brownstein, *Lyme Disease: Implications of Climate Change*, in CLIMATE CHANGE FUTURES, *supra* note 42, at 45.

73. See Christine A. Rogers, *Carbon Dioxide and Aeroallergens*, in CLIMATE CHANGE FUTURES, *supra* note 42, at 48.

74. *Id.* at 49, 51.

75. *Id.* at 51–52.

76. Ann E. Carlson, *Heat Waves, Global Warming, and Mitigation*, 26 UCLA J. ENVTL. L. & POL’Y 169, 174–76 (2008).

77. Laurence S. Kalkstein et al., *supra* note 42, at 54.

78. *Id.* at 55. See *id.* at 56–57 for a discussion and chart of projected excess deaths in Detroit, New York, Philadelphia, St. Louis, and Washington, D.C., if a heat wave on par with Europe’s 2003 heat wave were to hit the U.S. For a thorough discussion of the 2003 heat wave and its likely relationship to climate change, see Marc Pomadere et al., *The 2003 Heat Wave in France: Dangerous Climate Change Here and Now*, 25 RISK ANALYSIS 1483, 1488–89 (2005).

See Ann E. Carlson, *supra* note 76 for a discussion of heat waves and an interesting analysis of why people perceive other weather-related mortality as more significant than heat-related mortality.

faded from memory here in the United States, over 52,000 people are estimated to have perished in the 2003 heat wave.<sup>79</sup>

Both life insurance and health insurance will become more expensive to underwrite if, as expected, negative health outcomes become more common. As Gary Guzy of the risk consulting firm Marsh has noted, events including the 2003 heat wave and the devastation of the 2004 and 2005 hurricane seasons “demonstrated that health and life insurance coverages could be impacted, in addition to property/casualty lines.”<sup>80</sup> To the extent that the insurance industry does not, or cannot, take these changes into consideration in pricing its products—for example, where insurance is already priced high enough to begin to erode the market for products—the industry will be affected financially. And to the extent that these trends might require underwriting of fewer policies, or pricing that is high enough to make insurance unaffordable, these insurance consequences will have public policy consequences.

Climate change will also affect liability insurance. Climate change-related lawsuits brought by third parties against liability insurance policyholders will trigger duties of defense and indemnity.<sup>81</sup> For example, nuisance claims against greenhouse gas emitters have already alleged injury from the direct and indirect effects of climate change, and other similar lawsuits may follow.<sup>82</sup> These claims are likely to be covered under either commercial general liability or environmental liability insurance policies.<sup>83</sup> Negligence, products liability, and other tort theories may also lead to significant defense costs, and possibly indemnity costs, for insurers whose policyholders may have contributed to climate change or have not planned adequately for

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79. See Tom Kosatsky, Editorial, *The 2003 European Heat Waves*, EURO SURVEILLANCE, July 1, 2005, <http://www.eurosurveillance.org/em/v10n07/1007-222.asp>; Janet Larsen, *Setting the Record Straight: More than 52,000 Europeans Died From Heat in Summer 2003*, EARTH POL'Y INSTITUTE, July 28, 2006, <http://www.earth-policy.org/Updates/2006/Update56.htm>.

80. Gary Guzy, *Insurance and Climate Change*, in GLOBAL CLIMATE CHANGE AND U.S. LAW 541, 546 (Michael B. Gerrard ed., 2007).

81. Christina Ross, Evan Mills & Sean B. Hecht, *Limiting Liability in the Greenhouse: Insurance Risk-Management Strategies in the Context of Global Climate Change*, 26A STAN. ENVTL. L.J. 251, 253 (2007), 43A STAN. J. INT'L LAW 251, 253 (2007); LLOYD'S OF LONDON, *supra* note 47, at 5 (“We foresee an increasing possibility of attributing weather losses to man made factors, with courts seeking to assign liability and compensation for claims of damage. Exposures can also be expected to increase in respect of property, business interruption and political risks, demanding the same response.”). Goldman Sachs has likened potential corporate liability for carbon emissions to liability for asbestos. GOLDMAN SACHS, PORTFOLIO STRATEGY UNITED STATES 4 (2005), available at <http://www.pewclimate.org/docUploads/Goldman%20Environment%20Portfolio%20Strategy%202005.pdf>.

82. Ross, Mills & Hecht, *supra* note 81, at 288; see also *infra* note 171 and accompanying text.

83. *Id.* at 283–89.

climate change's impacts. At least one negligence case has been brought against defendants whose negligence allegedly caused the release of chemicals after Hurricane Katrina. While Katrina-related damage cannot itself be attributed to climate change, increased severe weather will heighten the risks run by companies whose businesses are affected by those weather conditions.<sup>84</sup> Similarly, climate change-related conditions will contribute to business interruptions, such as disruptions in power supply, communications, transportation, equipment, and supply chains. Insurers will have to defend claims where a policyholder is alleged to have responded inadequately to climate change-related risks related to business interruptions.<sup>85</sup>

Finally, analysts see increased professional liability risk from climate change. Directors' and officers' coverage and other professional liability insurance lines will be impacted by failure to disclose or address climate-related risks.<sup>86</sup> Directors and officers of companies have fiduciary obligations to protect their companies from climate change risk.<sup>87</sup> Moreover, and perhaps more significantly, these directors and officers must comply with a growing body of risk disclosure rules.<sup>88</sup> Both of these types of obligations present significant potential insurance exposure.<sup>89</sup>

Climate related risk from liability insurance may be significant regardless of the merits or magnitude of individual claims, because of insurers' obligation to pay defense costs.<sup>90</sup> This risk may ultimately be more significant to the insurance industry than first-party claims, partly due to the potential for significant claims arising under past years' coverage.<sup>91</sup> Because premiums

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84. *Id.*

85. *Id.*; see also CLIMATE CHANGE FUTURES, *supra* note 42, at 7 (noting the energy sector's vulnerabilities to climate change as including blackouts due to heat waves, pipeline and power transmission problems due to melting tundra, nonfunctional power plant cooling systems due to warmed waters, and an increased number of lightning claims).

86. See Ross, Mills & Hecht, *supra* note 81, at 290–92.

87. Jeffrey A. Smith & Matthew Morreale, *The Fiduciary Duties of Officers and Directors*, in GLOBAL CLIMATE CHANGE AND U.S. LAW, *supra* note 80, at 497, 497–529 (providing a comprehensive discussion of fiduciary responsibilities in the context of climate change).

88. See Jeffrey A. Smith & Matthew Morreale, *Disclosure Issues*, in GLOBAL CLIMATE CHANGE AND U.S. LAW, *supra* note 80, at 453, 458–68 (providing a detailed discussion of SEC disclosure issues and climate change).

89. See Smith & Morreale, *supra* note 87, at 497–529; Smith & Morreale, *supra* note 88, at 458–68.

90. See Ins. Info. Inst., *The Insurance Industry's Contribution to the Legal Services Industry*, <http://www.economicinsurancefacts.org/economics/industries/legal> (last visited May 9, 2008). In a table on this webpage, the Insurance Information Institute shows that over the period 2004 through 2006, defense and cost containment expenses (including legal fees, costs of investigation, costs of engaging expert opinion, and other related litigation and pre-litigation expenses) averaged over 86 percent of all insurers' expenses in products liability lines, over 36 percent in the liability portion of commercial general peril lines, and over 27 percent in general liability lines. *Id.*

91. Maynard, *supra* note 1, at 140.

for past years' coverage have already been set and paid based on past years' assumptions about risk, these claims, like environmental liability claims in the late twentieth century, have the potential to impact the insurance industry significantly over the coming years.

Because of the potential for large losses associated with a single event and other correlated losses, all these climate change-related risks deeply affect the reinsurance industry. Retail insurers transfer large amounts of risk to large companies that specialize in reinsurance and surplus insurance, such as Lloyd's, Swiss Re, and Munich Re. Often, those insurers serve as the primary insurers for risks that are seen as uninsurable by smaller insurers, both because of the deep access to capital that the surplus insurers enjoy and because the surplus insurers are subject to less regulation since they are typically nonadmitted in jurisdictions, such as U.S. states, that maintain strict regulatory requirements on underwriting.

In all, the changing climate is likely to have a wide-ranging and deep impact on the insurance industry.<sup>92</sup> The attention that insurers—including large international insurers such as Swiss Re, Munich Re, AIG, and Lloyds of London, and an increasing number of domestic insurers—have placed on climate change is itself evidence that the industry expects climate change to transform its business practices.<sup>93</sup>

## B. Climate Change and Insurability of Risks

Climate change presents significant risks to insurability. These risks, in turn, may limit the insurance industry's ability to continue to grow and to be profitable in those insurance lines affected by climate-related risk, unless insurers adapt to the changing conditions—itsself a challenge because of the

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92. See generally MILLS, *supra* note 9.

93. See *id.* at 6–9; see also LLOYD'S OF LONDON, CLIMATE CHANGE: ADAPT OR BUST, *supra* note 47 (arguing that climate change poses a crisis and a set of opportunities for the insurance industry, and proposing an agenda for the industry to address climate change); ClimateWise, Reducing the Risk for Tomorrow, <http://www.climatewise.org.uk> (last visited May 9, 2008) (articulating the commitment of a consortium of insurers, including AIG, Allianz, Lloyds, Munich Re, Swiss Re, and many other companies, and the Association of British Insurers to “taking action on climate change and to reporting publicly on our own performance”); AIG, Climate Change and the Insurance Industry, <http://phx.corporate-ir.net/phoenix.zhtml?c=76115&p=irol-govresponsclimateindustry> (last visited May 9, 2008) (stating on AIG's website that “[p]erhaps no other industry has responded as quickly to changes in climate patterns as the insurance industry—with the AIG companies playing a leading role in this response”); Swiss Re, Tackling Climate Change 7 (2004), available at [http://www.swissre.com/resources/d8262880455c7a0fb0dcba80a45d76a0-Tackling\\_climate\\_change.pdf](http://www.swissre.com/resources/d8262880455c7a0fb0dcba80a45d76a0-Tackling_climate_change.pdf) (setting forth the impacts that Swiss Re believes climate change will have on the insurance industry, including impacts to property, health, agriculture, business operations, and professional liability, and associated opportunities for the insurance industry).

uncertainties inherent in climate change-related risk. Reinsurers will be affected disproportionately, since they bear such a high proportion of catastrophic risk. But innovations in capital markets and the reinsurance industry may enable the insurance sector to continue to manage risks effectively.

1. Climate Change's Threat to Insurability: Uncertainty, Potential for Losses High Enough to Threaten Solvency, and Correlated Risks

Climate change presents a particularly challenging type of risk for insurers because its effects may impact the insurability of a significant number of risks across various insurance product lines. This is especially true to the considerable extent that climate change-related losses are catastrophe-related. Catastrophes are viewed by some commentators as at the edge of insurability to begin with, for reasons described *supra* in Part II.A.<sup>94</sup> An increase in the uncertainties associated with the frequency or severity of these events renders them even more difficult to insure, as the possibility of immense, related, or concentrated risks rises.<sup>95</sup>

First, climate change's relationship to global weather patterns increases the potential for losses so large that they threaten the solvency of insurers as more severe weather becomes more common and overall variability of conditions increases.<sup>96</sup>

Second, uncertainties in assessing climate change's impacts are high, affecting property and casualty, business interruption, health, and liability insurance, among others. As a result, where a risk has significant ambiguous components, insurers are both more likely to charge a significantly higher premium and more likely to avoid insuring the risk entirely than where a risk is more well-defined.<sup>97</sup> Current catastrophe models, epidemiological assessments, and litigation risk models are likely not adequate to predict future risks.<sup>98</sup>

Third, it is likely that many climate change-related risks are correlated, creating a skewed risk pool and exacerbating the risk of extremely large losses,

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94. BERLINER, *supra* note 16, at 10.

95. *Id.* at 29–36.

96. Kunreuther & Michel-Kerjan, *supra* note 6, at 1798–1804.

97. *Id.* at 1822–23; Maynard, *supra* note 1, at 142 (“In these circumstances, insurers must review whether insurance coverage can remain unchanged. If not, then terms and conditions are revised and, *in extremis*, cover is removed altogether.”).

98. WHARTON RISK MGMT. AND DECISION PROCESSES CTR., *supra* note 24, at 154–58 (discussing the high levels of uncertainty in catastrophe modeling).

and that some of these risks are not well-distributed across existing insureds.<sup>99</sup> Severe weather-related losses, in particular, raise these issues, as does sea-level rise.

Finally, as a result of insurers' uncertainty aversion and need to protect against extremely large losses from single or related events, it is not clear that insurers will be willing to insure against some climate change-related risks at a price that policyholders are willing to pay.<sup>100</sup>

Thus, many of the basic criteria of insurability are threatened by climate change. Moreover, the higher the magnitude of climate change in store for the Earth, the greater each of these challenges becomes. There is remarkable uncertainty about conditions around the globe at levels of future global warming that are considered extreme but possible even as soon as 2100.<sup>101</sup>

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99. See Daniel A. Farber, *Adapting to Climate Change: Who Should Pay?*, 23 J. LAND USE & ENVTL. L. 1, 19 (2007) ("The case for insurance is weaker when harms are more predictable, such as the impact of gradual sea level changes on coastal areas. When harms are completely predictable, however, insurance has no role: everyone who would buy a policy would also collect for the loss, providing no room for loss spreading."). Some commentators have characterized catastrophe insurance markets as generally vulnerable to adverse selection, which, if true, would yield even more skewing of the risk pool relative to premiums. See Boardman, *supra* note 15, at 822–23. Adverse selection should be a problem in weather catastrophe insurance markets, however, only where premiums are limited by regulation. Adverse selection refers to the phenomenon where consumers prone to greater risk are systematically more likely to insure because of that greater risk, and at the same time insurers are unable to distinguish those consumers from others with lower risk profiles. In these cases, insurers will tend to mis-price risks, consistently charging too little for insurance, and also the risks will be too concentrated within the risk pool. In the case of severe weather catastrophes, while insurers' underwriting is vulnerable to uncertainties, it is unlikely that consumers would typically have more precise information about their risk profile than the insurers have, and so adverse selection appears to be a serious concern only where insurers are forced to write insurance at rates that do not accurately reflect risks. Nonetheless, where insurers are able to price products at a level commensurate with risk, having a risk pool with a high risk concentration might well result in an inability to price insurance at a rate that any policyholders are willing to pay.

100. Charpentier, *supra* note 16, at 95. Cf. BERLINER, *supra* note 16, at 42–43.

101. See MARK LYNAS, *SIX DEGREES: OUR FUTURE ON A HOTTER PLANET* (2007), for a discussion, based on peer-reviewed scientific literature, of the predicted impacts of climate change at various levels of warming, including the increasing level of uncertainty at extreme but possible levels of warming. Lynas notes: "With five degrees [Celsius] of [average] global warming, an entirely new planet is coming into being—one largely unrecognizable from the Earth we know today." *Id.* at 207. Even more startling, if that is possible, is his assessment of the level of uncertainty surrounding the consequences of six degrees Celsius of average warming:

As we enter a world six degrees warmer than today's, there are few clues to what really lies in store. My Virgil guides in this latter-day version of Dante's inferno have so far been mostly climate modeling scientists, yet the majority of them have fallen by the wayside now: the current generation of climate models almost all stop short of simulating six degrees of warming by 2100. (But as we have already seen, models do have the tendency to be conservative by design, so this outcome cannot be discounted—and indeed is part of the IPCC's scenario of projections on which this book is based.)

*Id.* at 233; see also INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 2, at 10 (assessing the "likely" range of global average warming under the most pessimistic emissions scenario used for modeling as 2.4°C to 6.4°C).

## 2. Implications for the Insurance Industry of Climate Change's Threat to Insurability

Under these conditions, climate change poses a potential threat to the stability of the insurance industry over the next several decades if insurers do not take the necessary steps to adapt.<sup>102</sup> One clear consequence of this situation is that insurers should be motivated to conduct research to help to better understand climate change's likely impacts. Insurers are already doing this.<sup>103</sup> But it is less clear that insurers will work hard to adapt their basic products to a world in which the climate is changing. Uncertainty aversion and the possibility of enormous losses can motivate insurers either to attempt to create a business model that addresses climate change-related risk, or alternatively to withdraw from markets entirely.

This latter course of action unfortunately may be the most likely course of action for many insurers, at least in the short term. Insurers often will react to unanticipated losses or to significant changes in risk profile or uncertainty by limiting their underwriting.<sup>104</sup> Regulated insurers, who have relatively less ability to price novel risks at a comfortable premium, are more likely to react this way than nonadmitted insurers such as large reinsurance companies. But even nonadmitted insurers have difficulty assuming risks that are too uncertain or novel, or that cannot be priced at a level that is marketable.<sup>105</sup> So, for example, even large surplus insurers withdrew from the pollution insurance market in 1984 when they judged underwriting environmental liability insurance at marketable rates untenable.<sup>106</sup> Similar problems occurred in the reinsurance market after the insurance industry grossly underestimated potential losses from Hurricane Andrew in 1992.<sup>107</sup>

Climate change is likely to result in a combination of unanticipated losses and increased uncertainty that could create a similar, or even greater, potential for contraction of the insurance industry's overall coverage. But in

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102. See LLOYD'S OF LONDON, CLIMATE CHANGE: ADAPT OR BUST, *supra* note 47.

103. See, e.g., MILLS, *supra* note 9, at 7–9 (discussing various insurers' research relating to climate change risks).

104. See, e.g., Martin T. Katzman, *Pollution Liability Insurance and Catastrophic Environmental Risk*, 55 J. RISK & INS. 75, 76–77 (1988) (discussing insurers' withdrawal from environmental liability insurance market after the passage of RCRA and CERCLA).

105. See *supra* note 57 and accompanying text.

106. Katzman, *supra* note 104, at 76 (discussing insurers' withdrawal from environmental liability insurance market after the passage of RCRA and CERCLA).

107. Ins. Info. Inst., Reinsurance (Mar. 2008), <http://www.iii.org/media/hottopics/insurance/reinsurance>.



the long run, such contraction will hurt the industry, and so innovative insurers will be looking for ways to make risks insurable.

Climate change should also provide an incentive for the insurance industry to work to reduce our society's overall greenhouse gas emissions. The difference between the more pessimistic end of the predicted climate spectrum in the future and the more optimistic end—the difference between the real chance of a scenario where “an entirely new planet is coming into being—one largely unrecognizable from the Earth we know today” and the likelihood of a more manageable set of societal risks<sup>108</sup>—will involve dramatic cuts in greenhouse gas (GHG) production worldwide.<sup>109</sup> To the extent that climate change's impacts can be limited, they will be more predictable and thus more insurable, creating business opportunities for insurers.

Climate change thus poses a challenge to the insurance industry's long-term stability, if insurers do not adapt. But taking action to address climate change will better enable the industry to manage its future successfully. This appears to be a primary motivation for the engagement of companies such as Lloyds, Munich Re, and Swiss Re in research, lobbying, and public education about climate change.<sup>110</sup> These initiatives reflect the reality that the entire industry could be harmed by the increasing uncertainty that climate change will bring.

### 3. The Role of Reinsurance and Other Risk Transfer Instruments in Helping Insurers Cope With Climate Change

Insurers' ability to cope with the dramatic and significant risks posed and exacerbated by climate change is dependent in large part on their ability to

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108. LYNAS, *supra* note 101, at 207. Compare *id.* at 3–53 (discussing the likely impacts from a global average temperature rise of one degree Celsius), with *id.* at 207–259 (discussing the likely impacts, and uncertainties about impacts, resulting from a temperature rise of five to six degrees Celsius).

109. See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, Summary for Policymakers, in CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS 12–18 (2007) (linking anthropogenic increases in atmospheric greenhouse gas (GHG) concentrations to climatic change and to average global temperature increases). See generally INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, Summary for Policymakers, in CLIMATE CHANGE 2007: MITIGATION (2007), available at <http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-spm.pdf> (identifying the need for carbon dioxide emissions cuts to reach atmospheric greenhouse gas stabilization and evaluating strategies for achieving those cuts).

110. See, e.g., MUNICH RE, PERSPECTIVES: TODAY'S IDEAS FOR TOMORROW'S WORLD (2006), available at [http://www.munichre.com/publications/302-05051\\_en.pdf](http://www.munichre.com/publications/302-05051_en.pdf) (Munich Re); Swiss Re, Our Position and Objectives, [http://www.swissre.com/pws/about%20us/knowledge\\_expertise/top%20topics/our%20position%20and%20objectives.html](http://www.swissre.com/pws/about%20us/knowledge_expertise/top%20topics/our%20position%20and%20objectives.html) (last visited May 9, 2008) (Swiss Re); Lloyd's of London, Rapid Climate Change (2006), available at [http://www.lloyds.com/NR/rdonlyres/FCA144E6-24D5-425E-B058-3A64E020E18F/0/360\\_RapidClimateChangeReport.pdf](http://www.lloyds.com/NR/rdonlyres/FCA144E6-24D5-425E-B058-3A64E020E18F/0/360_RapidClimateChangeReport.pdf) (Lloyd's).

transfer risk to reinsurers or other parties. Reinsurance and other vehicles that allow insurers to spread their own risk play a crucial role in allowing insurers to take on risks of large losses. These vehicles allow insurers to reduce both their average loss and maximum possible loss, increasing their capacity to cover risks.<sup>111</sup> In an era in which catastrophe exposure is growing and the limits of insurability of catastrophic loss coverage may be increasingly uncertain, reduction of insurers' average and maximum losses will be even more central to future insurability of these risks.<sup>112</sup>

Unfortunately, the reinsurance market has historically faced challenges covering catastrophic losses.<sup>113</sup> Some losses strain the reinsurance market's liquidity and functionality.<sup>114</sup> As a result, limitations on reinsurance capacity have limited the catastrophe insurance market. Companies and individuals exposed to catastrophe risk have had to turn to other avenues to preserve their capital and reduce this risk. Insurers and other financial institutions are looking to alternative risk-spreading instruments in order to accomplish this goal. Insurance-linked securities (ILSs) and "special-purpose vehicles" are the chief instruments being developed and implemented for this purpose.<sup>115</sup> These instruments allow insurers and other companies to hedge climate risk. They include catastrophe bonds, industry loss warranties, weather derivatives, and "sidecar" companies whose purpose is to issue securities that hedge insurers' and reinsurers' risk.<sup>116</sup> These instruments all allow an insurer or reinsurer to obtain access to capital if a specified set of conditions arises (for

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111. BERLINER, *supra* note 16, at 44–45.

112. See Erwann Michel-Kerjan & Frederic Morlaye, *Extreme Events, Global Warming, and Insurance-Linked Securities: How to Trigger the "Tipping Point,"* 33 GENEVA PAPERS 153, 153–56 (2008).

113. Jaffee & Russell, *supra* note 16, at 205–06 (noting the failure of insurance markets in catastrophe risk to remain strong after then-recent catastrophic losses from the Northridge earthquake and other disaster risk); *id.* at 217–18 (discussing the capital limitations on the reinsurance industry's ability to cope with catastrophic risks).

114. *Id.* at 217–18; see Kenneth A. Froot, *The Market for Catastrophe Risk: A Clinical Examination*, 60 J. FIN. ECON. 529, 542–54 (2001); Kenneth A. Froot & Steven E. Posner, *The Pricing of Event Risks With Parameter Uncertainty*, 27 GENEVA PAPERS ON RISK & INS. THEORY 153, 164 (2002).

115. A discussion of the operation of these instruments is beyond the scope of this Article. See Michel-Kerjan & Morlaye, *supra* note 112, for a thoughtful and comprehensive discussion of these various methods of addressing the capital requirements of responding effectively to catastrophe risk, along with recommendations for how to address current limitations on the markets for these instruments and expand those markets.

116. See Michel-Kerjan & Morlaye, *supra* note 112, at 157–68 (discussing the operation of each of these hedging vehicles). See Cesare Dosi & Michele Moretto, *Global Warming and Financial Umbrellas*, J. RISK FIN., Summer 2003, at 18, and Patrick L. Brockett, Mulong Wang & Chuanhou Yang, *Weather Derivatives and Weather Risk Management*, 8 RISK MGMT. & INS. REV. 127 (2005), for background information and interesting discussions of the use of some of these instruments to hedge the risk of severe weather events.

example, low rainfall, high temperatures, or a storm of a particular size making landfall). The sellers of the securities are, in essence, betting that the condition will not happen; they receive a premium that they are entitled to keep in the event that the condition is not met. If the condition is met, the sellers agree to pay a much higher, specified amount to the purchaser. Major reinsurers are developing these products.<sup>117</sup> Their market has increased dramatically over the past few years, though it has not yet reached the level that researchers believe will be necessary to sustain a robust catastrophe insurance market.<sup>118</sup>

The huge amount of risk held by a comparatively small number of reinsurers may explain why those companies have been the most proactive in addressing climate risks.<sup>119</sup> Moreover, because reinsurers also often act as nonadmitted insurers, they may be doubly exposed to these risks to the extent they act as primary insurers of significant risks associated with climate change.

In short, the success of reinsurance and similar vehicles in allowing insurers and large businesses to spread catastrophic risks will be essential to our society's ability to address climate change. Because insurers rely on risk-spreading instruments to manage their own exposure to high-magnitude or correlated losses, the supply of insurance for catastrophic events depends on the availability of these instruments.

### III. THE POTENTIAL FOR INSURANCE PRODUCTS TO INFLUENCE CLIMATE CHANGE-RELATED BEHAVIOR

Through their insurance products, insurers can play two primary roles to influence climate change-related outcomes. First, by creating retail insurance products and pricing structures that align policyholders' financial incentives with behavior that promotes climate-positive outcomes, insurers can promote actions by businesses and individuals that will help to improve climate change outcomes. Second, by providing capital to new ventures and by reducing the financial risk to investors in these ventures, insurers can also facilitate the creation of new markets and services that will help to solve the climate change problem.

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117. See, e.g., Mike Anderson & Oliver Suess, *Hedge Funds, Betting on Hurricanes, Wade in to Fund Insurers*, BLOOMBERG.COM (July 12, 2006), available at <http://www.bloomberg.com/apps/news?pid=20601103&sid=akBREf1htxSw> (discussing the involvement of major reinsurers in selling insurance-linked securities (ILSs) and the purchase of these securities by hedge funds).

118. See Michel-Kerjan & Morlaye, *supra* note 112, at 158–74 (discussing the growing use of these instruments, barriers to their wider acceptance, and possible means to reaching a “tipping point” in which the market will become robust).

119. See sources cited *supra* note 110 and accompanying text.

Insurers have incentives to play these roles,<sup>120</sup> but they have done relatively little so far to develop products to address global climate risk. This lack of development raises the question of what barriers may be preventing insurers from incorporating climate change considerations into their product development and pricing.

Barriers to this type of innovation exist on both the supply and the demand sides. On the supply side, collective action issues, perverse incentives provided by regulation, uncertainty aversion, and concerns about short-term profits all tend to hinder the development and deployment of products that will help to solve climate change-related problems. On the demand side, cognitive biases cause individuals and risk managers to treat many catastrophe risks as trivial if their probability is perceived as below a threshold amount, and to place an extremely high discount rate on contingent future events. This Part explores some of these issues.

#### A. Climate Change and Insurance Supply

Where climate-friendly behavior is correlated with reduced insured risk, insurers should be motivated to provide incentives for that behavior.<sup>121</sup> To the extent consumers can reduce the risks to which they are exposed by engaging in climate-friendly behavior, insurance companies will (accidentally or deliberately) encourage that behavior simply by pricing premiums accurately. By charging more to those consumers who choose to take on greater risk, insurers will naturally provide incentives to do the climate-friendly thing.

The desired policyholder actions may include promoting energy efficiency or other GHG reduction practices, increasing adaptive capacity,

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120. See *supra* text accompanying note 110; see also James W. Hutchin, *Environmental Conservation and the Risk Industry: A Natural Alignment of Interests*, 27 GENEVA PAPERS ON RISK & INS. 246, 246 (2002) (arguing that there is a considerable common interest between the insurance industry and “those who are working to protect the planet”).

121. Cf. D.J. RASBASH, *EVALUATION OF FIRE SAFETY* 72 (Wiley 2004) (discussing the role of the insurance industry in developing building codes and fire safety standards in the United States); Insurance Institute for Highway Safety Homepage, <http://www.iihs.org> (stating that the Insurance Institute for Highway Safety, “wholly supported by auto insurers,” is “dedicated to reducing the losses—deaths, injuries, and property damage—from crashes on the nation’s highways”). But in some cases, insurers’ apparent motivation to provide incentives for loss prevention may be secondary to their motivation to reduce uncertainty. See Robert Kneuper & Bruce Yandle, *Auto Insurers and the Air Bag*, 61 J. RISK & INS. 107 (1994) (arguing that insurers’ aggressive lobbying for adoption of airbags in cars resulted from a desire to reduce uncertainty rather than risk). This observation is consistent with two facts about the industry. First, predictable risks can be managed by insurers if they have the flexibility to charge a sufficient premium, but at a given premium level each dollar of additional loss is money out of an insurer’s profit. And second, as discussed above, uncertainty makes risk less insurable.

adequately disclosing climate change impacts to stakeholders or regulators, or engaging in other practices that help address climate change's causes or impacts.<sup>122</sup> In these cases, accurate pricing (correlating premiums tightly to risk) will help to solve the climate change problem, assuming that policyholders respond to the price signals sent by the differential premiums.<sup>123</sup> By contrast, in other cases, insured risk bears no intrinsic relation to GHG reduction. Where actuarial risk is not correlated with climate-friendly behavior, it is far more difficult to justify incorporating climate concerns into policy pricing.

Additionally, as discussed above, insurers theoretically should be motivated to take significant actions aimed at reducing overall societal greenhouse gas emissions and increasing adaptive capacity. These actions will reduce overall uncertainty and other barriers to insurability, by reducing insurers' potential exposure to catastrophic risks in excess of their capacity as well as the potential for property/casualty and liability claims in excess of current pricing structures. It will also allow insurers to price their products at marketable rates, giving them wider potential markets of policyholders.

Despite the incentives that the insurance industry appears to have to make climate risk more manageable, there is a significant market failure that limits insurers' motivation to do so through their product pricing. A stable climate, like clean air or other similar common resources that cannot be owned, is a public good. The benefits of insurers' contributions to this public good cannot be internalized through the operation of the insurance market. Moreover, insurers in particular will collectively benefit from a stable climate because of their high exposure to climate-related risk and uncertainty. But no individual insurer can reap the benefits of its incremental contribution to reducing climate risk.

Insurers' efforts to address climate change thus raise a problem that can be framed as a collective action problem or as a "tragedy of the

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122. See MILLS, *supra* note 9, at 12–14, for examples of insurance coverages where these incentives are well aligned.

123. See Susan K. Laury & Melayne Morgan McInnes, *The Impact of Insurance Prices on Decision Making Biases: An Experimental Analysis*, 70 J. RISK & INS. 219, 220, 230–31 (2003) (concluding that pricing insurance to reflect accurately the risks of policyholders' consumer choices provides information that motivates even nonpolicyholders to make decisions that more accurately reflect the impact of those risks). Cf. Howard Kunreuther, *Disaster Mitigation and Insurance: Learning From Katrina*, 604 ANNALS AM. ACAD. POL. & SOC. SCI. 208, 211–16 (2006) (noting widely documented research showing that people do not accurately assess future consequences of actions and therefore do not adopt loss-prevention measures, but concluding that premiums that accurately reflect risk will help to motivate loss prevention among consumers).

commons.”<sup>124</sup> Incremental contributions to mitigating greenhouse gas emissions generate positive externalities as each contribution generates no profit for an insurer (unless that contribution to addressing climate change happens to be correlated with other risks that can be underwritten profitably by the insurer).<sup>125</sup> As Ann Carlson has noted, “a rational individual reasons that if she behaves in a manner consistent with the collective good, her behavior will be meaningless unless other members of the group also participate.”<sup>126</sup>

While the problem of climate change will be solved only if many large actors all contribute to the solution, and while insurers as a group will likely benefit from measures to mitigate greenhouse gas emissions and to address impacts of climate change, each insurer will gain little from its own contribution if others do not participate. And solution-oriented behavior will often produce positive externalities instead of benefits for an insurer itself. As a consequence, insurers may lack motivation to act.<sup>127</sup>

Regulation also poses a potential barrier to insurers’ efforts to address climate change through their products. As discussed more fully in Part V.A, regulators have in some cases prevented insurers from pricing their products in a way that reflects risk accurately, as is the case with insuring coastal property in much of the United States against risks from wind, other storm-related damage, and potential sea level rise. To the extent that this is the case, insurers are unable to provide accurate price signals that would motivate individuals and businesses to engage in behavior that is more adapted to a changing climate.<sup>128</sup>

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124. See ELINOR OSTROM, *GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION* 2–5 (1990), for a critical discussion of these basic frames. See generally MANCUR OLSON, *THE LOGIC OF COLLECTIVE ACTION: PUBLIC GOODS AND THE THEORY OF GROUPS* (rev. ed., Harvard University Press, 1971); Garrett Hardin, *The Tragedy of the Commons*, 162 *SCIENCE* 1243 (1968).

125. But see Part IV, *infra*, for examples where insurers are acting in ways that address climate change risk through their products, and a discussion of why this may be so.

126. Ann E. Carlson, *Recycling Norms*, 89 *CAL. L. REV.* 1231, 1243 (2001).

127. There are clearly some barriers even to recognition of the problem. For example, some advocates for the U.S. insurance industry generally are still openly questioning the validity of possible links between climate change and increasing insured risks. See, e.g., Robert Hartwig, Senior Vice-President and Chief Economist for the New York-based Insurance Information Institute, *The US View, in LLOYD’S, WHAT NEXT ON CLIMATE CHANGE?* 8 (2006), available at [http://summits.ncai.org/docs/global%20warming\\_lloyds\\_Oct\\_2006.pdf](http://summits.ncai.org/docs/global%20warming_lloyds_Oct_2006.pdf).

128. ALLIANZ GROUP & WWF, *CLIMATE CHANGE AND INSURANCE: AN AGENDA FOR ACTION IN THE UNITED STATES* 31 (2006), available at <http://www.worldwildlife.org/climate/WWFBinaryitem3840.pdf>; Martin F. Grace & Robert W. Klein, *Facing Mother Nature*, *REG.*, Fall 2007, at 28, 31–33 (criticizing regulators for subsidizing the risk of coastal homeowners after the 2005 hurricane season); see also Letter From Robert Detlefsen, Ph.D., Vice President, Public Policy, National Association of Mutual Insurance Companies, to Mike Kreidler, Chair, Climate Change and

High transaction costs also tend to favor existing modes of doing business over innovation. Insurers typically benefit from large economies of scale and put large amounts of capital at risk. The transaction costs of adapting business practices are especially likely to affect insurance lines that aggregate risk from a very large number of policyholders. This phenomenon may explain, in part, the increased willingness of large surplus insurers and reinsurers, which engage in fewer transactions overall, to explore taking on climate change more aggressively.

Finally, insurers, most of which are publicly-traded companies, may have incentives to be concerned with short-term profits rather than risks that may materialize over the long term. According to a 2005 McKinsey & Company report, “shortsighted behavior is widespread” among corporations.<sup>129</sup> The report notes that a majority of corporate managers participating in a study “said that they would forgo an investment offering a decent return on capital if it meant missing their quarterly earnings expectations,” and more than 80 percent “said they would cut expenditures on R&D and marketing to ensure that they met their quarterly earnings targets—even if they believed that the cuts were destroying long-term value.”<sup>130</sup>

While researchers have not focused on identifying this general trend specifically within the insurance industry, there is no reason to think that the industry is immune from it; the main examples cited in the McKinsey report are from financial services companies,<sup>131</sup> which generally have some of the same long-term incentives to preserve capital as insurers. Insurers may thus price their products based on market conditions that have immediate and tangible impacts on their bottom line, even at the expense of ignoring long-term trends. This myopia would tend to disfavor developing products that are designed to reduce long-term climate risk.

## B. Climate Change and Insurance Demand

Property, casualty, health, and liability insurance for individuals and businesses all present opportunities for insurers to influence policyholder behavior. Insurance terms and conditions can create incentives to improve climate

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Global Warming (EX) Task Force, National Association of Insurance Commissioners (NAIC) (Jan. 10, 2008) (on file with author).

129. Richard Dobbs, Keith Leslie & Lenny T. Mendonca, *Building the Healthy Corporation*, 2005 MCKINSEY Q. 63, 65, available at <http://www.bmacewen.com/blog/pdf/McKinsey.BuildingTheHealthyFirm.pdf>.

130. *Id.*

131. *Id.*

outcomes. Conditioning the availability of insurance on climate-friendly behavior can also create these incentives, as can creating pricing structures that give financial advantages to policyholders who engage in climate-friendly behavior.

Nonetheless, demand-side incentives do not always work effectively or efficiently. There is a significant body of theoretical and empirical research analyzing the ways in which individuals and firms respond to risk, and concluding that people often do not maximize expected utility. People react to risk in ways that reflect various cognitive biases and heuristics, as well as specialized values, that cause them to evaluate risk differently from what would be expected based on classical economic models.<sup>132</sup> Examples of these biases include use of invalid methods to predict the outcome of future events from past trends and other information; the availability heuristic, a phenomenon where individuals overweight risks that are more salient; and loss aversion, characterized by valuing a loss more heavily than a gain of an equal amount.<sup>133</sup>

In the insurance context, recent research has suggested that insurance buyers develop and implement plans to achieve multiple, simultaneous goals in their insurance purchasing decisions. Not all these goals involve protecting against financial risk.<sup>134</sup> As the Wharton Risk Management & Decision Processes Center has noted:

In practice, individuals make their insurance decisions by constructing or selecting plans designed to achieve multiple goals. For example, a plan to purchase homeowners insurance may satisfy as many as seven goals simultaneously: (1) reducing the chances of a catastrophic loss; (2) reducing anxiety about risks of fire and theft; (3) avoiding regret and/or providing consolation in case a loss occurs; (4) satisfying conditions required by a bank; (5) presenting the appearance of prudence to others who will learn about the insurance purchase; (6) maintaining one's relationship with an insurance agent; and (7) avoiding highly burdensome insurance premium payments.<sup>135</sup>

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132. See Paul Slovic, *Perception of Risk*, 236 *SCIENCE* 280, 280–85 (1987) (discussing the differences between laypeople's risk perception and that of identified experts). Slovic concludes that "there is wisdom as well as error" in lay perceptions of risk, and that laypeople's "basic conception of risk is much richer than that of the experts and reflects legitimate concerns that are typically omitted from expert risk assessments." *Id.* at 285. See generally Daniel Kahneman & Amos Tversky, *Prospect Theory: An Analysis of Decision Under Risk*, 47 *ECONOMETRICS* 263 (1979), for the classic exposition of the factors that underpin decisionmaking about risk.

133. Amos Tversky & Daniel Kahneman, *Judgment Under Uncertainty: Heuristics and Biases*, in *JUDGMENT UNDER UNCERTAINTY: HEURISTICS AND BIASES* 3, 4–14 (Daniel Kahneman, Paul Slovic, & Amos Tversky eds., 1982).

134. WHARTON RISK MANAGEMENT & DECISION PROCESSES CENTER, *supra* note 24.

135. *Id.*



This complex set of factors highlights the difficulty in motivating individuals (and those who manage risk for companies) to behave in a specific way through incentives provided by insurance. Because consumers do not always behave purely as risk managers, offering products that allow them to manage risk effectively at a reasonable price will not necessarily motivate them to do so.

Specifically, researchers have noted a significant lack of demand for first-party catastrophic risk insurance.<sup>136</sup> Research suggests that heuristics and cognitive biases, in addition to complex decision processes, play a role in this phenomenon. Individuals and businesses fail to purchase insurance against high-magnitude, relatively rare risks even in contexts in which it would appear rational for them to do so.<sup>137</sup> People generally behave as if such risks have a zero probability of occurring if their probability is below a certain threshold level.<sup>138</sup> Relatedly, the implicit discount rate that people place upon the costs of future catastrophic risks is astronomically high.<sup>139</sup> In addition to motivating people not to buy insurance, these factors likely influence loss-mitigating behavior as well, causing people not to take protective measures that would make their property or businesses more resilient to climate change.<sup>140</sup>

Researchers have suggested several possible explanations for this behavior. First, limits on time and other resources necessary to obtain or to use information about small risks may cause people to disregard those risks.<sup>141</sup> Second, people may be motivated to choose not to think about outcomes that are scary or negative.<sup>142</sup> Third, people may assume that if an event is terrible enough, someone else will bail them out.<sup>143</sup> Fourth, perceived or real budget constraints may be motivating a lack of interest in paying for

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136. Michael G. Faure & Véronique Bruggeman, *Catastrophic Risks and First-Party Insurance* 8–36 (Sept. 2007), available at <http://ssrn.com/abstract=1086036>; Howard Kunreuther & Mark Pauly, *Insurance Decision-Making and Market Behavior*, in 1 FOUNDATIONS AND TRENDS IN MICROECONOMICS 63, 92 (2005).

137. Kunreuther & Pauly, *supra* note 136, at 63, 110; Kunreuther, *supra* note 123, at 211; Kunreuther, *supra* note 18.

138. Kunreuther, *supra* note 123, at 211; Kunreuther & Pauly, *supra* note 136, at 63, 110. See RICHARD A. POSNER, *CATASTROPHE; RISK AND RESPONSE* 92–123 (2004), for an engaging and wide-ranging discussion of the reasons that people tend to discount the value of low-probability catastrophic risks.

139. Kunreuther, *supra* note 18, at 174–76; Paul R. Kleindorfer & Howard Kunreuther, *The Complementary Roles of Mitigation and Insurance in Managing Catastrophic Risks*, 19 RISK ANALYSIS 727, 734 (1999).

140. Kunreuther, *supra* note 123, at 216.

141. Kunreuther & Pauly, *supra* note 136, at 110–11.

142. *Id.*

143. *Id.*

insurance (or loss prevention) to cover these risks.<sup>144</sup> Fifth, people's view of insurance as an investment rather than as a hedge against loss—that is, their expectation that insurance (or money invested in mitigation) should yield a financial return over reasonable time horizons, rather than protect against total loss scenarios—may be responsible for underinsurance against catastrophe.<sup>145</sup> And finally, consumer myopia, a tendency to ignore any costs or benefits with a time horizon over approximately one year, may contribute significantly to this problem.<sup>146</sup>

Empirical evidence tends to disprove the theory that people fail to insure because they believe they will be bailed out.<sup>147</sup> To the extent that lack of access to information, or lack of motivation to seek out information, explains this behavior, more education about risks may help to remedy the problem, but given the inevitability of information deficiencies, some researchers have suggested that the government might play a role in determining the scope of coverage, through targeted regulation or even mandatory insurance coverage.<sup>148</sup> And to the extent that budgetary concerns are motivating the failure to purchase insurance or mitigate against catastrophic risks, providing capital in the form of low-interest loans, grants, or other incentives is a possible solution.<sup>149</sup> Nonetheless, given the malleable nature of affordability in this context, it is likely that incentives will not provide a total solution to the problem even if budget is driving the issue.

It is also likely that consumer distrust of insurers, and real and perceived behavior by insurers that greatly increases transaction costs for consumers and lowers the expected value of insurance (including contesting claims and lowballing loss estimates), contribute to a reluctance to purchase insurance.<sup>150</sup>

Given the evidence that heuristics, subjective values, and cognitive biases drive these decisions, it appears likely that people ignore low-probability, high-magnitude risks because of the expectation of receiving a return on what they incorrectly perceive as an investment, myopia, or other similar reasons that cannot be remedied through the existing insurance market. As a result, some researchers have proposed either requiring the

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144. *Id.* at 80–82.

145. *Id.* at 97; Faure & Bruggeman, *supra* note 136.

146. Kunreuther, *supra* note 123, at 212.

147. Kunreuther & Pauly, *supra* note 136, at 111.

148. *Id.* at 115–16.

149. See Kunreuther, *supra* note 123, at 221.

150. See, e.g., Jennifer Bayot, *Mississippi Sues Insurers Over Damage From Storm*, N.Y. TIMES, Sept. 16, 2005 (describing the Mississippi Attorney General's lawsuit against insurers for alleged unfair business practices in settling property and casualty claims relating to Hurricane Katrina).

bundling of all risks together in insurance policies,<sup>151</sup> making coverage for catastrophic risks mandatory,<sup>152</sup> or requiring lenders to make catastrophic coverage mandatory to qualify for mortgages or other loans.<sup>153</sup> While it is unclear which of these solutions will be politically feasible or most effective and to what extent each potential remedy will have negative distributional effects, innovative responses such as these will be necessary in order to remedy the apparently intractable problem of low demand for voluntary, stand-alone coverage against catastrophic risks.

#### IV. INSURANCE PRODUCTS AND CLIMATE CHANGE

Insurance products that may help society to mitigate or adapt to climate change can be classified into three groups.<sup>154</sup> First, some insurance products have the potential, either incidentally or by design, to reduce greenhouse gas emission reductions directly. Second, some insurance products facilitate adaptation to climate change impacts by providing incentives or capital to build resilience to those impacts. And finally, other insurance products help to develop new markets for private ventures to create climate change-related solutions. Below is a discussion of the attributes, and the supply- and demand-side barriers to implementation of some specific insurance products within each of these three groups.

##### A. Insurance Products That Help Mitigate GHGs

Individuals and businesses will need to make substantial cuts in greenhouse gas emissions in order to reduce our societal emissions to a level that will render climate change manageable.<sup>155</sup> Insurance products

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151. Kunreuther, *supra* note 18, at 182 (1996); Dan R. Anderson, *All Risks Rating Within a Catastrophe Insurance System*, 43 J. RISK & INS. 629, 633–51 (1976) (proposing a comprehensive “all-risks” private insurance system with national guidelines). Anderson noted that the system of allowing risks to be insured ad hoc is costly, inefficient, inequitable, and leaves many homeowners uninsured for at least one catastrophe peril. *Id.* at 633.

152. Faure & Bruggeman, *supra* note 136. The idea of compulsory insurance is not new. Cf. John V. Krutilla, *An Economic Approach to Coping With Flood Damage*, 2 WATER RESOURCES RES. 183 (1966), reprinted in 2 THE ECONOMICS OF NATURAL HAZARDS 13, 16–19 (Howard Kunreuther & Adam Rose eds., 2004) (suggesting a compulsory insurance program for floodplain residents).

153. Kunreuther, *supra* note 123, at 221.

154. Insurers offer services such as risk management and risk assessment that also can be considered products. This Article does not discuss the role that these products might play in addressing climate change, but instead focuses on core insurance underwriting. Nonetheless, these services may contribute importantly to insurers’ efforts to address climate change.

155. See, e.g., S. Pacala & R. Socolow, *Stabilization Wedges: Solving the Climate Problem for the Next 50 Years With Current Technologies*, 305 SCIENCE 968 (2004) (discussing the magnitude of

that provide direct incentives for policyholders to mitigate their own greenhouse gas emissions are therefore a promising tool for addressing climate change.<sup>156</sup> Nonetheless, these products have been available for only a short time, and thus are not well developed and have limited market penetration to date. While some of these products appear to be actuarially sound, there are barriers on both the supply side and the demand side to widespread adoption of many of these measures. A discussion of some current and anticipated insurance products in the property/casualty and liability lines that may influence businesses' and individuals' mitigation of greenhouse gases follows.

### 1. Property/Casualty Coverage

Property/casualty insurers have begun to offer coverage that appears to reward climate-friendly practices by their policyholders. These include offering "green rebuilding" insurance that encourages policyholders to rebuild to strict environmental standards after a loss,<sup>157</sup> and offering discounted premiums to drivers of hybrid vehicles.<sup>158</sup>

These coverages may reflect actual risk ratings. In some cases, the insurers may perceive, or have calculated, that these measures are actually correlated with reduced risk. Evan Mills has noted some insurers' perception of a "halo effect" in which low-risk behaviors are correlated with environmentally-friendly conduct.<sup>159</sup> In some cases there are clear synergies between behavior that reduces carbon dioxide emissions or increased adaptive capacity and reduced actuarial risk.<sup>160</sup> But despite insurers' theoretical industry-wide incentive to reduce GHG emissions in light of the overall risk to the industry, one would expect individual insurers to have little reason to offer incentives for any energy-efficiency measures that are

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greenhouse gas emissions reductions necessary to solve climate change, and proposing particular emissions reductions strategies). Cf. Michael P. Vandenberg, Jack Barkenbus, & Jonathan Gilligan, *Individual Carbon Emissions: The Low-Hanging Fruit*, 55 UCLA L. REV. 1701 (highlighting changes that individuals and households can make to reduce greenhouse gas emissions).

156. Compare Vandenberg, Barkenbus & Gilligan, *supra* note 155, at 1717–19, for an insightful analysis of the ways in which a large number of people each making small changes in everyday habits to reduce individual emissions will have a significant aggregate impact on greenhouse gas emissions.

157. Fireman's Fund, Green Building Solutions, <http://www.firemansfund.com/servlet/dcms?c=business&rkey=437> (last visited July 15, 2008).

158. Travelers, Hybrid Travelers, <http://www.hybridtravelers.com> (last visited July 15, 2008).

159. MILLS, *supra* note 9, at 14.

160. *Id.*

uncorrelated with insured risk, in light of the potential collective action problem associated with these reductions.

Insurers have been actively marketing some coverages that reward environmentally friendly policyholder behavior, and perceive benefit from them. For example, Fireman's fund states on its website: "Lower energy costs, improved indoor air quality . . . fewer incidents of loss—green buildings outperform traditional buildings on many levels. In recognition of this, Fireman's Fund offers discounted pricing for building owners who commit to greens [sic] standards."<sup>161</sup> The products offered by Fireman's Fund include "green rebuilding" insurance and rebuilding discounts, which would reward energy efficiency practices in case of a covered loss by encouraging rebuilding to high environmental standards.<sup>162</sup>

Fireman's Fund also offers premium discounts for property insurance on LEED-certified<sup>163</sup> buildings.<sup>164</sup> This product recognizes long-term benefits from sustainable practices. According to Stephen Bushnell, a high-level manager for the company, the discount is based specifically on the actuarial conclusion that "commissioning"<sup>165</sup> of heating, ventilation, and air conditioning (HVAC) systems, plumbing, and electrical systems—an element of LEED-certified construction—reduces electrical fire-related, water damage-related, and HVAC-related losses, which are the largest sources of insured losses in commercial buildings.<sup>166</sup> According to Mr. Bushnell, "[w]e know that commissioning . . . addresses the electric, plumbing and HVAC systems, making them greener and safer."<sup>167</sup> Nonetheless, he notes that "[t]here are not enough certified green buildings to generate the necessary premium

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161. FIREMAN'S FUND, HOW GOING GREEN CAN KEEP YOU IN THE BLACK (2007) (promotional leaflet).

162. Fireman's Fund, *supra* note 157.

163. The U.S. Green Building Council notes that its "Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ encourages and accelerates [the] global adoption of sustainable green building and development practices through the creation and implementation of universally understood and accepted tools and performance criteria." U.S. Green Building Council, *What Is LEED?*, available at <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=222> (last visited July 15, 2008).

164. C. Bradley Cronk, *The Case the Business Builds for Building Green*, REAL ESTATE WEEKLY (May 9, 2007), available at [http://findarticles.com/p/articles/mi\\_m3601/is\\_39\\_53/ai\\_n19155525](http://findarticles.com/p/articles/mi_m3601/is_39_53/ai_n19155525).

165. According to the Building Commissioning Association, a trade association, "[b]uilding commissioning provides documented confirmation that building systems function according to criteria set forth in the project documents to satisfy the owner's operational needs. Commissioning existing systems may require developing new functional criteria to address the owner's current requirements for system performance." Building Commissioning Association Homepage, <http://www.bcx.org> (last visited July 15, 2008).

166. E-mail communication from Stephen Bushnell to Sean Hecht (May 8, 2008) (on file with the author).

167. *Id.*

loss data necessary for an actuarial determination of the safety of green buildings compared to traditional buildings,” and that it is unclear when if ever those data will be robust enough to conclude whether green buildings in general generate fewer losses than traditional buildings.<sup>168</sup> Thus, the rewards to policyholders stem not directly from the energy efficiency elements of LEED which are correlated with reduced greenhouse gas emissions, but from other associated features.

This example shows that some insurers are investigating the opportunities available to assess the benefits of green practices. But it does not demonstrate that insurers in this context are surmounting the collective action problem and recognizing long-term benefits to the industry from offering incentives simply to engage in sustainable practices, regardless of whether the products are actuarially sound. Rather, it reflects careful attention to actuarial realities, some of which demonstrate correlations between climate-friendly practices and insured losses, and some of which do not.

Discounted auto insurance policies for hybrid drivers have been hailed by some as an important new product to help address climate change, but it is not clear that these policies will prove enduring. As the National Association of Mutual Insurance Companies has pointed out, if there is no established link between risk and driving alternative fuel vehicles, it makes no sense actuarially to offer it, and the industry will not perceive this pricing strategy as viable.<sup>169</sup> It is possible that right now, the typical hybrid vehicle driver has a reduced risk profile that warrants lower premiums based strictly on risk rating. But if so, as hybrids and other alternative fuel vehicles penetrate further into the U.S. market, this differential will inevitably decrease.

On the other hand, some products instead may be loss leaders<sup>170</sup> designed to draw in new customers, calculated attempts to cultivate a green reputation among customers, potential customers, or corporate responsibility advocates, or the manifestations of a belief that there are other business advantages to green practices beyond the direct impacts on corporate revenue. It is unclear to what extent the products will be enduring or transformative over time. Nonetheless, some products—such as pay-as-you-drive automobile insurance,

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168. *Id.*

169. See Letter From Robert Detlefsen, *supra* note 128. *But see* MILLS, *supra* note 9, at 14 (noting a “halo effect” whereby “adopters of climate-change mitigation technologies are viewed as low-risk customers,” underscoring the correlation between “behaviors that are risk-averse with those that are environmentally responsive”).

170. A loss leader is “[a] product or service sold at a substantial discount in order to generate additional sales.” *Loss Leader*, INVESTORWORDS.COM, [http://www.investorwords.com/2898/loss\\_leader.html](http://www.investorwords.com/2898/loss_leader.html) (last visited July 11, 2008).

discussed below—offer opportunities for direct correlation between insured losses and energy efficiency.

Demand for these products generally would be expected to be limited by policyholders' tendencies toward myopia, undervaluing small risks, and application of a high discount rate to future benefits. These cognitive biases generally result in low demand for products that require a higher outlay of mitigation dollars in exchange for a lower insurance premium. These products do seem to tap into a facet of demand that has not previously been exploited by insurers, however. To the extent that a perception that a product shown to be good for the environment is more desirable than one that is less environmentally-friendly penetrates far into the insurance market, there may be significant demand for the products.

## 2. Liability Insurance Coverage

Because liability insurance may be triggered by lawsuits<sup>171</sup> against policyholders who are high emitters of greenhouse gases (or against their officers and directors), insurers would appear to have a considerable, direct incentive to encourage greenhouse gas emission reduction among their policyholders.<sup>172</sup> Liability insurance lines are expected to see an increasing correlation between climate-unfriendly behavior and losses (including both defense costs and indemnity for legal liability), so products in these lines present an opportunity to address climate change impacts, in the basic sense that insurers' interests are directly aligned with policyholder behavior that

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171. Examples of such lawsuits include *Connecticut v. Am. Elec. Power Co.*, 406 F. Supp. 2d 265 (S.D.N.Y. 2005), and *California v. Gen. Motors Corp.*, No. C06-05735 MJJ, 2007 WL 2726871 (N.D. Cal. Sept. 17, 2007), both of which involve allegations that major greenhouse gas emitters are liable to various U.S. states under a nuisance theory for the impacts of climate change on those states. While neither of these lawsuits was successful in the trial court, both are currently on appeal. Another pending case that makes similar allegations is *Native Village of Kivalina v. ExxonMobil Corp.*, No. 4:08-CV-01138-SBA (N.D. Ca.). The plaintiffs in *Kivalina* have included a cause of action for civil conspiracy, raising distinct legal and factual issues from those rejected by the district courts in the other two cases cited above. See Complaint at 47, *Native Village of Kivalina*, No. 4:08-CV-01138-SBA, available at <http://www.climatelaw.org/cases/country/us/kivalina/Kivalina%20Complaint.pdf>. It is by no means clear that these causes of action will ultimately be rejected by courts. And even if these lawsuits and other similar cases are ultimately dismissed, it will likely be years before the relevant legal doctrines are finally resolved. In the meantime, the potential for defense costs in these cases is still significant. See *supra* note 90 and accompanying text.

172. See Ross, Mills & Hecht, *supra* note 81, at 274–99, for a comprehensive discussion of climate change-related liability insurance risks. Some of these risks are discussed *supra* notes 81–91 and accompanying text.

promotes climate change solutions. In addition, building policyholders' resilience to climate change impacts will directly reduce insurers' exposure.<sup>173</sup>

Nonetheless, risks covered by liability insurance are extremely ambiguous. Because climate change-related liability is new to our legal system, many liability theories are untested in courts, making it difficult to assess the scope or magnitude of potential liability. It is unclear who, if anyone, bears legal responsibility for either the causes or impacts of climate change in a wide variety of contexts. As a result, it will be extremely difficult for insurers to price these risks accurately, and they must operate for now in a mode of uncertainty.

To date, it is unclear to what extent insurers are considering liability for greenhouse gas emissions in pricing their liability insurance products, or even to what extent it would be possible for them to do so given the uncertainties that underlie the relevant risks. But there is some evidence of such consideration; Evan Mills has noted that "[l]ate in 2002, Swiss Re acknowledged that climate change risks were among the many criteria it used to evaluate its exposures under corporate D&O policies."<sup>174</sup> In the future we may expect to see higher liability insurance premiums, or even conditions that require policyholders to meet certain requirements to be eligible for coverage, for businesses that are major GHG emitters or otherwise are exposed to climate risks, based on the increased risk of liability.<sup>175</sup> Reducing this risk will involve adopting GHG mitigation technology, disclosing climate-related risk, and decreasing vulnerability to climate impacts.

Pricing liability insurance risks in a way that motivates climate-friendly behavior appears to run into fewer barriers to demand, compared to first-party property and casualty risks. Liability insurance is typically not optional; insurers have a captive market in which businesses and some individuals must purchase this insurance in order to conduct their affairs.

On the supply side, if uncertainty-averse insurers decline to offer liability insurance policies to businesses that are not climate-friendly, or if they charge extremely high premiums to those companies, policyholders will be presented with direct incentives to become more climate-friendly. Nonetheless, the current ambiguity in legal liability regimes relating to responsibility for climate change will continue to

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173. *Id.* at 314–16.

174. MILLS, *supra* note 9, at 13.

175. *See id.*; cf. Daniel A. Farber, *Adapting to Climate Change: Who Should Pay?*, 23 J. LAND USE & ENVTL. L. 1, 26–36 (2007) (discussing various alternative means of allocating costs of adapting to climate change and tentatively favoring targeting high emitters of greenhouse gases as a significant source of compensation, whether through litigation or through an alternative compensation scheme).



pose a challenge to insurers who attempt to consider climate change-related liability risks in their underwriting.

### 3. Example of Aligned Incentives: Linking Automobile Insurance Premiums to Miles Driven

Pay-as-you-drive (PAYD) auto insurance provides perhaps the best example of an insurance product that holds the potential for correlated reductions in insured losses and greenhouse gas emissions.<sup>176</sup> PAYD insurance sets insurance premiums according to miles driven. PAYD can be seen as a transportation demand management (TDM) measure, reducing the number of vehicle miles traveled by influencing consumer behavior. TDMs thereby help to reduce congestion, accident rates, and air emissions from vehicles, as well as greenhouse gas emissions.<sup>177</sup> Viewing PAYD insurance as a promising GHG-reduction measure that the insurance industry should have incentives to implement is based on the simple insight that both automobile accident rates and automobile greenhouse gas (carbon dioxide) emissions are directly correlated with miles driven.<sup>178</sup>

PAYD is unlikely to have the demand-side drawbacks discussed in the previous part. It provides a steady, small payoff in the form of reduced premiums for drivers who reduce miles driven, consistent with consumers' view of insurance as an investment. And it does not require consumers to view rationally the expected losses from low-probability contingent future events. Overall, it has been estimated that PAYD insurance can yield a 10 to 15 percent reduction in vehicle miles traveled.<sup>179</sup> PAYD thus has significant potential to reduce greenhouse gas emissions. According to a study sponsored by the U.S. Environmental Protection Agency, a 10 percent reduction in vehicle miles traveled in the U.S. would yield an emissions reduction of about 4500 million tons carbon dioxide equivalent in 2050, or approximately

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176. For a comprehensive discussion of pay-as-you-drive (PAYD) insurance availability and costs and benefits, as well as an analysis of means to provide governmental incentives to offer PAYD, see Megan Hinkle, *Can Auto Insurance Go Green? Regulatory Options for Mile-Based Premiums* (Jan. 11, 2008) (unpublished manuscript, on file with the author).

177. SIMON MUI, JEFF ALSON, BENJAMIN ELLIES & DAVID GANSS, A WEDGE ANALYSIS OF THE U.S. TRANSPORTATION SECTOR 17–18 (2007); PROGRESSIVE INSURANCE, TEXAS MILEAGE STUDY: RELATIONSHIP BETWEEN ANNUAL MILEAGE AND INSURANCE LOSSES (2005), available at <http://www.nctcog.org/trans/air/programs/payd/PhaseI.pdf> (finding a direct linear relationship between miles driven and insurance losses).

178. Hinkle, *supra* note 176, at 7–9.

179. TODD LITMAN, PAY-AS-YOU-DRIVE PRICING IN BRITISH COLUMBIA 7 (2007).

one-ninth of the total reduction necessary to stabilize GHG emissions from the United States transportation sector.<sup>180</sup>

Until recently, PAYD insurance was not widely available in the United States or in foreign countries, though its use is beginning to grow internationally.<sup>181</sup> According to a 2003 study, insurers' auto premiums are linked only weakly at best with miles driven.<sup>182</sup> While the introduction of new PAYD products has risen substantially since then, few carriers offer them even today. This appears counterintuitive, since an insurance policy with a PAYD component would more accurately price risks. PAYD insurance is far more efficient than other pricing models, since it eliminates subsidies from policyholders who drive fewer miles to policyholders who drive more miles.

PAYD's unpopularity among insurers appears to be driven at least in part by cost concerns. In particular, companies may be concerned about the cost of monitoring miles driven.<sup>183</sup> There are practical solutions to this problem, however, including odometer audits at emissions check stations or oil change retail outlets, or "black box" monitoring of miles driven.<sup>184</sup> These solutions are becoming easier and cheaper to implement.

More significantly, however, insurers may not believe that even an efficiently run PAYD system would be worth the costs of changing current practices, because PAYD will generate significant positive externalities. A significant portion of the benefits of offering these policies will not accrue to the insurers, reducing insurers' incentives to price their products in a way that

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180. MUI, ALSON, ELLIES & GANSS, *supra* note 177, at 17–18.

181. Hinkle, *supra* note 176, at 16–18 (noting the lack of market-wide availability of PAYD insurance in the U.S. despite laws explicitly allowing the product in some states). Hinkle discusses the few pilot programs that have been attempted in the United States, notably that of Progressive Insurance, and notes that "[t]hrough the availability of non-pilot mile-based policies in the United States is limited, at least nineteen companies across Europe, Asia, and Africa offer mile-based policies". *Id.* at 18. GMAC is also offering such a product. The company recently began to offer a PAYD insurance pilot program to customers who own GM vehicles with a OnStar computerized vehicle diagnostic system installed. OnStar, Auto Insurance First: Technology Lets Americans Who Drive Less, Pay Less, available at [http://www.onstar.com/us\\_english/jsp/new\\_at\\_onstar/low\\_mileage.jsp](http://www.onstar.com/us_english/jsp/new_at_onstar/low_mileage.jsp) (last visited July 15, 2008).

182. Aaron S. Edlin, *Per-Mile Premiums for Auto Insurance*, in, *ECONOMICS FOR AN IMPERFECT WORLD: ESSAYS IN HONOR OF JOSEPH E. STIGLITZ* 53 (Richard Arnott et al. eds., 2003). Many insurers use crude categorizations of miles driven in calculating premiums, such as differentiating between drivers who drive more or less than a particular distance each year.

183. *Id.* at 73.

184. Hinkle, *supra* note 176, at 12–14. The OnStar program is an example of the "black box" approach. OnStar, *supra* note 181. This approach can be criticized based on privacy concerns. See Hinkle, *supra* note 176, at 14–15. GMAC appears to be aware of these concerns, and its promotional material states that "no additional data is gathered or used for any purpose other than to help manage transportation costs." OnStar, *supra* note 181.

accurately reflects the societal costs of current insurance rating systems. In particular, there is evidence suggesting that PAYD has broad social benefits linked to both accident rate and congestion reduction that may outweigh the private gains to insurers of implementing the system,<sup>185</sup> even without taking climate change or other environmental benefits into account.<sup>186</sup> The fact that so many of the benefits of PAYD are externalized is at least one likely cause of the general lack of correlation between premiums and miles driven.

It is likely that supply incentives will be depressed when public goods are created through insurance pricing. Regulators can motivate insurers to offer PAYD and similar pricing structures by creating mechanisms to internalize the insurance companies' benefits, such as rewarding them for conferring social benefits that do not make their way into insurers' bottom lines. Moreover, regulators should consider requiring insurers to make miles driven a central factor in pricing their auto insurance policies.<sup>187</sup> The State of California is now considering such a proposal.<sup>188</sup> In other contexts, insurers argue that regulators should not require them to rate policies based on non-risk-based factors. Here, by contrast, a mandate for insurers to incorporate a factor, miles driven, that is well correlated with risk, can overcome market failures associated with the product.

For those climate-related practices that are not well-correlated with policyholders' risks, such as overall energy consumption, regulators should consider whether and how to motivate insurers to engage in more climate-friendly practices. As shown above, while greenhouse gas reduction is in insurers' long-term interest, they may not be motivated to take action, given the difficulties internalizing benefits, the collective action problem, and the tendency to look at relatively short time horizons when making business decisions. Consequently, regulators should consider requiring insurers to create incentives for policyholders to mitigate greenhouse gas emissions. While this action should be designed and implemented only if it can be done while allowing insurers to generate revenue and to price their products based largely on risk, regulation to overcome the collective action issue, and myopia of the industry may be beneficial to the industry.

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185. Edlin, *supra* note 182, at 73.

186. *Id.* at 72.

187. See Hinkle, *supra* note 176, at 19–32, for a discussion of various alternative means that state regulators, or a new federal regulatory regime, could employ to remove barriers to PAYD implementation or to require such implementation.

188. Insurance Journal, California Considering Pay-As-You-Drive Auto Insurance, available at <http://www.insurancejournal.com/news/west/2008/06/23/91252.htm> (last visited July 15, 2008) (stating that “the [California] Department [of Insurance] intends to adopt regulations with the goal of making PAYD insurance widely available in California and to encourage participation”).

B. Insurance Products That Facilitate Adaptation to Climate Change Impacts

Insurers are also developing new products that facilitate adaptation to climate change. Broadly, these can be divided into two types: products that help to create the conditions for active adaptation to building physically resilient communities, and products that provide capital and liquidity to help communities to cope with losses caused by climate change catastrophes. While some of these products appear to align insurers' incentives with incentives for policyholders to engage in climate-friendly practices, many of these products are constrained by various supply and demand side barriers identified above.

Insurance innovations with the most promise to build adaptive capacity might simply involve insurers pricing their policies to reflect the level of climate change-related risk assumed by the insurer. These products will tend to reward behavior that reduces risk of financial losses from climate change, and thus will encourage adaptive behavior. Products that incorporate these features include, for example, offering premium discounts on property insurance for climate-resilient commercial or residential buildings (or the theoretical equivalent, charging a higher premium for less resilient buildings).

Offering differential premiums to customers depending on the customers' level of protection from loss caused by weather-related disasters would seem to be a clear opportunity for insurers to reduce their own overall and maximum possible loss exposure while promoting communities' overall resilience in the face of climate change's impacts. For example, risks could potentially be reflected in discounts for businesses or homeowners that have taken specific steps to ensure that their buildings are resistant to floods, wind damage, or other hazards. Insurers can also condition their policies on compliance with laws such as building codes, thus playing a role in enforcing laws that promote climate change resilience.

Nonetheless, programs that discount premiums for building disaster resilience are comparatively rare.<sup>189</sup> And even where such programs have been mandated by law, insurers have not marketed them aggressively. For example, since 2002, homes that comply with the Florida Building Code are eligible for premium discounts, but insurers have publicized the discounts only to the extent required by law.<sup>190</sup> Kunreuther has suggested both that

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189. Kunreuther, *supra* note 18, at 180.

190. Robert T. Ward, Celine Herweijer, Nicola Patmore & Robert Muir-Wood, *The Role of Insurers in Promoting Adaptation to the Impacts of Climate Change*, 33 GENEVA PAPERS 133, 135–136 (2008).

demand would be low for such products anyway, given the low premium reductions that would result in light of highly discounted contingent future benefits, and that the opportunity costs and transaction costs of developing and implementing these programs may outweigh their benefit to insurers.<sup>191</sup> More recently, however, Kunreuther and Pauly have interpreted the lack of development and marketing of these products as a byproduct of regulation, reasoning that regulators' requirement that insurers charge highly subsidized rates in hazard-prone areas makes insurers prefer not to offer products that would entice even more homeowners to purchase insurance.<sup>192</sup> It seems unlikely, however, that this is the case, since homeowners ordinarily must purchase insurance as a condition of obtaining a mortgage, and any efforts to promote loss reduction should improve insurers' expected financial outcomes, as long as the premium reduction is rationally related to the reduction in expected losses.

Creating the conditions that will overcome these obstacles on both the supply and the demand sides will be essential to establishing a market for insurance products that will encourage climate-resilient construction and retrofitting. If insurers' resistance indeed results from a regulatory structure that creates incentives for insurers to systematically underprice insurance in those areas where the climate-related risk is highest, by motivating insurers to discourage anything that will attract more policyholders, the answer may have to come from regulatory reform. Nonetheless, remedies to this problem will inevitably raise questions of distributional fairness and equity, as current homeowners, businesses, and other policyholders have to cope with the serious consequences of insurance that is priced accurately to reflect risk, such as losing the ability to purchase insurance on their home or losing significant value from their investments as they become insurable only at extremely high cost.

Moreover, it is possible that building resilient houses in communities that ultimately will have to retreat from climate impacts—by floodwaters or storms—will ultimately be counterproductive. If the increased investment encourages homeowners to “stay put” and ask for governmental assistance to protect their investment, the goal of building adaptive capacity will be thwarted.

The second type of insurance product that facilitates adaptation provides capital to cope with catastrophes after the fact. The products are more readily available, but still not robust. Insurance-linked securities and similar instruments, discussed above, are examples of this type of product.

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191. Kunreuther, *supra* note 18, at 174–76, 180–81.

192. Kunreuther & Pauly, *supra* note 136, at 110.

These insurance arrangements are intended to bring needed capital that will reduce the risk posed by future climate-related hazards to those who are most likely to be in peril. For example, insurers collaborating with international NGOs have developed microinsurance and weather derivative products to protect rural communities in developing countries against drought, crop failure, and other weather-related catastrophe.<sup>193</sup> And the Caribbean Catastrophe Risk Insurance Facility (CCRIF) will provide immediate capital to Caribbean governments that are hit with a natural disaster, through a risk-transfer instrument paid for by the participating governments.<sup>194</sup>

These products have been identified by researchers as adaptation-oriented because they help to build the capacity of nations, communities, and businesses to cope with climate change's impacts.<sup>195</sup> But these products may also discourage preventive adaptation. The buyer of such a product, whether in the public or private sector, may take fewer steps to mitigate future losses as a result of the security associated with the ILS. This type of insurance product thereby creates a moral hazard problem, increasing policyholders' incentives to do nothing to adapt.

In order for these products to be most effective, they must be accompanied by measures that will provide incentives for the purchasers to take real steps to increase climate resilience. So, for example, requiring the purchasers of these products to undertake loss-prevention measures, such as growing crops that are inherently less vulnerable, or growing them in areas that are less vulnerable geographically, would reduce insurers' uncertainty and at the same time lower the risk of catastrophic loss by insurance purchasers.

### C. Insurers as Market Facilitators

Insurers also play a crucial role in reducing risk and attracting financing for new ventures. New products and services relating to alternative energy development, carbon offset projects, and other relatively recent commercial enterprises are central to addressing climate change, but many are untested both technically and financially. As a result, insurers are already involved in managing risk associated with these new products and services. This is in general an area of great opportunity for insurers to help to create climate change solutions.

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193. Maynard, *supra* note 1, at 144.

194. *Id.*

195. MILLS, *supra* note 9, at 18.

For instance, energy is a capital- and risk-intensive industry: investments in alternative energy development are fraught with both direct financial risk and regulatory risk.<sup>196</sup> Other solution-oriented technologies such as carbon sequestration, hybrid vehicle development, and biomass energy production also involve risk.<sup>197</sup> These risks can include technical perils such as machinery breakdown and construction risk, failure of credit, business interruption, political risk, and the impact of harsh weather on the projects. Carbon emissions reduction projects, such as those that operate under the Kyoto Protocol's Clean Development Mechanism (CDM) and Joint Implementation, also require innovative insurance arrangements. These projects involve contracts that promise future reduction of greenhouse gas emissions.<sup>198</sup> They run financial and regulatory risk, including design, operational, financial, performance, and political risks that may cause them to fail to provide the promised level of greenhouse gas reduction.<sup>199</sup> Understandably, lenders demand protection against these risks.<sup>200</sup>

Insurers can reduce dramatically the downside risk of new ventures, allowing new technologies to develop. Innovative models can assist companies in projecting risk and return in order to optimize the use of insurance.<sup>201</sup> In this context, insurers play a crucial role in enabling these important technologies to flourish. Insurers are providing capital and risk management services to alternative energy enterprises<sup>202</sup> and CDM projects,<sup>203</sup> facilitating the development of new alternative energy markets as well as carbon offset markets.

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196. Emmanuel Leblanc, *Challenges of the Renewable Energy Industry Generate New Demands for Risk Advisory: How to Value an Insurance Package From a Financing Perspective?*, 33 GENEVA PAPERS 147, 148-49 (2008).

197. Maynard, *supra* note 1, at 143.

198. Guzy, *supra* note 80, at 558; Michael Wara, *Measuring the Clean Development Mechanism's Performance and Potential*, 55 UCLA L. REV. 1759 (2008).

199. See Wara, *supra* note 198; Leblanc, *supra* note 196, at 150; see also Ins. Bus. Rev., Zurich Provides Political Risk Insurance for Carbon Credit Projects (February 21, 2008), available at [http://www.insurance-business-review.com/article\\_news.asp?guid=7A182C83-34FD-4EEA-9466-0D3716F16D6A](http://www.insurance-business-review.com/article_news.asp?guid=7A182C83-34FD-4EEA-9466-0D3716F16D6A) (discussing the Zurich Financial Service Group's new product that "helps to protect against risk of host government actions that might prevent an investor from receiving benefits associated with emission credits generated").

200. Leblanc, *supra* note 196, at 150.

201. *Id.*

202. *Id.*

203. These projects "run the risk that they will not deliver the greenhouse gas reduction they were expected to; and if CDM credits have been sold there is a liability to deliver. This can discourage capital providers supporting such products. Swiss Re has teamed up with RNK capital to provide insurance against this risk, a good example of using [the insurance industry's] core industry skill to promote mitigation." *Id.* at 143. Zurich Financial Services Group provides similar protection against governmental actions that may put a project at risk. *Supra* note 199.

The supply and demand side barriers identified above do not generally apply to these products. Insurers will directly reap the benefits—current revenue—by insuring these products. Many of these products have specific design and engineering features whose risk characteristics can be evaluated. And the products' investors and creators will be motivated to purchase whatever insurance is necessary—at the right price—to allow the products to be developed effectively and for their investment to be protected. As these products develop, insurance offerings will continue to evolve to spread the risk of designing, manufacturing, marketing, and operating them.

These actions by insurers surely constitute significant work to address climate change. To the extent that insurers see business opportunities in assisting with the development of innovative products and services in this area, their efforts will continue to be an important part of the solution. Nonetheless, the ability of insurers to fund this work profitably at a level and price that provides incentives for new ventures to thrive will depend significantly on government efforts to develop measures that deter carbon-based fuel production and support markets in carbon sequestration and offset projects. The less speculative the ventures, the more insurable they will be.

## V. THE INFLUENCE OF REGULATORS, RATING AGENCIES, AND OTHER THIRD PARTIES ON INSURANCE PRODUCTS

In addition to insurers, their customers, and reinsurers, other third parties significantly influence insurers' products and pricing. Among these third parties are governmental insurance regulators, which provide oversight over insurers' underwriting and investment practices; rating agencies, which evaluate insurers' financial strength; and other nongovernmental organizations, including investors and organizations that advocate for corporate social responsibility, which promote various interests through shareholder and public pressure. Each of these stakeholders influences insurers' behavior in the context of climate change.

### A. Domestic Insurance Regulation

With few exceptions, the U.S. insurance industry is regulated at the state level.<sup>204</sup> The goals of insurance regulators are generally consumer oriented, balancing protections for current and future policyholders against

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204. See McCarran-Ferguson Act, 15 U.S.C. § 1012 (2000) (allowing the regulation of insurance practices by "the several states").



the need for insurers to earn a reasonable profit in order to keep the industry robust. The general objectives of regulators are ensuring that insurance is available and offered at a fair price, protecting insurance company solvency (which protects insurers as well as policyholders from the possibility of failing to make good on their insurance contracts), and preventing unfair practices by insurance companies.<sup>205</sup> Admitted insurers are regulated for solvency and rates, nonadmitted carriers that write policies in U.S. jurisdictions are regulated only for solvency. Major surplus insurers operating in the United States, such as Lloyd's, are domiciled and regulated in Europe, and thus are not subject to premium regulation in the United States. But they are nonetheless subject to U.S. solvency regulation to the extent they write policies in the U.S.<sup>206</sup>

None of the goals of insurance regulation is necessarily aligned with addressing climate change in the short term. For example, there are contexts in which sending an accurate price signal about a risky behavior will cause serious hardships to some policyholders, motivating insurance regulators to require insurers not to fully incorporate this risk in pricing insurance. For example, if homeowners who own coastal property were suddenly to find themselves without the ability to purchase insurance at an affordable rate because of storm risk, they would have to remain uninsured, with possibly significant consequences for the resale of their property as well as for their own financial and emotional security. The lack of availability or affordability of insurance might also have serious consequences for the marketability of the homeowner's property.

Regulators have generally sided with the financial interests of affected policyholders in situations where affordability or availability of insurance is threatened, limiting insurers' ability to charge purely risk-based premiums. This practice is understandable as a means of protecting less affluent

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205. Susan Randall, *Insurance Regulation in the United States: Regulatory Federalism and the National Association of Insurance Commissioners*, 26 FLA. ST. U. L. REV. 625, 629 (1999). For a comprehensive discussion of state insurance regulation in the context of catastrophic risk, see WHARTON RISK MANAGEMENT AND DECISION PROCESSES CENTER, *supra* note 24, at 32–48.

206. Some commentators believe that foreign insurance regulation may be more well-adapted than U.S. regulation to the task of assisting insurers with overcoming obstacles to addressing climate change risks. See, e.g., ROBERT W. KLEIN & SHAUN WANG, *CATASTROPHE RISK FINANCING IN THE US AND THE EU: A COMPARATIVE ANALYSIS OF ALTERNATIVE REGULATORY APPROACHES* (2007). Insurance regulators in other countries often take a different approach to regulation than U.S. regulators. A discussion of non-U.S. insurance regulation is outside the scope of this Article. For in-depth discussions of Europe's approach to solvency regulation, see generally Martin Eling, Hato Schmeiser & Joan T. Schmidt, *The Solvency II Review Process: Overview and Critical Analysis*, 10 RISK MGMT. & INS. REV. 69 (2007); Michael Butt, *Insurance, Finance, Solvency II and Financial Market Interaction*, 32 GENEVA PAPERS 42 (2007).

consumers from distributional impacts, especially given the political realities faced by insurance regulators. But it often results in a subsidy to some consumers who make riskier choices, and contributes to an environment in which admitted insurers cannot charge high enough premiums, which sends an inaccurate risk signal to policyholders or, even worse, motivates insurers to withdraw from markets entirely. For example, according to a recent report cosponsored by a major insurer and an international environmental protection advocacy group, “some insurers are withdrawing from high-risk coastal locations in Florida, or the state as a whole, in part because regulators are preventing them from raising rates to reflect the increasing risk, thus hampering the market’s ability to send price signals to consumers that would begin to educate the public on the perils of building along exposed coastlines or fire-prone areas.”<sup>207</sup> Indeed, the largest insurer of homes in Florida today is the Citizens Property Insurance Corporation, an “insurer of last resort” created by the state in order to deal with the consequences of hurricane-related risk.<sup>208</sup>

Given the importance of climate change to long-term affordability and availability of insurance, as well as insurer solvency, the National Association of Insurance Commissioners (NAIC) has undertaken a serious study of how climate change might be addressed by insurance regulators. In 2006, the NAIC created a Climate Change and Global Warming Task Force.<sup>209</sup> This task force recently issued a white paper examining the impacts of climate change on the property/casualty and health insurance sectors.<sup>210</sup> The report tentatively proposes several possible ways in which insurers might respond to these impacts, including promoting research, disclosure, and action on the relationship between climate change and long-term solvency; requiring disclosures specifically on insurers’ plans to handle catastrophe risk; and supporting insurance products that encourage sustainable development.<sup>211</sup> The NAIC recently released a draft set of reporting requirements that would require insurers to report information about their practices in the areas of emissions disclosure and emissions management, strategic analysis of

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207. ALLIANZ GROUP & WWF, *supra* note 128, at 31; *see also* Letter From Robert Detlefsen, *supra* note 128 (criticizing insurance regulators for impeding insurers’ ability to price according to risk).

208. Guzy, *supra* note 80, at 558.

209. *See* Nat’l Ass’n of Ins. Comm’rs Climate Change & Global Warming (EX) Task Force, The Potential Impacts of Climate Change on Insurance Regulation (May 28, 2008), *available at* [http://www.climateandinsurance.org/news/080528\\_NAICdisclosure.pdf](http://www.climateandinsurance.org/news/080528_NAICdisclosure.pdf).

210. *Id.*; *see* Nat’l Ass’n of Ins. Comm’rs, Climate Change Study Focuses on Insurance Impact (June 2, 2008), *available at* [http://www.naic.org/Releases/2008\\_docs/climate\\_study.htm](http://www.naic.org/Releases/2008_docs/climate_study.htm) [hereinafter NAIC Impact].

211. *Id.* Notably, the letter, drafted by a committee of state insurance regulators, focuses more concretely on actions that the federal government, rather than state governments, can take to improve insurers’ ability to deal with climate change.

climate risks, regulatory risks, and physical risks.<sup>212</sup> Nonetheless, the NAIC has not yet addressed the perverse incentives created by inaccurate price signals and other consequences of regulators' focus on affordability and availability.<sup>213</sup>

Some representatives of the regulated insurance industry argue that insurance rates should be essentially unregulated. They suggest that a free market would provide the proper prices and incentives to deter climate-unfriendly behavior that poses high actuarial risk, such as building housing in areas at significant risk of insured hazards.<sup>214</sup> Some researchers have expressed similar concerns, concluding that regulation often does more harm than good.<sup>215</sup> Critics of U.S. insurance regulatory policy have also focused on the strict rules that insurers must follow in their investing and raising capital, concluding that U.S. insurance solvency regulation and taxation policies often discourage development of innovative methods of financing catastrophe risk.<sup>216</sup> If so, the affected insurers will be less able to adapt to the need to address catastrophe risk through creative financing as that risk becomes more severe.

Insurance regulators point to the important role they have played in ensuring that insureds are treated fairly in the face of the potential for abusive conduct by insurers, and in maintaining solvency requirements for the protection of consumers and insurers.<sup>217</sup> Some scholars have pointed out that deregulation would have significant potential implications for equity, economic growth, and other important socioeconomic issues.<sup>218</sup>

Regulators may indeed have a significant role to play in attempting to change their regulatory structure to promote incentives to properly incorporate risk. If they do not do so, they will not only sacrifice the long-term health of the insurance industry, but may impede opportunities

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212. NAIC Climate Change and Global Warming (EX) Task Force, Climate Risk Disclosure Proposal (May 28, 2008), available at <http://www.climateandinsurance.org/news/080604NAIC.pdf>.

213. NAIC Impacts, *supra* note 210.

214. Letter From Robert Detlefsen, *supra* note 128 (“[U]sing disclosure requirements to pressure insurance companies into adopting a particular agenda for combating global warming is a flawed approach to addressing the challenges proposed by large-scale catastrophic risk. . . . [Instead, the white paper should examine] the role that regulation often plays in distorting insurance markets and thereby increasing the risk of property loss and human suffering in disaster-prone regions.”).

215. See, e.g., Grace & Klein, *supra* note 128, at 28.

216. KLEIN & WANG, *supra* note 206, at 27–44.

217. NAT'L ASS'N OF INS. COMM'RS, STATE REGULATION: BUILT TO LAST 408 (2007), available at [http://www.naic.org/documents/about\\_2007\\_annual\\_report.pdf](http://www.naic.org/documents/about_2007_annual_report.pdf).

218. See Kunreuther & Michel-Kerjan, *supra* note 6, at 1842 (“[H]ow should we deal with individuals who have been living in high-hazard areas for some time but cannot afford to pay for higher insurance premiums that reflect the new risk assessment?”).

to help to address climate change where insurers' interests are aligned with climate-friendly practices.

Over time, it is likely that climate change-related risk will have a negative impact on the solvency of insurers if insurers do not take significant steps to adapt to that risk. As a result, regulators should be deeply concerned about how to regulate more effectively to deal with this long-term risk, especially in light of the demonstrated market failures on both the supply and demand sides to address climate change-related risks. Evan Mills has made suggestions on the role that regulators can play to solve some of these problems. These include requiring that insurers conduct enhanced research on climate risk and more robust catastrophe modeling; providing incentives for risk-based pricing in the climate context; promoting climate-friendly insurance products and premium incentives; showing leadership on improving building codes; encouraging or requiring insurers to publicly disclose their own analyses of climate change impacts; and other initiatives.<sup>219</sup>

Regulators can also help to solve some of the supply-side market failures and other barriers identified in this Article as impeding insurers' ability to incorporate climate change considerations into their underwriting. For example, insurers are not motivated to create collective goods, such as a marginal reduction in carbon dioxide emissions from which the insurer cannot obtain a financial benefit, or a reduction in health care costs from accidents where those costs are borne by consumers or other insurers. To the extent that insurance regulators can focus on creating mechanisms to allow insurers to internalize the benefits of these public goods, they will make a significant contribution to addressing climate change. Moreover, the use of tools such as mandatory disclosure of climate risk may motivate insurers to respond to peer pressure (from the competitive practices of other insurers) and market pressure to address climate risks. If so, this type of disclosure can help to overcome some of the barriers to offering insurance products that will help to solve the problem.

While a detailed discussion of the ways in which regulators can address these issues is beyond the scope of this Article, it is worth noting that because regulators exercise considerable power over insurers' practices, they may hold the key to addressing some of the most important challenges discussed in this Article. For example, requiring insurers to write "all risks" policies that spread the risk of multiple types of catastrophes is a regulatory

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219. Evan Mills, *The Role of U.S. Insurance Regulators in Responding to Climate Change*, 26 UCLA J. ENVTL. L. & POL'Y 45 (2008).

action long favored by researchers.<sup>220</sup> To the extent that regulators can help insurers to look towards long-term solvency, adopt creative financing mechanisms for catastrophe risk, and price their products in a way that provides incentives for policyholders to take action to address climate risks, the insurance industry will be better positioned to help to address the risks and uncertainties posed by climate change.

#### B. The Role of Rating Agencies

Rating agencies also play a quasi-regulatory role in the insurance industry. Five independent companies, A.M. Best, Fitch, Moody's, Standard & Poor's, and Weiss, evaluate the financial strength of insurers.<sup>221</sup> These agencies' ratings have a significant impact on insurance companies' ability to market their products and services successfully, because they represent an objective evaluation of insurers' ability to follow through on their commitments.<sup>222</sup> To date, it is unclear whether these rating agencies are specifically focusing on climate change-related risk in evaluating insurers' financial condition. Nonetheless, rating agencies are paying more attention to catastrophe risk generally as a component of insurers' insolvency risk.<sup>223</sup>

Given the fact that the insurance industry itself has identified climate change as a significant issue affecting its future health, rating agencies are likely to be considering climate risk. Their scrutiny could push insurers toward addressing their climate risk exposure as they attempt to retain high ratings. Those companies that have been proactive on climate issues may be better positioned in the future as regulators review their risk portfolios.

#### C. The Role of NGOs Advocating Corporate Responsibility

Nongovernmental organizations advocating corporate social responsibility also may play a significant role in influencing insurers' behavior. These organizations put pressure on companies to engage in environmentally beneficial behavior, through shareholder resolutions, educational campaigns, and adoption of nonmandatory reporting protocols that encourage companies to engage in climate-friendly behavior. Their efforts have pressured

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220. See *supra* note 151.

221. Ins. Info. Inst., How Can I Assess the Financial Strength of an Insurance Company?, <http://www.iii.org/individuals/life/buying/strength> (last visited July 15, 2008).

222. See Michel-Kerjan & Morlaye, *supra* note 112, at 153, 168 ("Rating agencies' influence in the insurance market has soared tremendously").

223. WHARTON RISK MGMT. & DECISION PROCESSES CTR., *supra* note 24, at 152–53 (discussing rating agencies' increased recent attention to catastrophe risk in insurers' portfolios).

insurers to report risk related to greenhouse gas emissions. The goals of some of these organizations include changing business practices on a large scale to address climate change risk.

The Carbon Disclosure Project (CDP), for instance, represents institutional investors that collectively manage \$57 trillion in assets.<sup>224</sup> CDP maintains the world's largest repository of information on corporate greenhouse gas emissions; it has developed its own methodologies for disclosure of this information and has over 3000 corporations participating in its program,<sup>225</sup> including many major U.S. insurers and foreign surplus insurers.<sup>226</sup> Interestingly, U.S. companies tended to provide less robust and less transparent responses.<sup>227</sup>

Institutional investors have also put pressure on insurers. In February, 2008, the Investor Network on Climate Risk, a project of the nonprofit organization Ceres,<sup>228</sup> developed an "Investor Network on Climate Risk Action Plan" that calls on companies to respond comprehensively to climate change-related risk.<sup>229</sup> Forty-nine major institutional investors, including giant CalPERS, signed onto the Action Plan.<sup>230</sup> The signatory investors pledged, among other things, to "[r]equire that our asset managers, consultants, and financial advisors consider climate risks and opportunities," to "[u]rge comprehensive corporate responses to climate risks," to "[h]elp investors evaluate and address corporate climate risks," and to "[e]xpand climate risk scrutiny and collaboration by investors, stock market analysts, and others in the finance sector."<sup>231</sup>

It remains to be seen whether insurers, motivated by pressure from these major investors, are likely to respond to this type of tactic. Nonetheless, it is

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224. Carbon Disclosure Project, About the Carbon Disclosure Project, <http://www.cdproject.net> (last visited May 8, 2008).

225. *Id.*

226. *Id.*

227. MILLS, *supra* note 9 ("With important exceptions, the U.S. responses tended to be superficial compared to those of their peers in other countries, and a larger share of responding U.S. companies declined to have their responses made public.")

228. According to its website, "Ceres (pronounced "series") is a national network of investors, environmental organizations and other public interest groups working with companies and investors to address sustainability challenges such as global climate change." Ceres, About Us, <http://www.ceres.org/NETCOMMUNITY/Page.aspx?pid=415&srcid=705> (last visited July 15, 2008). Its mission is "integrating sustainability into capital markets for the health of the planet and its people." *Id.*

229. Investor Network on Climate Risk, Investor Network on Climate Risk Action Plan (February 2008), <http://www.ceres.org/NETCOMMUNITY/Document.Doc?id=279>.

230. Investor Network on Climate Risk, U.S. and European Investors Tackle Climate Change Risks and Opportunities, <http://www.incr.com/NETCOMMUNITY/Page.aspx?pid=839&srcid=235> (last visited June 16, 2008).

231. Investor Network on Climate Risk, *supra* note 229.

possible that pressure from investors and NGOs will play a significant role in pushing the insurance industry toward more climate-friendly products.

## VI. CAN INSURERS PLAY A QUASI-REGULATORY ROLE?

Private contracting has increasingly been recognized as a significant and potentially effective means of influencing private actors' behavior internationally, and even as an alternative to regulation in some cases.<sup>232</sup> The insurance industry in particular has significant potential to influence the behavior of other market actors through its contracting.<sup>233</sup> It is thus possible that the insurance industry could play an important role in filling regulatory gaps in areas where developing robust regulatory structures is impossible. The industry may be able to fill a governance role on climate change issues, in conjunction with increased disclosure by insurers and a significant role by governments in facilitating behavior by insurers oriented towards solutions to climate change. While it is beyond the scope of this Article to undertake a comprehensive analysis of the potential for insurance products to supplement or substitute for regulation, below is a sketch of the issues raised by this idea.

Firms with significant market power can use contracts and other instruments to achieve broader environmental goals, complementing and in some cases substituting for governmental regulation. Private governance "serves typically governmental purposes (attainment of improved environmental conditions) and plays typically governmental functions (constraining the environmentally harmful behavior of firms)."<sup>234</sup> For instance, in some cases there is a lack of public sector institutions willing or able to address an environmental problem effectively, because of collective action problems or other disincentives for nations to establish effective institutions to address the problem, private governance may be more effective than governmental or intergovernmental action.<sup>235</sup>

In light of its market power, influence, and incentives, the insurance industry is a potentially powerful instrument of private governance to address

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232. For an important recent study of this phenomenon, see Michael P. Vandenbergh, *The Private Life of Public Law*, 105 COLUM. L. REV. 2029 (2005) [hereinafter Vandenbergh, *The Private Life of Public Law*]. See also Michael P. Vandenbergh, *The New Wal-Mart Effect: The Role of Private Contracting in Global Governance*, 54 UCLA L. REV. 913 (2007) [hereinafter Vandenbergh, *The New Wal-Mart Effect*], for an empirical study of the role of supply-chain contracting in environmental governance.

233. See CLIMATEWISE, *supra* note 1, at 10–12; Mills, *supra* note 6.

234. Vandenbergh, *The New Wal-Mart Effect*, *supra* note 232, at 943.

235. See *id.* at 919–21.

climate change. The industry wields enormous market power internationally by serving as a facilitator of new ventures and spreader of risk for new and existing ventures. Its contracts affect individuals and businesses around the globe. And consumers of insurance are often beholden to insurers' unilateral decisions about the pricing and the availability of insurance products (subject to market competition and regulators' dictates). As a result, the industry may provide a structure that facilitates both mitigation of atmospheric greenhouse gases and adaptation to climate change's inevitable impacts. The insurance industry is theoretically well positioned to serve as a quasi-regulator of individual and corporate behavior. It serves as a gatekeeper for individuals and businesses to secure financing for everything from home purchases to sophisticated business ventures.

On the individual end of the spectrum, legal requirements link the ability to undertake certain actions, such as driving automobiles, with insurance; on the business end, corporations' reliance on risk spreading by insurers is essential to global commerce. As a result, as Trevor Maynard of Lloyd's has suggested, the industry may provide a structure that facilitates both mitigation of atmospheric greenhouse gases and adaptation to climate change's inevitable impacts.<sup>236</sup> The industry may also have business incentives to do so.

Overall, the industry seems a likely candidate to have a significant influence on other actors' behavior.<sup>237</sup> For example, Michael Vandenberg has observed that "environmental insurance agreements often create incentives for private parties to play traditional regulatory functions." He cites examples such as premium discounts for environmental compliance, obligations to comply with standards that either mirror or exceed regulatory standards, and monitoring requirements as features of traditional environmental insurance agreements, and notes that these tools influence policyholders' behavior.<sup>238</sup> Other researchers have noted that existing environmental laws contemplate a private quasi-regulatory role for insurers. For example, CERCLA serves a regulatory function, with insurance taking the place of statutes and regulations to identify and assess chemical risks, to provide financial incentives for chemical risk reduction, and to provide efficient deterrence and just compensation for harms.<sup>239</sup>

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236. Maynard, *supra* note 1, at 140–46.

237. Michael Vandenberg, *The Private Life of Public Law*, *supra* note 232, at 2063.

238. *Id.*

239. Katzman, *supra* note 104, at 82.



In order to constitute effective governance, private sector efforts affecting contracting parties must meet two general criteria. First, the private arrangements must be successful, or efficacious, at meeting the governance goals, meaning in this context that they must reduce harm from climate change.<sup>240</sup> Second, the parties must be accountable to those who have a stake in the governance goals.<sup>241</sup> These criteria ensure that the role of democratic government—achieving objectives such as protecting public safety and solving problems of market failure, in a context in which stakeholders are able to witness, criticize, and receive answers to their questions about the regulatory structure and implementation—is not replaced with a system that lacks these essential features.

#### A. Efficacy

In the context of supply chain agreements—contracts between retailers and the manufacturers, wholesalers, and distributors that supply their products—Vandenbergh suggests that “efficacy” in meeting environmental goals requires: first, that private standards be adopted widely in contractual provisions or policies; second, that the standards be substantively adequate to achieve environmental objectives; and third, that the standards be implemented adequately by the other parties to the contract.<sup>242</sup> If these three criteria are met, the private contracts will generally serve the role of a regulating body. These criteria are equally useful in evaluating insurance arrangements’ potential to serve a regulatory function.

Overall, the industry’s incorporation of climate change-related standards into its products is not well developed enough to meet the efficacy criterion. As this Article shows, the industry has both incentives and opportunities to motivate other private actors to address climate change through its products, and has begun to do this in a variety of ways. But there are also significant barriers on both the supply and demand sides to development and market penetration of these products.

Insurers’ incentives are often aligned only incidentally, if at all, with broader societal environmental goals. Based on their own assessment of risks, uncertainties, and opportunities, segments of the industry are likely to react to climate change in ways that do not promote the long-term interests of either the industry or the environment, either by withdrawing from markets

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240. Vandenbergh, *The New Wal-Mart Effect*, *supra* note 232, at 943–44.

241. *Id.*

242. *Id.* at 944.

entirely, by pricing products in ways that reflect uncertainty aversion, or by ignoring climate risk. It remains to be seen whether the industry will embrace climate change as an opportunity, or will attempt to retreat from the challenge because the long-term health of the industry is not accounted for in insurers' reactions.

Moreover, as shown above, governmental regulation of insurance can either facilitate or hinder the potential for private insurance products to perform a meaningful role in shaping private actors' responses to climate change. Insurance regulators must look at the insurance industry's ability to fill society's needs over the long term, taking climate change into account. At the same time, regulators will have to make difficult choices about how to address these needs in the face of short-term crises and distributional impacts that will make it politically and practically challenging to favor policies that support or motivate industry efforts to address climate change. Regulators' ability to meet this challenge will greatly influence insurers' decisions to market products that benefit insurers and policyholders while helping to solve climate change-related problems.

Overall, private insurance contracts are likely to provide significant incentives to engage in behavior that affects climate change one way or the other. Given the influence of the industry on policyholders' behavior, the public sector must work together with the insurance industry both within the United States and internationally to develop partnerships and regulatory relationships that promote sound climate policy while benefiting insurers and policyholders. On the demand side, insurers and regulators will have to overcome the inclinations of individuals and businesses to underinsure against the types of risks that climate change will exacerbate. Unless and until these challenges are overcome, the insurance industry will have limited ability to help society address climate change through its products.

## B. Accountability

Accountability is the second crucial component of an effective governance regime. Vandenberg evaluates accountability by examining whether stakeholders can coerce the actors that are involved in governance into changing their behavior, whether there is enough transparency to facilitate that coercion, and whether the participation in coercion is adequate to

represent enough of the relevant stakeholders' preferences.<sup>243</sup> Based on these criteria, there are significant structural and institutional ways in which the insurance industry and its regulators could be made accountable to stakeholders for its actions. Nonetheless, the industry currently does not have enough accountability to fully legitimize any actions it might take as a form of governance.

Stakeholders have limited but important means to influence the insurance industry. As discussed above, insurance regulators and rating agencies both exercise significant oversight over insurers' activities, leading to disclosure of important information as well as providing an incentive for insurers to operate in a way that satisfies these agencies.<sup>244</sup> Corporate regulators, such as the Securities and Exchange Commission in the United States, also require information disclosure.<sup>245</sup> And nongovernmental organizations such as Ceres and institutional investors have been putting significant pressure on insurers and other financial institutions to incorporate social responsibility on issues such as climate change into their business practices, with considerable success.<sup>246</sup> Major consulting firms and analysts are pushing the industry to address climate risk.<sup>247</sup> Finally, industry leaders such as Lloyd's, Swiss Re, and Munich Re have the potential to influence others in the business. Peer pressure and market pressure to appear consumer friendly, and concern about regulators' and rating agencies' harsh judgments if climate concerns are not addressed, may well drive both admitted and nonadmitted insurers to do more and to be significantly transparent about any work in the climate change area. Both the availability of actuarially questionable climate-friendly products and the rise in voluntary disclosure of climate change-related business liabilities may be indicative of this potential.

Nonetheless, the industry currently does not appear to be accountable to climate stakeholders in a way that warrants viewing insurers as playing a meaningful quasi-regulatory role. Insurers are resisting accountability. For example, domestic insurance trade organizations have been active in calling for a reduced role for insurance regulators, and have

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243. *Id.* at 956–59. Vandenberg discusses and synthesizes alternative models of accountability to arrive at these criteria.

244. See discussion *supra* Parts V.A and V.B.

245. Ross, Mills & Hecht, *supra* note 81, at 266–69.

246. See discussion *supra* Part V.C.

247. See ERNST & YOUNG, *supra* note 5.

strenuously opposed efforts to require increased transparency in the climate change context in particular.<sup>248</sup>

Significantly, regulators' mixed goals and political nature create an enormous challenge for the accountability of the insurance industry for its business practices. Policyholders and politicians want insurance to be affordable and available in the short term, even at the expense of rational assessment of risks. Thus, while insurers may be held accountable for satisfying short-term preferences of consumers and regulators, these preferences are not necessarily aimed at solving climate change overall. Rather, the collective action problems and distributional equity concerns associated with prioritizing climate change may overwhelm incentives to address the problem. Thus, while insurers are accountable to regulators, and regulators are in some sense accountable to the electorate, this accountability does not necessarily support the goal of efficacy in addressing climate change-related impacts.

Overall, insurers should have motivation to use their products to help to address climate change. Tools are available to make insurers accountable enough to justify an important role for the industry in using its products to motivate other private actors to address climate change. It is important that regulators and rating agencies prioritize long-term impacts of climate change and consider possible unintended consequences and perverse incentives that may result from their regulatory policies. Regulators, rating agencies, and other third parties will need to take a larger role to motivate insurers to take account of climate change in their underwriting. They will also need to aggressively work to compile and analyze information about insurers' climate change-related practices.

## CONCLUSION

Climate change has the potential to affect the insurance industry profoundly. Our capital markets' ability to spread risk effectively will depend on insurers' success at adapting to the possibly dramatic impacts of climate

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248. See Letter From Robert Detlefsen, *supra* note 128 ("In our view, using disclosure requirements to pressure insurance companies into adopting a particular agenda for combating global warming is a flawed approach to addressing the challenges posed by large-scale catastrophe risk."); Letter From David Snyder, Vice President and Assistant General Counsel, American Insurance Association, to Mike Kreidler, Chair, Climate Change and Global Warming (EX) Task Force, National Association of Insurance Commissioners (NAIC), Response to Draft NAIC Climate Risk Disclosure Proposal 6 (Jan. 11, 2008), available at [http://www.naic.org/documents/committees\\_ex\\_climate\\_comments\\_from\\_AIA.pdf](http://www.naic.org/documents/committees_ex_climate_comments_from_AIA.pdf) ("Rather than taking further action on fashioning its own, and potentially duplicative and burdensome disclosure process, AIA recommends that the NAIC continue to closely monitor voluntary and SEC-related disclosures by insurers before deciding whether further actions are necessary.").

change, including rising sea levels, heat-related impacts including increased incidence of disease, more severe and erratic weather, and disruption and dislocation of businesses. On the other hand, insurers may be able to create new business opportunities as they seek to make risks insurable, and in doing so they may provide a critical link in addressing climate change's causes and impacts. In order to thrive in a changing environment, the industry will have to become a leader on climate issues, providing incentives and capital that government cannot provide to manage massive risks and to provide more certainty in an environment of increasing risk ambiguity. Insurers also have the potential to influence the behavior of a wide range of individual and corporate actors as they manage climate risk.

So far, despite years of attention to the issue by large European reinsurers, the insurance industry as a whole—and particularly the community of domestic U.S. insurers—has been slow to incorporate climate change in its product development. The industry may continue to attempt to reduce its coverage in areas that it perceives as especially vulnerable to climate-related uncertainty, or may leverage the climate change issue as a means to raise premiums in a way that does not provide the incentives that will be necessary to change behavior. And current regulatory structures and demand-side challenges may hinder insurers' ability to market products aligned with solutions to climate change.

But given the near certainty that climate change will impact most insurable risks over time, insurers will have ample motivation in the long run to continue to find ways to render insurable even those risks that are deeply affected by climate change, and to price these risks accurately. The potential for enormous revenues and industry-threatening losses as a result of climate risk will cause the industry to move toward developing products that align customer incentives more closely with strategies that promote both greenhouse gas mitigation and climate change adaptation. Nonetheless, while examples can be found in the current portfolio of insurance products—consider pay-as-you-drive auto insurance, insurance to reduce the financial risk of developing and marketing Clean Development Mechanism projects, or microinsurance to assist developing countries in managing climate risk—these products are still relatively novel and limited because of supply- and demand-side anomalies and the lack of regulatory initiative on this issue. It is still unclear exactly which types of insurance products will really help to solve the problem in the long run.

If our society is to survive climate change without significant human costs, we must develop robust institutions to manage climate change-related

risk. The insurance industry is the natural place to seek such risk management. If the industry rises to the challenge, it will secure its own future and help governmental and private actors across the globe to cope with the unprecedented and extreme risks that climate change will pose. It will take creativity on the part of insurers, regulators, and third parties with a stake in climate change to determine how the industry can face climate change and accomplish the crucial task of understanding and effectively spreading the risks it poses.