



OLR RESEARCH REPORT

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OLR BACKGROUNDER: IMPLICATIONS OF CLIMATE CHANGE FOR THE INSURANCE INDUSTRY

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SUMMARY

According to *America's Climate Choices*, a 2011 report by the National Academies of Science (NAS):

Climate change is occurring, is very likely caused primarily by the emission of greenhouse gases [GHG] from human activities, and poses significant risks for a range of human and natural systems. Emissions continue to increase, which will result in further change and greater risks.

<http://dels.nas.edu/Report/America-Climate-Choices/12781>

Climate change confronts the insurance industry with risks, uncertainties, and opportunities. Among the risks of climate change are those associated with continued warming and sea level rises, more frequent extreme precipitation events (e.g., downpours and blizzards), and ecosystems changes, including those that may affect human health. At the same time, the industry will deal with substantial uncertainties, such as the relationship between climate change and tropical storms and how governments, businesses, and individuals will respond to climate change. Climate change presents the insurance industry with opportunities for new markets for a variety of products and related services, some of which are currently being offered. However, the bulk of

market activity is in Europe, primarily from property and casualty insurers. And even among these firms, the offerings and overall market penetration are limited.

The Department of Energy's Lawrence Berkeley Laboratory (LBL) has a website on the implications of climate change for the insurance industry, <http://insurance.lbl.gov/>, which is the source of much of the information in this report. The Insurance Information Institute also has a website on climate-related issues for the industry, http://www.iii.org/issues_updates/climate-change-insurance-issues.html.

OBSERVED CHANGES IN CLIMATE

There is a broad scientific consensus that the Earth is warming and other climate changes are occurring, and that these changes are primarily due to human activity. In 2007, the International Panel on Climate Change (IPCC) issued a report that stated:

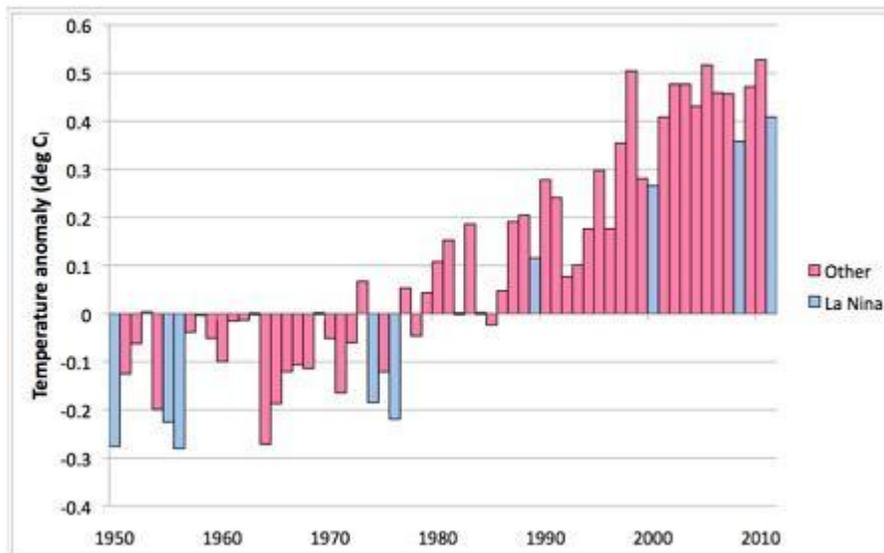
Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level ... Most of the observed increase in global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic [man-made] GHG concentrations (http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf, emphasis in original - IPCC uses "very likely" to mean a 90% or better probability).

In 2009, the national science academies of 13 countries, including the United States, Canada, China, Great Britain, Japan, and Russia, found that "climate change is happening even faster than previously estimated; global CO₂ emissions since 2000 have been higher than even the highest predictions, Arctic sea ice has been melting at rates much faster than predicted, and the rise in the sea level has become more rapid." www.nationalacademies.org/includes/G8+5energy-climate09.pdf.

The 2011 NAS report noted that observations of surface temperature assembled and analyzed by several different research groups show that Earth's average surface temperature was 1.4°F warmer during the first decade of the 21st century than during the first decade of the 20th century, with the most pronounced warming over the past three decades. These data were corroborated by independent observations that indicate warming in other parts of the Earth, such as the lower atmosphere and the oceans.

According to a 2011 [World Meteorological Organization](#) report, 2010 was tied for being the hottest globally since records began being kept in the 19th century. In addition, 2011 is set to become the 10th hottest year on record. The report also notes that 13 of the warmest years on record in terms of average global temperature have occurred within the past 15 years. Measures of Arctic sea ice this year show its area is the second lowest on record, and its volume is the lowest. Figure 1 shows the trend in global average temperatures since 1950. The bars in blue are years, including 2011, when the *La Niña* weather phenomenon occurred. These years tend to be cooler, on average, than other years but they have also been getting warmer over time.

Figure 1: Global Average Temperature 1950-2011



Source: World Meteorological Organization, [Provisional Statement on the Status of the Global Climate](#) (2011)

These trends are more noticeable in areas located closer to the poles than the equator, including the United States. According to a 2009 report by the federal interagency Global Change Program, [Global Climate Change Impacts in the U.S.](#):

1. average air temperature increased in the United States by more than 2°F over the past 50 years, and total precipitation increased on average by about 5%;
2. sea level has risen along most of the U.S. coast, eroding shorelines, drowning wetlands, and threatening the built environment;
3. there have been widespread temperature-related reductions in snowpack in the northeastern and western United States over the last 50 years, leading to changes in the seasonal timing of river runoff; and
4. precipitation patterns have changed, with heavy downpours becoming more frequent and more intense.

While a 2°F increase may seem modest, it is the difference between the historical average annual temperature in Hartford, Connecticut compared to Buffalo, New York.

Natural factors, such as variations in incoming energy from the sun, cannot explain the recent global warming trend. Natural climate variability, such as the El Niño/La Niña cycles, does however lead to substantial changes from year to year.

While most of the public debate on climate change has focused on average temperatures, IPCC and other climate research organizations have found an increasing trend of extreme weather and climate events. The rise in yearly temperatures contributes to extreme weather events like droughts, heat waves, and heavy precipitation. As discussed below, these extreme events are of particular relevance to the insurance industry.

PROJECTED CLIMATE CHANGE

The 2007 IPCC report stated:

Continued GHG emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century ... Altered

frequencies and intensities of extreme weather, together with sea level rise, are expected to have mostly adverse effects on natural and human systems.

A 2011 [IPPC report](#) stated that it is very likely that the length, frequency, and intensity of heat waves will increase over most land areas. If GHG emissions continue at their current rate, it is likely that temperatures typically now reached once every 20 years will occur every other year by the end of this century.

We have not found any projections of climate change specific to Connecticut, but a 2009 [study](#) of climate in the greater New York City metropolitan region (which included much of Connecticut) projects that average annual temperatures will increase an additional 1.5° to 3° F by the 2020s, 3° to 5° F by the 2050s, and 4° to 7.5° F by the 2080s. The study, which used the IPCC models, also projects further increases in sea level and in the frequency and intensity of extreme weather events. The models used in the report project that there will be 29 to 45 days per year when the temperature exceeds 90° F by mid-century and 37 to 64 such days by the end of the century, compared to the current average of 14 days per year.

INSURANCE INDUSTRY ISSUES

The Insurance Information Institute (www.iii.org) states that:

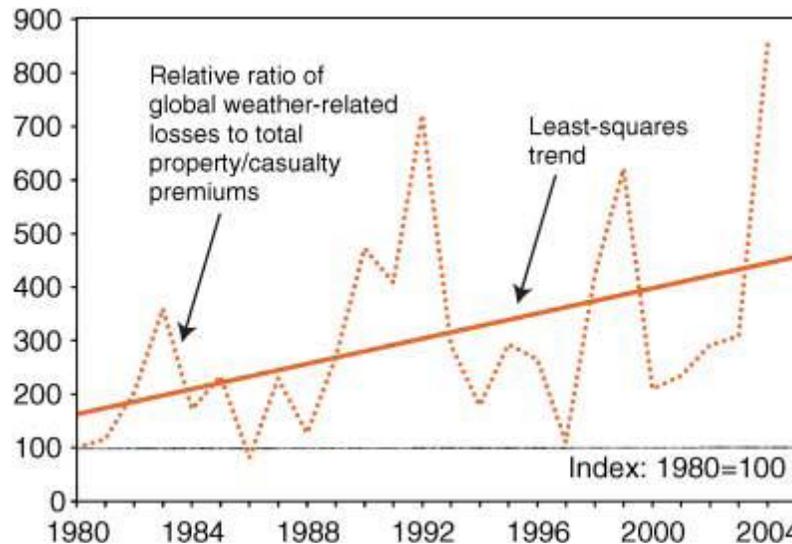
Global warming has the potential to affect most segments of the insurance business, including life insurance if rising temperatures lead to an up-tick in death rates. Property losses of all kinds are most likely to increase, and there is the potential for much higher commercial liability losses if shareholders and consumers try to hold businesses responsible for changes to the environment.

It observes that as assumers of property and liability risk, insurers seek to mitigate potential losses through risk management. Since climate change could lead to losses on a scale never before experienced, insurers are not waiting for researchers to produce all the answers.

Globally, weather-related insured losses in recent years have been increasing much faster than population, inflation, or losses due to other events. Figure 2 describes the relationship between weather-related losses and total property and casualty premiums for the period 1980 through 2004. There was a great deal of variability from year to year, largely due to the effects of catastrophic events, such as hurricanes and

droughts. Nonetheless, the trend (the orange line in the figure) is steadily increasing over time. A subsequent report found that worldwide economic losses from weather-related natural disasters were about \$130 billion in 2008 (of which \$44 billion was insured) and the losses have continued to rise more quickly than population or inflation.

Figure 2: Relationship between Premiums and Weather-Related Losses



Source: E. Mills, "Insurance in a Climate of Change," *Science* 309, August 12, 2005

Most of the growth in weather-related losses was due to increased exposure unrelated to climate change, including increased property values and demographic trends, such as the migration of people towards coastal areas that are prone to hurricanes. However, changes in the incidence and impacts of extreme weather events and sea-level rise have also contributed to this trend.

Risks

The climate changes projected by IPCC and others will have both positive and negative impacts on the risks the insurance industry covers. For example, the warming observed in recent decades has been particularly pronounced in the winter. In the northeast, the 4° F average increase in winter temperatures since 1970 has been twice the increase in the year-round average. Assuming this trend continues, precipitation will tend to fall more frequently as rain than snow, reducing risks for vehicles. Warmer winters will also lead to reduced mortality from decreased cold exposure. (As discussed below, climate change may open a wide variety of opportunities for insurers.)

However, a 2007 [study](#) by the U.S. Government Accountability Office found that climate change also poses potentially significant risks to insurers in coming decades. It noted that extreme weather events pose a unique financial threat to insurers' financial success because a single event can cause insolvency or a precipitous drop in earnings, liquidation of assets to meet cash needs, or a downgrade in the market ratings. The insurance industry has a stake in climate change because increased climate change-related risk in the future may change its underwriting practices, possibly causing premiums to rise and limiting the insurability of properties.

The federal Global Change Program made climate projections for the Northeast in its 2009 report, [Global Climate Change Impacts in the U.S.](#) In particular, the report projects that severe flooding due to sea-level rise and heavy downpours is likely to occur more frequently and the densely populated coasts of the Northeast face substantial increases in the extent and frequency of storm surges, coastal flooding, erosion, property damage, and loss of wetlands.

A 2011 [study](#) of climate change by the New York State Energy Research and Development Authority found that the state is already experiencing impacts as a result of climate change, and impacts are projected to increase with further warming. Of relevance to the insurance industry, the study stated that:

Projected higher average annual precipitation and frequency of heavy precipitation events could also potentially increase the risks of several problems, including flash floods in urban areas and hilly regions; higher pollutant levels in water supplies; inundation of wastewater treatment plants and other vulnerable development in floodplains saturated coastal lands and wetland habitats; flooded key rail lines, roadways, and transportation hubs; and travel delays ... Sea level rise will increase risk of storm surge-related flooding, enhance vulnerability of energy facilities located in coastal areas, and threaten transportation and telecommunications facilities.

In its 2010 report, [*Climate Change Adaptation in New York City: Building a Risk Management Response*](#), the New York City Panel on Climate Change noted that any increase in the frequency or intensity of weather-related catastrophic events will increase insurance risk and directly affect property and casualty premiums. For New York City, the primary near-term risk from weather-related disasters is coastal flooding from nor'easters. In the future, storm surges from nor'easters and hurricanes will be exacerbated by already ongoing sea level rise.

Climate change poses risks for health and life insurers as well as property and casualty insurers. The premise of a [2005 study](#) by the Center for Health and the Global Environment at Harvard Medical School was that climate change will affect the health of humans as well as the ecosystems and species on which we depend, and that these health impacts will have economic consequences. The insurance industry may be asked to both absorb risk and help business and society adapt to and reduce these new risks through its pricing policies and recommendations. Among the report's key findings are that (1) warming favors the spread of disease; (2) extreme weather events create conditions conducive to disease outbreaks; and (3) climate change and infectious disease threaten wildlife, livestock, agriculture, forests, and marine life that constitute human life-support systems.

The 2009 report by the federal Global Change Program anticipates that extreme heat and declining air quality will likely pose increasing health problems, especially in urban areas. By late this century, cities that currently experience a few days above 100°F each summer would average many more, nearly 30 such days in Hartford. In addition, cities that now experience air quality problems would see those problems worsen with rising temperatures, if no additional controls were placed on ozone-causing pollutants. The New York City panel's 2010 report states that projected future climate changes will affect life and health insurance, as global changes in precipitation and temperature will shift the distribution of infectious diseases.

The New York City panel noted that climate change poses a unique risk-related challenge for the insurance industry as a whole. The physical systems that affect climate (e.g., transfers of heat between the atmosphere and oceans), are highly resistant to change. At the same time, most GHGs remain in the atmosphere for decades. As a result, there is a lag of several decades between changes in GHG concentrations in the atmosphere and the resulting changes to climate. These lags make it difficult to project the timing and magnitude of climate change impacts far into the future. In addition, trends in GHG emissions are difficult to predict, yet these future emissions significantly shape the magnitude and

timing of future climate change impacts. Thus, there is a mismatch between the term of insurance policies (commonly one year) and the period over which climate changes (decades to centuries). At this time, insurers do not have enough information to justify raising premiums today to reserve for possible future increases in climate change-related risk.

Litigation is another type of risk associated with climate change. The Insurance Information Institute notes that shareholders or consumers may file lawsuits against a business for actions or inactions that could harm the environment. In addition, shareholder lawsuits may target a company for failing to disclose important information that could materially affect its financial health and thus influence shareholder investment decisions.

Some of the risks associated with climate change are international in nature. A 2009 [report](#) by Lloyd's International Institute for Strategic Studies argues that "the greatest early impact of global warming will be on food supply, which even now is barely adequate to meet demand in many regions of the world ... As arable land becomes scarcer, the probability of state failure and conflict between states is likely to increase." Similarly, climate change is likely to alter rainfall patterns, with some areas getting significantly drier. Lloyd's believes that, as a result, water will become a scarce and expensive commodity in many countries and in some parts of the world it could become a source of inter-state conflict.

Uncertainties

There are at least three types of uncertainties that affect the insurance industry regarding climate change. The first is uncertainty about aspects of climate change. While most scientists agree on the basics of climate change, there are many unresolved data and modeling issues. The 2011 NAS report notes that "uncertainties in projecting future greenhouse gas emissions and in estimating the sensitivity of the climate system to greenhouse gases make it difficult to project the exact severity, location and timing of climate change impacts." Similarly, a [2011 IPCC report](#) notes that, because extreme events are rare there are few data available to measure changes in their frequency or intensity. This is particularly true for events such as droughts, for which the historic data are less reliable than for temperature trends. The report also states that there is low confidence in data trends over the last 40 years in the intensity, frequency, and duration of tropical storms, after

accounting for past changes in observing capabilities. In addition, current climate models cannot simulate the smaller scale processes that drive some extreme events, such as severe storms and flooding, that are needed for insurance industry catastrophe models.

There is also uncertainty in global climate models regarding basic scientific relationships, such as the dynamics of melting of land ice sheets. According to the National Aeronautics and Space Administration (<http://climate.nasa.gov/>), one of the nation's leading organizations for climate change, another area of uncertainty is how climate is affected by clouds, which reflect about one third of the total amount of sunlight that hits the Earth's atmosphere back into space. Similarly, the impact of aerosols (dust, smoke, and soot), which come from human and natural sources, is not fully understood. Different types of aerosols have very different effects on climate, with some causing heating while others cause cooling.

More generally, there are questions about the carbon cycle. Natural processes remove about half of each year's human carbon dioxide emissions from the atmosphere. According to the IPCC, it is not well understood where this carbon dioxide goes. There is some evidence that Earth's ability to continue absorbing carbon dioxide may decline as it warms, leading to faster accumulation in the atmosphere. But this possibility is not well understood either.

A second type of uncertainty is how governments and other entities will respond to climate change. Internationally, the Kyoto protocol will expire in 2012. The United States did not sign this treaty, which seeks to stabilize GHG concentrations in the atmosphere at a level that would prevent dangerous impacts on the climate. The treaty did not require GHG emission reductions from developing countries, several of which have become major emitters, and actual GHG concentrations have been rising. Negotiations on developing a successor treaty are on-going, but it is unclear what, if any, binding emission reduction mechanism will be developed and whether it would be approved by the United States and other major GHG emitters.

In the absence of national initiatives, a number of states and localities have taken steps to reduce GHG emissions, adapt to the projected changes caused by climate change, or both. In 2008, Connecticut became one of a handful of states to require GHG reduction targets. [PA 08-98](#) calls for emissions to be reduced by 10% below 1990 levels by 2020 and 80% below 2001 levels by 2050. The northeastern states, including Connecticut, participate in the Regional Greenhouse Gas Initiative (www.rggi.org), which is a cap and trade program to reduce carbon dioxide emissions from power plants. California is implementing a similar program, which will include other GHG sources.

In addition to these efforts to reduce GHG emissions, a number of states and municipalities have adopted initiatives to adapt to changes brought about by climate change. In Connecticut, the Governor's Steering Committee on Climate Change established an Adaptation Subcommittee, which submitted its [report](#) to the legislature in 2010. OLR Report [2010-R-0337](#) discusses the subcommittee's findings. In New York City, the city's comprehensive sustainability plan includes GHG mitigation and climate change adaptation measures. It is uncertain at this point the extent to which these mitigation and adaptation initiatives will reduce risks associated with climate change. Adaptation plans have been developed in areas as diverse as Louisiana and South Boston.

A third type of uncertainty is who will be held responsible for insurance claims arising from climate change. On September 16, 2011 the Virginia Supreme Court [ruled](#) in favor of an insurance company in what may be the first case on whether insurers are liable for claims arising from climate change (*AES Corp. v. Steadfast*). The court unanimously ruled that an Alaska Native village's claims against AES Corp. (an energy company) were not covered by AES' liability insurance carrier, Steadfast Insurance Company. In the decision, the court held that the alleged "damages [the plaintiff] sustained were the natural and probable consequences of [the policyholder's] intentional emissions." Accordingly, because the injury alleged did not arise from an accident or occurrence, there was no possibility of coverage and, therefore, no duty to defend. On the other hand, the decision did not address whether carbon dioxide and other GHGs may fall within the ambit of "pollutants" for purposes of standard-form "absolute" pollution exclusions. These exclusions, originally intended to exclude coverage for Superfund liability, are often raised as a coverage defense when allegedly toxic substances are involved. The pollution exclusion was one of the defenses raised in this case in the lower court, but was not an issue on appeal.

As noted above, weather-related insurance losses have been increasing in recent years. Evan Mills, an LBL scientist who has written extensively on the effect of climate change on the insurance industry, argues that regardless of the relative weights of climate change and increased exposure in causing this increase, rising uncertainty will complicate the actuarial and pricing processes that underlie well-functioning insurance markets.

Opportunities and Industry Response

Climate change has led the insurance industry to offer new products and services and provides opportunities for further growth. A 2008 [review](#) prepared by Mills for Ceres (a consortium, of environmental groups, businesses, and public interest groups) found 643 specific activities related to climate change involving 244 insurance entities from 29 countries. The activities involved 189 insurers, eight reinsurers, 20 intermediaries, and 27 insurance organizations. Property (commercial, home, and vehicle) insurance companies are responsible for most of the activity, while life and health insurers have undertaken a few initiatives.

Some of the more common insurance products designed to reduce GHG emissions are:

1. products tailored to the renewable energy markets, providing insurance and risk management for all aspects of renewable energy deployment from construction to delivery;
2. insurance specifically tailored for green buildings or to encourage property owners to upgrade to green building specifications in the event of a loss); and
3. pay-as-you-drive insurance that provides a financial incentive for driving less.

A number of companies are also getting involved in the carbon markets, both in carbon trading, in offering insurance to protect buyers of carbon credits against seller insolvency, and carbon credit delivery insurance, for both the purchaser and supplier of credits. There are also products that bundle carbon credits along with the coverage, such as carbon neutral auto policies.

Two insurers, Zurich and Liberty Mutual, have introduced directors and officers' coverage specifically tailored to address liability risks associated with climate change. Other companies are beginning to offer products providing insurance against climate change litigation, addressing the risks specific to carbon capture and storage, and insuring the deployment and operation of electric vehicles.

The 2007 GAO study found that many large insurers were incorporating climate change into their risk management practices. Some already factor climate change into their models for measuring, pricing, and distributing risk. Swiss Re, the second-largest reinsurer, is developing scenarios using probabilistic modeling to help government officials cope. The reinsurer has studied the effects of climate change in vulnerable areas, such as Miami and tropical islands.

Major insurance and reinsurance companies, such as Allianz, Swiss Re, Munich Re, and Lloyds of London, have published reports that advocate increased industry awareness of the potential risks of climate change and outline strategies to address the issue. Some companies have evaluated climate risks to investments in individual companies and disclosed information to shareholders about company-specific risks due to climate change. Some insurers have pushed for stricter building codes and more resilient materials in catastrophe-prone zones. An industry group, the Institute for Business and Home Safety, has worked with the federal Alliance for Safe Homes to promote and market FORTIFIED, a program to designate buildings that exceed building codes and are less subject to climate risks.

However, the insurance industry's level of activity should not be overstated. In 2009, the National Association of Insurance Commissioners (NAIC) adopted a resolution requiring insurance companies with annual premiums of \$500 million or more to disclose publicly to regulators the financial risks they face from climate change, as well as actions they are taking to respond to those risks. NAIC subsequently allowed states to make the filings private and a number of states declined to require insurers to file. A 2011 [analysis](#) by Ceres of insurer responses to a climate change survey [shows](#) that only one in eight insurers that responded has a formal climate policy.

Mitigating GHG emissions and creating a "low carbon" economy may lead to further opportunities to provide new or expanded insurance and risk management products to help deploy technological solutions, such as low carbon fuels, carbon capture and storage (i.e., trapping and sequestering the GHGs from burning fossil fuels), energy efficiency, and sustainable land-use and forestry practices.

The industry may also help insureds and governments adapt to climate change. Among other things, it could:

1. help maintain long-term insurability and provide incentives for adaptation through risk-based premium pricing;
2. use insurance risk-evaluation tools (e.g., catastrophe models) to help policymakers and other better understand and assess the financial implications of climate change;
3. encourage research aimed at making global climate models more useful to insurance underwriters and adaptation planners; and
4. provide educational information on climate change–related risks and increase awareness among customers.

Further information about the potential opportunities for insurers associated with climate change is available at <http://insurance.lbl.gov/opportunities/risk-to-opportunity-2008.pdf>

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