

MANAGING THE ESCALATING RISKS OF NATURAL CATASTROPHES IN THE UNITED STATES

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This report was produced by the International Regulatory Affairs and Exposure Management departments at Lloyd's. Lloyd's Exposure Management team is responsible for understanding and managing market aggregation risks and alerting the market to emerging risks. Lloyd's International Regulatory Affairs team is responsible for managing international regulatory compliance and supervisory environment risk to deliver a competitive trading position for Lloyd's.

KEY CONTACTS

Sean McGovern
Tel: 020 7327 6142
Sean.McGovern@lloyds.com

Trevor Maynard
Tel: 020 7327 6141
Trevor.Maynard@lloyds.com

Giles Taylor
Tel: 020 7327 6462
Giles.Taylor@lloyds.com

Neil Smith
Tel: 020 7327 5605
Neil.J.Smith@lloyds.com

CONTRIBUTING AUTHOR

Alice LeBlanc is an independent consultant on climate change solutions, renewable energy, corporate sustainability, insurance and the carbon markets. She has worked for the past twenty years to promote economic mechanisms as tools for environmental protection and sustainable development.

Alice formerly headed the Office of Environment and Climate Change at AIG and was a Senior Economist at the Environmental Defense Fund. She has presented extensively on topics related to climate change and emissions trading throughout the US, including Congressional testimony, and globally.

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04	Foreword
05	Introduction
06	Summary of Lloyd's Principles
07	Lloyd's Principles
20	Conclusion
21	Appendix 1: Case Studies of Government and Policy Responses Related to Insurance
25	Appendix 2: Climate Change Adaptation Planning in the United States
26	Appendix 3: Insurance Industry and Lloyd's Response to Climate Change
27	References

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FOREWORD

From floods in Australia to earthquakes in Chile, Japan and New Zealand, we appear to be in a period of unprecedented natural catastrophes, both in terms of scale and frequency. These catastrophes are having devastating human, social and economic consequences across the world.

The US is not immune from this trend and this year alone has suffered devastating floods, hurricanes, wildfires and tornadoes. This trend towards increasing natural catastrophes is reflected in the rising economic and insured losses from these events in the US over recent decades. This is undoubtedly a result of both economic development in catastrophe-prone areas and rising individual wealth and property values.

The insurance industry has a crucial role to play in helping communities and economies recover from these devastating natural disasters. To be able to do this as effectively and efficiently as possible, it is vital that the industry is able to function properly. Unfortunately this has not always been the case in the US and the

development of government-run insurance programmes, in particular, has unintentionally disrupted the effective functioning of the private insurance market in some areas and unnecessarily placed a huge, and in certain cases unsustainable, burden on government and taxpayers.

This is a complex issue and resolving it will not be easy. Many detailed studies have been undertaken and much research conducted. We have produced this report, not to over-simplify the issue but to take the debate back to first principles. Policymakers, regulators, the industry and its clients need to work together to ensure catastrophic risk management in the US is sustainable in the long term.



Sean McGovern

Director, North America and
General Counsel

INTRODUCTION

Since the early 1990s, total economic losses from natural catastrophes in the US have averaged tens of billions of dollars per year¹. These disasters cause death and injury, damage property and the natural environment, interrupt business activities, and disrupt society generally. Furthermore, owing to trade and other commercial activities, the impact of these natural catastrophes often extends well beyond the immediate disaster area to other regions within the US and even to other nations.

Damages from natural catastrophes in the US are rising and are expected to continue to grow in the future. Increases in population and economic activity coupled with development in riskier and more environmentally vulnerable areas, will expose more property, infrastructure and other assets to damage from natural catastrophes. Inflation, recovering property values and increasing individual wealth may further amplify the potential costs of damages. Whatever the cause, it is evident that we are experiencing more frequent extreme weather events.

Many individuals and organisations have a vested interest in managing natural catastrophe risks. Property owners (both private and real estate interests), the insurance industry and the government all have a role to play. Property owners have an interest in managing risks to their property and/or investments. The business of the insurance industry is to help property owners manage risk by transferring it from an individual policyholder to a larger risk sharing community with premiums set to represent an insured's contribution to the overall risk. Government participates through its regulation of the insurance industry and when its involvement is necessary to correct environmental externalities, support risk mitigation or subsidise damage claims for the common good of society.

The increasing vulnerability arising from more people, economic activity and infrastructure in high risk areas, coupled with increasing evidence that climate change is leading to more frequent and severe weather events, points to continuing increased natural catastrophe risk on a scale not experienced before. Because of the scope and long-term nature of the problem, collaboration and cooperation among the key stakeholders identified above will be essential.

Often the private natural catastrophe insurance market is unable to function properly where, for public policy reasons, government-run insurance programmes or pools offer insurance that does not reflect the true price of the risk. Insurance is not sustainable if it is offered at rates below what is required by sound, risk-based actuarial practices. When insurance is not risk-based, the wrong price signals are sent and there is little or no incentive to mitigate risk. In turn, this leads to wider adverse impacts on society, such as degradation of vulnerable environments and a reliance on emergency funds to help rebuild communities after catastrophic events.

Lloyd's plays an important role in the US natural catastrophe market, helping protect individuals and businesses from natural disasters and enabling companies and communities to recover and rebuild after severe events. In this paper Lloyd's sets out a set of principles for addressing the challenge of managing natural catastrophe risks in the US. Within these principles and the accompanying report, we examine ways that the insurance industry, government and property owners can work together to manage increasing natural catastrophe risks and make insurance in catastrophe-exposed areas more available and affordable for US policyholders.

¹Please refer to Figure 1, Principle 4 (Munich Re Nat Cat Service, 2010)

MANAGING THE ESCALATING RISKS OF NATURAL CATASTROPHES IN THE UNITED STATES

LLOYD'S PRINCIPLES

- 1** The first step in protecting US property owners from natural catastrophe losses is ensuring there is a healthy, private insurance market
- 2** Government intervention in private insurance markets should be kept to a minimum
- 3** Risk-based pricing is the fairest and most sustainable solution
- 4** Specialist international insurers and reinsurers add value to the US natural catastrophe market through additional capacity and expertise
- 5** Government and insurers must respond to changing trends in the frequency and severity of losses
- 6** Government has an important role to play in helping develop risk mitigation measures and rewarding adaptation to reduce the overall costs to the economy
- 7** The insurance industry has a key role to play in helping build more resilient communities
- 8** Good quality data and hazard mapping is critical to robust underwriting
- 9** We believe in encouraging a responsible approach to risk in society

LLOYD'S PRINCIPLES

1. The first step in protecting US property owners from natural catastrophe losses is ensuring there is a healthy, private insurance market.

The insurance industry should be allowed to perform its natural role, in particular, the risk-based pricing of premiums, the diversification of risk across differing classes of business and the spreading of risk through global (re)insurance markets. We want to work towards future solutions that do not negatively impact the proper functioning of the private insurance market.

Risk management is necessary for individuals and legal entities in the US and insurance performs a vital role in managing the cost of natural catastrophe risks.

Data from the Census Bureau shows that 35.7 million people were seriously threatened by Atlantic hurricanes in 2008, compared with 10.2 million in 1950¹. These twin problems of growing urbanisation in coastal areas and increasing populations in high-risk areas have been reflected in an increase in insured and economic losses during that time.

The insurance and reinsurance market has shown its ability to provide capacity and financial strength to manage the financial impact of natural catastrophes. Through reinsurance and other risk transfer mechanisms, the impact of disasters is spread manageably through the global financial system. The insurance industry can therefore help stop natural disasters becoming economic ones for those most immediately affected and for taxpayers at large.

The healthy functioning of the private insurance market relies on the true pricing of risk. Like any company, insurers need to factor in the cost of the risk to their capital in doing business. In calculating the cost of insurance coverage accurately, the insurance industry encourages a responsible attitude to risk by reflecting the nature and cost of behaviour, location, build quality and many other rating factors. Insurers must be able to reflect these variations between individual risks in order for a healthy market to operate.

A common response has been to institute government programmes to support policyholders. These may not be subject to traditional solvency requirements and may often rely on post-loss funding mechanisms to cover catastrophic losses. Responding to a public policy need, they may be subject to statutorily defined pricing² or to political pressures upon rates. This hinders the private market's ability to operate and removes the incentive to mitigate risks in both the short and longer term.

In economic terms, government programmes may lead to problems by centralising rather than diversifying losses. The loss experience following Hurricanes Katrina, Rita and Wilma in 2005 is a good example of this.

Hurricanes Katrina (Aug 2005), Rita (Sept 2005) and Wilma (Oct 2005)

Hurricanes Katrina, Rita and Wilma were devastating in terms of loss of life (1,905 confirmed fatalities) as well as in terms of insured losses (\$57bn in 2005, excluding the losses covered by the National Flood Insurance Programme)³. The insured losses from these three hurricanes were absorbed by the insurance and reinsurance markets both domestically within the US and throughout the worldⁱⁱ.

While the private market was able to manage these insured losses of \$57bn, the additional flood losses of over \$16.1bn⁴ from the 2005 hurricanes inflicted a huge debt on the National Flood Insurance Program (NFIP) and, in turn, on the US taxpayer. The NFIP is unlikely ever to be able to repay the debt⁵.

Ultimately, if there is a healthy private insurance market, the government will be relieved of some of its financial exposure to natural disasters. This would enable it to focus assistance on the most needy in a more targeted and sustainable way. By developing alternative strategies to tackle the costs of natural disasters, for example by promoting risk mitigation initiatives, the Government can work alongside insurers to encourage a better attitude to risk in society.

ⁱ 61% of claims by value from Hurricanes Katrina, Rita and Wilma were paid by the global reinsurance industry, RAA Press Release, 18 March 2011

2. Government intervention in private insurance markets should be kept to a minimum

The Government should only act as the insurer of last resort where insurance is unavailable or unaffordable in the private market. Government involvement can increase the potential burden on the taxpayer after a loss and create hidden subsidies. It can also limit the effectiveness of the insurance industry by distorting competition and reducing rates to uneconomical levels.

As risks of natural catastrophes escalate, both the government and the private insurance industry need to respond. These responses must be collaborative to maintain and strengthen the viability of the private insurance sector and to support measures to mitigate natural catastrophe risks. Allowing the private insurance industry to perform its natural role of providing insurance using risk-based pricing is vital in minimising the potential liabilities for the taxpayer.

In the past, these state and federal programmes created residual market ‘insurers of last resort’, offering insurance at above market rates to those who could not otherwise obtain it, either because of their risk-profile or for socio-economic reasons. Residual insurance programmes such as these can have a clear public policy benefit where they stick to their initial policy goal or tightly define their targeted policyholders.

Government has a vital part to play in conjunction with private insurers and reinsurers in addressing and managing the costs of natural disasters. However, in doing so, it must avoid compromising the private market’s ability to function to maximum effect.

How Problems of Intervention Emerge

In some instances government involvement in providing insurance has become extensive. In intervening in private insurance markets, the government must take care not to restrict the market’s ability to offer suitable alternative insurance products. Undercutting private markets can result in a vicious circle of knock-on effects that can prove counter-productive.

Taking the threat of catastrophic losses as our starting point, problems of availability and affordability of insurance may emerge in some markets. In some areas, these problems of availability and affordability in the face of catastrophes may become so severe as to grow into a major political issue. Public pressure may then build on politicians in the wake of natural disasters and the resulting hardship. This in turn may lead to the search for a public policy solution.

An easy, though mistaken, course of action is to depress the costs of insurance. One means of doing this is through the regulation of rates, which is of course the case for many admitted markets. Another is the establishment of publicly-funded residual market programmes. Both may result in a tension between actuarially sound pricing and offering the customer “affordable” but unsustainable insurance (i.e. insurance which does not reflect the risk).

Furthermore, residual markets such as these may expand beyond their original remit and experience has shown several examples of programmes growing rapidly while offering underpriced coverage. The combined effect is to create large liabilities for the taxpayer, both by expanding the number of policyholders and by increasing the implicit subsidy awarded to each policyholder. Examples of expanding residual market programmes include the Fair Access to Insurance Requirements and the Beach and Windstorm Plans.

Fair Access to Insurance Requirements (FAIR) Plans and the Beach and Windstorm Plans

The FAIR plans provide property insurance in both urban and coastal areas, whilst the Beach and Windstorm Plans, cover mainly wind only risks in selected coastal areas. In the course of the last 40 years, the FAIR and Beach Plans have experienced remarkable growth. Between 1990 and 2010, the total FAIR and Beach Plan policies in force rose from 931,550 to 2.8 million. Their exposure to loss rose from \$54.7bn in 1990 to \$757.9bn in 2010⁶. This shift has left some plans with huge concentrations of risk and the potential for severe financial difficulties.

Despite the growth in state plans, many homeowners are still either uninsured or under-insured, either because they feel the coverage offered is too expensive to be affordable or too cheap to be adequate. Often those without insurance end up with compensation from the government after a disaster, which can undermine the incentive to be properly insured. Since Hurricane Katrina in 2005, the Federal Emergency Management Agency (FEMA) has paid over \$7bn in disaster assistance through its Individuals and Households Programme alone⁷. An increasing reliance on private insurance and greater targeting of assistance would reduce the reliance on government emergency aid.

Reconciling the Private Industry's Role

The private insurance industry is at the forefront of natural catastrophe risk management. Insurers and reinsurers monitor changes in weather patterns as part of their underwriting and risk evaluation process and use increasingly sophisticated catastrophe models to estimate expected losses from weather-related catastrophes.

Historically, the insurance industry has developed risk solutions that enable insurance to be made affordable to as many potential policyholders as possible and supported government and private action to mitigate risks. Examples include early fire brigades and fireproofing of homes in areas prone to forest fires. It is healthy that insurers should be able to respond in this way.

Some government programmes were created following a major disaster or sequence of disasters or in other circumstances where the private market was not offering sufficient natural catastrophe insurance cover. This was the case with the California Earthquake Authority, which was created after the Northridge earthquake in 1994. The availability of capacity in the private insurance market is dynamic and in theory residual market demand will fluctuate as a result. Policymakers should reflect this and work to keep the scale of any such programmes within manageable limits. Treating the need for government support as constant is highly damaging as government programmes come to eclipse the role the insurance industry needs to play.

Insure Louisiana Incentive Programme

The Louisiana Citizens Insurance Company offers insurance throughout the state in a hybrid of the FAIR and Beach and Windstorm Plans. The company has staged several rounds of depopulation of the programme back into the private market. Now in its fifth round of depopulation, the Insure Louisiana Incentive Programme⁸ funded the writing of new property insurance policies in the state under strict requirements for qualifying private industry participants. As well as dealing with Louisiana Citizens' deficit, the programme reduced future taxpayer exposures to a disaster and enabled it to focus on core residual markets.

3. Risk-based pricing is the fairest and most sustainable solution

Risk-based pricing is a way of providing incentives for risk mitigation. While risk mitigation should be rewarded, insurers should be free to determine premium levels. Material cross subsidies should be avoided where possible. Residual markets should avoid restricting the use of private insurance markets, and avoid the risk falling on taxpayers.

Risk-based pricing allows insurers to rate their premiums based on the actual risk insured and the insured's risk of future losses. It is based on the insured's exposure to particular risks and the loss history of the insured. An insurer can also hedge individual risks against the diversifying effect of how its overall portfolio of business performs.

By contrast with private insurers who must maintain regulated solvency margins, government programmes are often not satisfactorily funded. As explained in Principle 2, the rates charged are often depressed below the cost of the risk insured. Thus, public finances are exposed to the risk of having to carry a debt for future years. This tends to produce a reliance on post-loss funding mechanisms to

cover catastrophic losses. Unlike private insurers, these programmes often result in hidden premium subsidies owing to political pressure and can also encourage a reliance on emergency disaster relief⁹. Consequently, these programmes incur large deficits after a disaster. In addition, these programmes can also suffer from adverse selectionⁱⁱⁱ, where homeowners who are at the most risk are those most likely to buy catastrophe insurance.

National Flood Insurance Programme (NFIP)

Most flood insurance in the U.S. is offered by the National Flood Insurance Programme (NFIP). According to a March 2011 report by the US General Accounting Office (GAO), the NFIP owed the Treasury \$17.8bn and was in serious need of financial reform¹⁰.

The NFIP is restricted by law in its ability to adjust existing rates and to offer risk based pricing. It also does not hold capital and is therefore not required to service this capital. The effect over time, therefore, is that it effectively subsidises many of its policyholders' rates in a way that is not transparent. It provides overall flood insurance at one-third of the true risk cost in higher risk areas¹¹. Unlike the private market and as the PCI White Paper of May 2011¹² explains: *"the NFIP bases its rates on its average annual administrative and cash-flow losses for very broadly defined type of flood zones. It does not use modern modelling or mapping techniques and does not purchase reinsurance"*. Proposals are before Congress at the moment to reform many aspects of its operations and to extend the programme for a further five years.

Risk-based pricing is the fairest and most efficient way to rate insurance risks, cover the cost of losses and protect policyholders against their future losses. Private insurers use catastrophe modelling to quantify the risk. Data included in these models gives accurate information on risks to underwriters on an individual basis and helps them to quantify the true price for the risk covered. The final price is a combination of pure premium (cost of meeting the losses), cost of capital (return) and

administrative costs (operating cost of the business). In this way, the amount charged will be sufficient to cover expected losses, including loss adjustment, expenses and provision of capital.

Moreover, risk-based pricing encourages risk mitigation by policyholders and, in turn, allows insurers to provide incentives in this regard. Risk mitigation can qualify for lower rates (provided the mitigation is a recognised rating factor) and may even be the difference between quotes being offered or not in the first instance. This is common practice within the private insurance industry but not within government programmes.

A good example is a study from the University of Michigan and the University of Pennsylvania on accidental underground fuel-tank leaks over a fourteen years period¹³. The study states that:

"eliminating a state-level government assurance programme and switching to private insurance markets to finance clean-ups reduced fuel-tank leaks by more than 20 per cent. This corresponds to more than 3,000 avoided fuel-tank release accidents over eight years in one state alone, a benefit in avoided clean-up costs and environmental harm exceeding \$400m. These benefits arise because private insurers mitigate moral hazards by providing financial incentives for tank owners to close or replace leak-prone tanks prior to costly accidents".

A failure to price on the basis of risk is unfair to those insuring better or 'safer' risks, particularly where they have taken steps to mitigate risk. This group may end up subsidising bad risks either directly, by paying a higher premium to the insurer than their risk deserves, or indirectly, by paying more taxes after a loss to fund the claims or emergency aid paid by a public body. Both are undesirable in that they lack transparency. If subsidies are to be used, it should be in a way that is open and that allows the real cost of risk to be understood.

ⁱⁱⁱ The GAO offers the following definition: "Adverse selection occurs when insurers cannot distinguish between less risky and more risky properties, although homeowners can. When premiums do not reflect differences in risk that are known to potential customers, those who buy insurance are often at greatest risk for the hazards covered. Adverse selection in the market for natural catastrophe suggests that homeowners who are at the highest risk of experiencing a natural catastrophe will buy available insurance", (p3).

4. Specialist international insurers and reinsurers add value to the US natural catastrophe market through additional capacity and expertise

International (re)insurers are fundamental to the US market, paying around 60% of catastrophe losses in the US. Global insurance markets benefit the US economy and American policyholders by diversifying US natural catastrophe risks out of the country. International (re)insurers also provide new perspectives from different regions and offer specialist underwriting expertise. They offer alternative potential solutions to US markets through their appetite for natural catastrophe risk, such as hurricane, flood and earthquake.

Figure 1 shows the losses, in constant inflation adjusted dollars, from US natural catastrophes, both insured and uninsured, from 1950 through 2010. There is a very clear trend towards increasing economic and insured losses in recent decades with the greatest losses in 2005, and to a lesser extent in the early 1990s.

The 2004 and 2005 hurricane seasons in the Gulf of Mexico resulted in an unprecedented 1,200 deaths and more than

\$100bn in insured losses. Even after adjusting for the spike in 2005, this chart reflects the trend towards increased natural catastrophe losses over the past few decades.

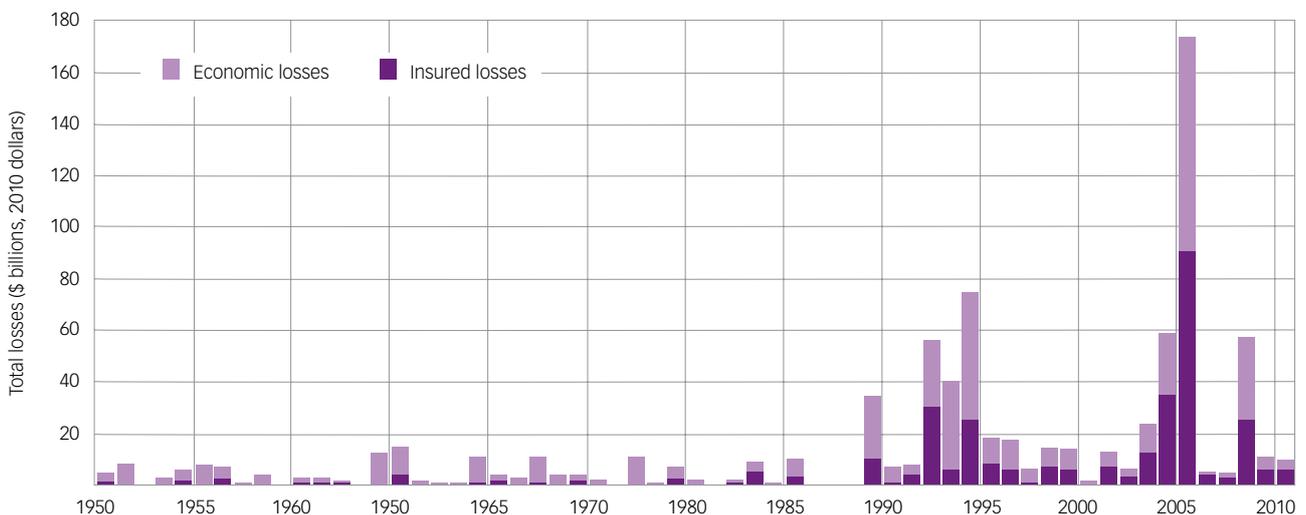
By accessing international markets, US policy holders are spreading some of the risk away from domestic markets and sharing the burden with overseas insurance markets. This means that even in the face of significant natural catastrophe losses, both the domestic private market and international reinsurers are more likely to remain healthy and robust and able to meet future claims. Furthermore, by holding capital collectively against a number of different risks, insurers are potentially able to offer policyholders lower premiums.

There is no single solution to assessing and managing natural catastrophe risks but international markets and insurers can bring different perspectives and ideas from their own domestic markets which may help in the US market. Examples include flood insurance in the UK and the Norwegian Natural Perils Pool. Please refer to Appendix I for case studies on government and policy responses related to insurance.

Figure 1: Significant US catastrophe losses (1950-2010)

Losses (\$1 billion economic loss and/or 50 fatalities)

Overall losses from US significant catastrophes in 2010 totaled \$8.6bn; insured losses totaled \$6.3bn.



Source: NatCat Service © 2010 Munich Re

5. Government and insurers must respond to changing trends in the frequency and severity of losses

Changes in climate and demographics, in particular increasing population concentrations and development in catastrophe-exposed areas and rising wealth and property values, are increasing loss severity. These are the result of a diverse set of causes and are evidenced in larger loss costs and more extreme event patterns. Acknowledging and responding to these are vital steps in mitigating the social, economic and environmental impacts of these changes.

The average inflation-adjusted damages from US natural disasters have increased over the past decades as both population and economic activity have grown in coastal regions that are prone to hurricanes and winter storms, as well as in areas vulnerable to wildfires, river flooding, earthquakes, droughts and other natural disasters.

Population

The entire US population grew by 70%, or 125 million people, during the 48-year period from 1960 to 2008,

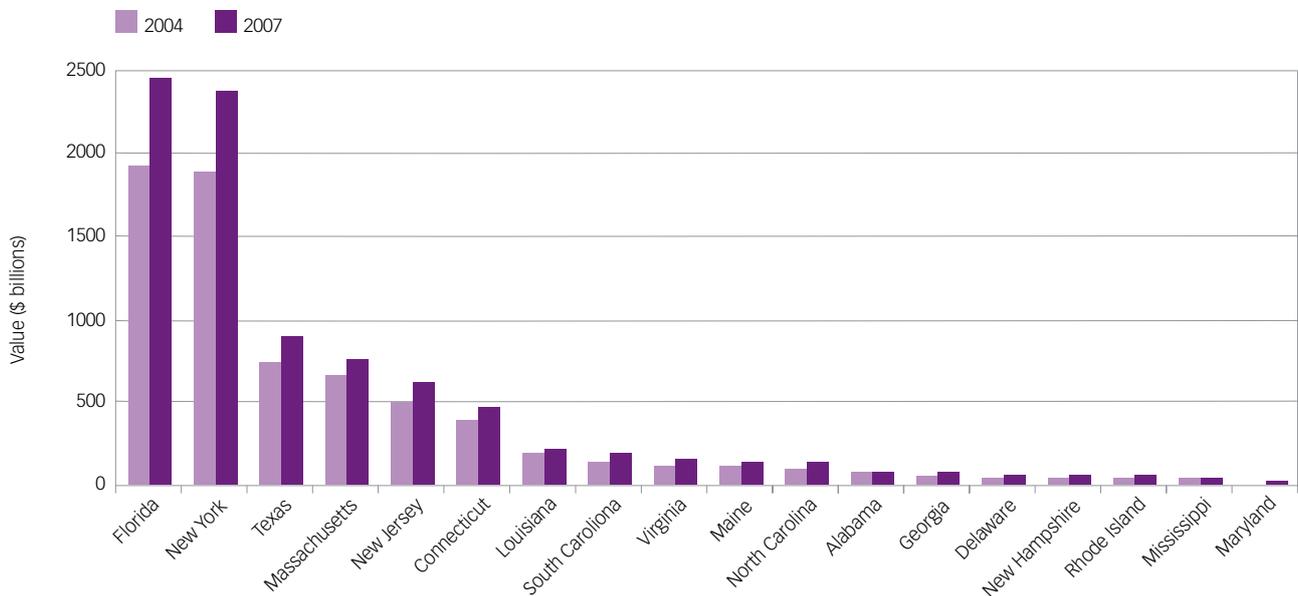
reaching 304 million in 2008. The coastal population increased 84% during that time period and the economy grew almost five fold, from around \$2.5trn to more than \$12trn (real GDP in 2000 US dollars).

Property

The value of insured coastal properties has grown significantly between 1960 and today. According to a 2008 study by AIR Worldwide¹⁴, from December 2004 through to December 2007, the insured value of properties in coastal areas of the United States continued to grow at a compound annual growth rate of just over 7%. Despite the recent weakening of the real estate market in many areas, the insured value - or the cost to rebuild properties - has maintained an annual growth rate that will lead to a doubling of the total value every decade. While insured losses are significantly less than all losses from hurricanes and other natural catastrophes, Figure 2 below provides an indication of the magnitude of potential losses for US coastal properties most at risk from hurricanes. In total, the value of insured coastal properties in all 18 coastal states rose to \$8.9 trn in 2007 from \$6.9 trn in 2004.

Figure 2: Value of insured coastal properties in US Gulf and East Coasts 2004 and 2007, billions of dollars.

(Data includes residential and commercial properties and is an aggregate of all insurance in force in each state).



Source: AIR Worldwide report, Coastline at Risk: 2008 Update to Estimated Insured Values of US Coastal Properties

Economic Development

The way economic development has occurred and is occurring in the US has resulted in more natural catastrophe risk. For example, environmentally important and sensitive areas are being weakened as a result of development. These include the ecosystems that border US coasts and rivers and protect water supplies and prevent erosion. Consequently, they have less ability to reduce or withstand the impacts of natural catastrophes. For example, Louisiana is losing 25-35 square miles per year of coastal swamps, marshes and islands. Extraction of oil in the Gulf, a process that leads to intrusion of salt water in fresh water marshes and degradation to marsh vegetation, is exacerbating this loss. In other parts of the US vegetation, wetlands and barrier islands along the coast, that provide buffers and protection from weather related disasters, are diminishing.

Development has also occurred, and is occurring, in high-risk areas. This is often because of government insurance programmes offering rates that do not reflect risk, inadequate information about risks and the non-enforcement or lack of regulations around risk mitigation. Examples include increases in offshore oil production, homes built in wildfire prone areas and building on flood plains. Policies intended to mitigate risks, or compensate for development in high-risk areas, sometimes fail to help. For example, most of the damage from Hurricane Katrina

resulted from the breakdown of the levee system, a man-made construct designed to protect low-lying property.

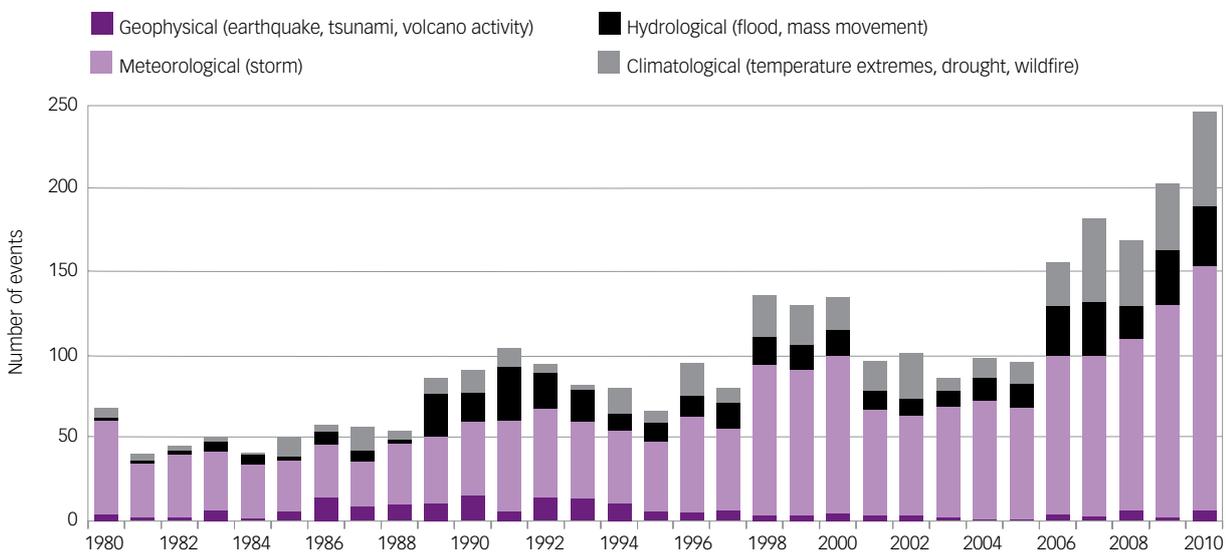
Climate Change

During 2010/11, the US has experienced many weather related disasters and extreme weather events, including exceptionally high temperatures, heat waves, wildfires, tornadoes and extreme flooding.

The earth’s average global land surface, sea surface and lower atmospheric temperatures, as well as the heat content of the oceans, have all risen since the late 1800s, with accelerating increases over the most recent decades. When the temperature increases so does the water-holding capacity of the atmosphere and it is argued that increased moisture content of the atmosphere favours stronger rainfall events, and therefore increases the risk of flooding¹⁵.

Figure 3 indicates a trend of increased numbers of natural disasters in the US over the past 30 years. This apparent growth can be attributed in some part to better reporting. However, scientists are attributing a significant portion of the increases in storms, temperature extremes, droughts, wildfires and floods shown in Figure 3 (across meteorological, hydrological and climatological categories) to climate change.

Figure 3: Natural disasters in the US (1980-2010) by type.



Source: MR NatCat Service ©2011 Munich Re

A report by the US Climate Change Science Programme cites heat waves, heavy precipitation events, increase in areas affected by drought and more intense hurricanes as climate change impacts that are already occurring and that can be expected to increase in the future¹⁶. Sea level rise is likely to continue and it will affect storm surge resulting from hurricanes and tropical storms as happened with Hurricane Katrina in 2005.

There is increasing evidence that climate change is already resulting in more frequent and extreme weather events and this trend is likely to continue. Actions to reduce greenhouse gas emissions and build resilience are necessary to lessen the potential impacts of future extreme weather events.

6. Government has an important role to play in helping develop risk mitigation measures and rewarding adaptation to reduce the overall costs to the economy

Government entities at the federal, state and local level have a critical role to play in planning and implementing risk mitigation and adaptation measures. Policymakers have a duty to protect and mitigate risks to civil infrastructure. Insurers should work with government to administer policies aimed, for example, at improving construction standards or discouraging building in inappropriate areas. Better risk management leads to lower pricing reducing the overall costs to the economy.

One of the key elements in managing escalating natural catastrophe risks is direct risk mitigation measures that render communities and ecosystems more resilient to the impacts of weather related and other natural catastrophes. While it is in the interest of the government, the policyholders, and the insurance industry to implement risk mitigation measures, thereby reducing the cost of insurance and the potential damages from natural catastrophes, the government has a critically important role to play in providing incentives for and/or requiring risk mitigation measures.

Achieving resilience to withstand natural disasters involves protecting buildings and civil infrastructure, adopting safer building codes and zoning practices and strengthening eco-systems. Planning to implement these measures in an effective way requires improvements in current data collection, mapping, models and other tools.

In helping develop risk mitigation measures and rewarding adaptation, we propose that government should focus on the following:

Building Codes and Retrofits

All buildings should comply with current codes to be eligible for rate-regulated insurance. Current codes should be evaluated by national and local officials and stakeholders with an eye to strengthening new construction and developing retrofit plans. The lifetime of the structure and future climate change scenarios should be considered when specifying new codes.

Florida implemented stronger, more hazard resistant codes for new buildings in 1995 - a few years after Hurricane Andrew. Florida's code leads the US in several respects:

- A standard for Miami-Dade county that exceeds the standard for any other part of the US in terms of wind design requirements (for example, requiring impact resistant glazing the full height of all new buildings)
- Stringent wind standards which are higher than those required for any other region
- A law requiring re-roofing standards such as a secondary water membrane, wind-rated shingles^{iv} and other improvements. This is an example of the legislature taking the lead by passing a law to change building codes.

In the US, the model building code is set by the National Institute of Building Scientists (NIBS) and updated every three years. The code is still backward-looking and the NIBS standard does not include climate change considerations. However, states and localities may modify the code to make it more stringent and to fit their specific circumstances.

^{iv} An additional waterproof substrate for roofs and roofing tiles, respectively.

Strengthen Ecosystems and Improve Agricultural Practices

Forests and wetlands help the ground absorb more water and provide buffers to break up wind force. Water from precipitation flows more slowly into rivers and streams if trees are present, thereby reducing the risk of flooding in many cases. Protecting, expanding, and strengthening ecosystems can accomplish goals of both resiliency and reduction of carbon dioxide in the atmosphere.

Examples of actions to strengthen ecosystems:

- In response to coastal degradation from hurricanes and oil spills, the state of Louisiana and the Corps of Engineers have opened the levees in two locations to allow fresh water, sediments and nutrients from the Mississippi River to replenish the coastal wetlands.
- The City of New York continues to protect land and forests upstate from development to protect the City's reservoirs and water supply. The City's "Plant a Million Trees" programme, a public-private partnership started in late 2009 with the goal of planting a million trees in New York City, is now approximately mid-way to its goal with 480,000 trees planted.

Zoning Changes

It is important to develop and enforce land use policies that restrain growth in high-risk areas. Flood plains by rivers and coastal areas and forested areas prone to wildfire are two areas of concern. Policies might include "no build" in the highest risk areas and only allowing new building with "code plus" standards in other designated areas.

Data and tools to determine the risks in a given location are essential. FEMA flood zone maps are required for insurance purposes, but these are largely inadequate and out-of-date. For example, the characteristics of a one in a hundred year flood event are likely to have changed since many of the maps were created and areas that should now be in the flood plain are excluded. There are ongoing discussions to update FEMA maps, but it appears that

the new maps will not consider climate change impacts and forecasts, nor will they be based on data collected by LIDAR^v, an advanced tool that may serve better for planning purposes.

Erosion set backs and rolling easements^{vi} are two ways to set zoning requirements that take into account increased natural catastrophe risks in coastal areas. They are used in several states, notably in the Mid-Atlantic region. In North Carolina, the requirements for erosion setbacks, or the distance from the coast required for new building, are evaluated every year based on average long term erosion rates over the past 50 years. They can be adjusted by government officials to place more weight on recent erosion rates.

Once a property is placed under a rolling easement, the landowner is allowed to develop it as they see fit, but is not allowed to put up barriers or otherwise protect the property from the ocean, nor to collect damages in the case of flooding. Rolling easements can be bought by the government or by a private group from the landowner. This gives the property owner a financial motive to create the easement. If the property is sold, the easement goes with it, thereby discouraging further development. In some states, these easements apply to properties close to estuaries and rivers as well as to the coast.

Protection of Civil Infrastructure

Potential vulnerabilities to natural catastrophes for public transportation (including roads and bridges), communications, power production and the grid, water supply, and sewage and waste, must be identified by municipalities and by relevant utility infrastructure owners. Both short and long-term measures to protect civil infrastructure from hazards should be specified, for example sandbagging to protect entrances to subways from flooding. Examples of activities that might be undertaken in urban areas include: power back-up systems for neighbourhoods or homes; placing power lines underground; using more resilient building materials; measures to enhance water absorption; and retrofitting of buildings with wind resistant windows. These measures could be funded, mandated or partially subsidised by the city, state or federal government.

^v Light Detection and Ranging (LIDAR) is a remote sensing technology used to collect topographic data to document changes along shorelines. It is important for providing adequate flood and coastal maps for adaptation plans.

^{vi} The US EPA defines a rolling easement as '...an interest in land in which a property owner's interest in preventing real estate from eroding or being submerged yields to the public or environmental interest in allowing wetlands, beaches, or access along the shore to migrate inland', Climate Ready Estuaries Rolling Easements Primer, James G. Titus, June 2011.

Costs of Risk Mitigation

Risk mitigation measures will require significant expenditures, which will be difficult to fund in today's political and economic climate, but which may complement insurance or make insurance more affordable. Other than more costly building codes for new properties, potentially very large costs will be incurred from retrofitting buildings and large infrastructure. However, in some cases, there are cost-effective risk mitigation measures available that local communities can put in place to better address current risks.

Community risk mitigation project in Illinois

One Illinois community found a way to pay to fix its levee when it was found to be insufficient. Levees along a 75 mile stretch of the Mississippi River were deemed to be inadequate and, as a consequence, a 174 square mile area was to be included in a special flood hazard area, in which residents and businesses were required to purchase flood insurance. The cost effectiveness of other steps besides insurance to mitigate the risks was judged to be favourable. Local officials therefore sued to halt the reclassification and at the same time took alternative steps to mitigate the risks. A \$180m project to bring the levees up to an adequate protection level is in progress. The money was obtained through a 0.25% sales tax increase.

Reward Adaptation

Financial incentives or subsidies will be important to encourage property owners to implement natural catastrophe risk mitigation measures. Incentives can be provided through direct government subsidies, or tax benefits, and through risk-based insurance pricing whereby insurance premiums may change to reflect any reduction in risk.

The state or federal government might offer free inspections and retrofit planning for selected households, such as moderate or low income ones, and small businesses. It could then subsidise the cost of retrofits to make buildings more resistant to damage from catastrophes through grants or tax credits. The "My Safe Florida Home" programme provided free wind inspections for 400,000 homes and grants to retrofit 33,000 homes, but ended in June 2009 due to budget constraints.

The state or federal government might consider subsidising risk-based insurance premiums for low or moderate income households that have adopted risk mitigation measures. This would provide a double incentive - with one based on a potentially lower, risk adjusted insurance premium from the insurance company and an additional government subsidy to help defray the insurance cost.

Tax-exempt adaptation savings accounts would provide incentives for homeowners to save money to cover risk mitigation expenses, which could improve the risk profile of their properties.

Climate Change Adaptation Planning

Government at various levels also has a role to play in encouraging adaptation planning to climate change. Some examples are provided in Appendix 2.

7. The insurance industry has a key role to play in helping build more resilient communities

The insurance industry should partner with policymakers to encourage customers to adopt risk mitigating measures such as "code plus" standards for new building and retrofits. It should incentivise policyholders to take risk mitigation measures through reduced premiums and other incentives.

It is in the interest of the insurance industry, as well as the policyholder and the government, to implement risk mitigation measures, thereby potentially reducing both the cost of insurance and the damages from natural catastrophes.

One way for the insurance industry to incentivise policyholders to take risk mitigation measures is through offering reduced premiums for implementing appropriate mitigating actions. Another option is for insurers to encourage policyholders to share a greater proportion of the risk through offering policies with higher deductibles. This provides a financial incentive for the policyholder to implement cost effective risk mitigation measures in order to keep losses as low as possible below the full

deductible amount. The incentive is also provided in part through savings in insurance premium.

Institute for Business and Home Safety Programs

The Institute for Business and Home Safety (IBHS), a non-profit organisation whose members are property and casualty insurance companies, has two programmes (“Fortified for Safer Business” and “Fortified for Safer Living”) which promote “code plus” building standards for light commercial and residential buildings in response to specific natural hazards. The IBHS also has a “Fortified for Existing Homes” programme, which develops and promotes retrofits for specific natural hazards. Member companies are encouraged to offer discounts to incentivise customers to implement retrofits. The IBHS programmes grew out of an earlier programme in Florida that developed techniques to retrofit homes paid for by the home owner with a matching grant from the government. This state-run initiative was popular, but ran out of funding.

Insurance companies can communicate to customers on the advantages of retrofits in hazard prone areas and consider offering home inspections and retrofit recommendations. Insurance companies can offer risk-based premiums to property owners who have mitigated risk and in some cases even make this a condition for insurance. For example, lower premiums might be offered to home owners who install fire-resistant, non-wood shingles^{vii} in fire prone areas, thereby encouraging their use.

The insurance industry can provide expertise and tools to help assess natural catastrophe risks. It can support risk mitigation and adaptation efforts by applying its catastrophe models to assess the loss scenarios of increasing natural catastrophe risks in the future. For example, the paper ‘Building a Resilient Energy Gulf Coast’ by Entergy, America’s Wetland Foundation and America’s Energy Coast in collaboration with the insurer SwissRe, contains a methodology for assessing costs and benefits of adaptation measures based on catastrophe model valuations¹⁷. The industry’s continuing research on weather-related catastrophe risks could be shared more widely with government researchers. The insurance industry can also continue to advocate additional data collection and development of tools that will benefit underwriting, risk mitigation and adaptation planning.

^{vii} Roof tiles (may be made from fibre-glass, wood or asphalt)

8. Good quality data and hazard mapping is critical to robust underwriting

The insurance industry requires better and more up-to-date mapping of natural hazards and improved data collection. Government and insurers should work together to improve hazard mapping and the quality and availability of data.

The insurance industry needs improved data collection, hazard mapping and other tools to manage increasing natural catastrophe risks in its underwriting processes. These overlap to some extent with what local and regional adaptation planners require to plan and make recommendations for government funded or mandated risk mitigation and adaptation measures. Additional data collection, tools and research are important to identify future trends and anticipate future risks of natural catastrophes, as well as to better understand current risks.

The government and the insurance industry can find ways to collaborate on collecting data, monitoring climate variables, developing and using risk assessment and valuation tools and designing research that will improve forecasts and increase understanding of the impact of increasing natural catastrophes.

Observational data collected both remotely by satellites and on the ground is necessary to provide information on weather patterns and changes in the climate system. The federal government collects and provides information and develops tools to assess risks. Agencies such as the National Oceanic and Atmospheric Administration (NOAA), NASA’s Goddard Institute for Space Studies, the US Forestry Service and FEMA, collect data and monitor severe weather events and other physical phenomena, including hurricanes, forest fires, droughts and floods. They provide tools to assess risk including monitoring systems, mapping of high-risk areas such as the mapping of flood plains, and global climate model research.

Adequate and up-to-date flood plain and coastal maps are needed to better determine current risk levels. They are essential for risk mitigation and adaptation

plans. Light Detection and Ranging (LIDAR) is a remote sensing technology used to collect topographical data to document changes along shorelines. It is important to help understand the impacts of sea level rise and flooding risk.

Better quantification of the probability and impact of future climate change requires the advancement of scientific understanding and the refinement of climate model forecasts. Specifically, the output of the climate models needs to be shorter term, to be focused on smaller geographic regions and to have less uncertainty surrounding the forecasts, although we understand the difficulties and challenges in being able to do this. This way they will be more useful for planners and underwriters. This is currently a subject of study by the Climate Prediction Project of the World Climate Research Programme, which seeks to revolutionise climate change forecasts especially at the regional scale.

Many construction standards, especially those used decades ago, were designed based on a set of expected stresses and associated levels of resilience that may no longer provide a sufficient safeguard from natural catastrophes. Even if the impact of future natural catastrophes were known with certainty, it would not necessarily be understood exactly how the standards need to be adjusted to reflect new levels of stress and resilience. Consequently, in many cases, engineering studies are required to identify the gap between current standards for disaster resilience and the standards required under escalating natural catastrophe risk.

9. We believe in encouraging a responsible approach to risk in society

Public and policymaker understanding of risk is critical. Governments, insurers and other stakeholders should work together to ensure there is a greater understanding of the economic and social consequences of poor risk management and to develop appropriate solutions.

The complexities and difficulties of managing natural catastrophe risks and the increasing impacts of climate change will require the cooperation of the insurance

industry, government, property owners at risk and other stakeholders. The insurance industry can take a leading role in involving a wider group of participants in today's risk management challenges by educating policyholders, the government and other concerned parties.

Real estate investors and mortgage lenders can play an important role by considering likely future natural catastrophe risks in lending and investment decisions and by promoting risk mitigation measures and more resilient buildings. They can require that the buildings they invest in or develop be built in low risk areas and to higher standards to withstand natural disasters. Some specific actions that real estate investors and mortgage lenders can take include:

- Modifying investment models to consider longer term valuations, thereby incorporating future natural catastrophe risk in investments made today in buildings with a long life
- Financing up-front costs of energy efficiency and renewable energy from energy savings over time.
- Providing preferential mortgage interest rates for homeowners with insurance and risk mitigation measures in place
- Requiring insurance and risk mitigation in high risk areas as a condition of home loans.

Private property owners have a responsibility and vested interest in taking actions to protect their property or investments. Risk mitigation measures could be required by the government or by an insurance company that makes the issuance of the insurance policy conditional on these measures. However, some property owners might also take action independently to protect their property or livelihood and choose a policy with a higher deductible. Utility companies (including gas, water and electric companies) might also provide incentives for adaptation by offering preferential rates or grants in exchange for the protection of equipment, or infrastructure on the homeowner's property.

In order to tackle the problem of managing increasing natural catastrophe risks in the US, cooperation among key stakeholders is essential. One way to enable this

will be to form coalitions between insurance companies, NGOs and other stakeholders focused on major issues relating to natural catastrophe risks. “SmarterSafer” is an example of a coalition of insurance industry companies, public policy non-profit organisations and environmental NGO’s formed to advocate for “environmentally responsible, fiscally sound approaches to natural catastrophe policy.” The group consists of more than 30 companies and organisations that lobby, among other issues, for reform of the National Flood

Insurance Programme based on accurate maps and risk-based rates. The group advocates a government role in promoting and supporting risk mitigation for private property owners, but opposes artificially low insurance rates such as those offered by government-run insurance. Such coalitions will be important in tackling the sheer scale and complexity of the issue of escalating natural catastrophe risks in the US and furthering public understanding of the subject.

CONCLUSION

When natural catastrophes strike, the impact on individuals, communities and wider society can be devastating. Insurance has an important role to play in helping people and businesses recover from these catastrophic events. Therefore it is vital that insurance should be available and affordable to those that need it. This paper does not provide an instant solution to current problems, but rather it aims to highlight the key issues and themes that we all need to work together to address.

Perhaps two overriding themes emerge from the report:

1. The scale of the challenges requires significant cooperation between government, insurers and planners. In particular, government efforts to assist must be focused in a way that allows the insurance industry to continue to function efficiently and effectively. Subsidies can be effective, and even essential in certain circumstances, in addressing some of the challenges of natural catastrophe insurance, but they must be deployed in a targeted way that allows insurers to continue to accept risks.
2. Society needs to foster a responsible attitude to risk and an understanding of the potential costs of natural disasters to both those affected and the wider economy. A greater understanding of how individuals and communities can take steps to mitigate the potential consequences of catastrophes and adapt to the future impacts of climate change before disaster strikes could significantly reduce the impact and costs of natural disasters.

Finally the extent of the challenge facing us, is perhaps best highlighted by the unprecedented series of natural disasters that have occurred in the US this year. Never has it been more timely or necessary to manage the escalating risk of natural catastrophes in the US.

APPENDICES

APPENDIX 1: CASE STUDIES OF GOVERNMENT AND POLICY RESPONSES RELATED TO INSURANCE

This section examines selected legislative and policy responses to highlight initiatives that have had varying degrees of success in advancing risk mitigation and providing appropriate insurance coverage. These examples also explore appropriate roles for the

government and the insurance industry. Maintaining a sustainable private insurance industry is paramount in managing natural catastrophe risk, but several of the policies below work counter to this notion.

Insurance	Type of Programme	Status	Issues
Citizens' Property Insurance Corporation/ Florida Hurricane Catastrophe Fund (Florida)	Government-run property and casualty insurance pool and reinsurance fund for wind and hurricane.	Citizens' issues almost 1.3 million policies (18% of admitted Florida market) ¹⁸ Citizens' \$11bn shortfall in 100-year event would be covered by assessments.	Reliance on post-loss funding.
National Flood Insurance Programme (US)	Government flood insurance programme authorised by statute. Original intent was to decrease reliance on ad hoc post disaster relief by offering insurance to those most at risk.	More than 5.6 million properties insured; current \$17.8bn deficit.	Risk mitigation measures required by the programme are not always implemented or enforced; flood maps are out of date; limited ability of the programme to adjust premiums or coverage to reflect risk.
Flood insurance agreement (UK)	Commitment by insurers to provide residential flood insurance in return for government provision of flood risk mitigation.	Not likely to be renewed post 2013.	Good in theory, but in practice government is not on target with risk mitigation efforts. Agreement allows new entrants to the market to be more selective in those insureds to whom they offer flood insurance.
California Earthquake Authority (CEA)	Publicly managed, privately funded residential earthquake insurance provider.	CEA is solvent; however, only approximately 12% of market is covered.	Fiscally solvent; risk based premium pricing; State does not subsidize CEA and vice-versa; inadequate uptake because of cost of premiums, resulting in part from high mandated reinsurance costs and from large risks of properties without retrofits.
Norwegian Natural Perils Pool (Norsk Naturskadepool)	Private insurance pool for natural disasters. Non-life insurers must join the pool when writing fire insurance and offer natural perils coverage.	The Pool is solvent with 83 insurance company members.	Compulsory membership for all market participants and compulsory natural catastrophe coverage for all fire policyholders.

Florida: Citizens Property Insurance Corporation and Hurricane Catastrophe Fund

The Florida Legislature created Citizens Property Insurance Corporation (Citizens) in 2002 when it merged two existing state-backed insurance pools. Citizens began as an “insurer of last resort” for residential property, mandated to set rates higher than those of private insurance companies. After the hurricane season of 2005, it was redesigned to provide “affordable” coverage and it now writes policies at rates below those of private companies.

Citizens has become Florida’s largest home insurer, providing 18% of residential coverage in the admitted market, mostly in high-risk coastal areas. On 12 January 2011 Citizens’ Chief Financial Officer Sharon Binnun testified before the Florida House of Representatives Banking and Insurance Subcommittee¹⁹ that rates for covered homeowners need to be raised by 55% to make the company “actuarially sound.”²⁰

Citizens’ is able to recover any post-loss shortfall by an assessment in the first instance on Florida policyholders. According to the Insurance Information Institute²¹:

“In a report released in March 2009, the Florida Department of Financial Services estimated that a 1-in-100 year hurricane event in Florida would result in \$61bn in residential insured losses. Such an event would leave Citizens with a deficit of \$2.5bn and the Florida Hurricane Catastrophe Fund with a deficit of \$20.1bn. These deficits would be paid with emergency assessments levied on Florida’s property/casualty insurers and passed on to insurance consumers.”

Theoretically higher-risk property holders within Citizens’ are shielded from having to pay the true actuarial costs to insure the risks to their properties. Although Florida has stringent standards for new building in high-risk areas, the under-pricing of insurance by Citizens undermines the incentive to mitigate risk by removing a disincentive to develop in high-risk areas.

National Flood Insurance Programme

In 1968, Congress created the National Flood Insurance Programme (NFIP) to provide flood insurance protection

associated with hurricanes, tropical storms and heavy rain, in return for local government commitment to sound flood plain management and related flood disaster mitigation efforts. The programme is managed by the Federal Emergency Management Agency (FEMA), which also provides flood plain maps and disaster relief. Participating communities must meet FEMA flood plain management requirements. As at March 2011 approximately 5.6 million properties were insured by the NFIP, with an aggregate value of \$1.2trn and with annual written premium of \$3.2bn²².

A report by the US Government Accounting Office stated that the NFIP is approximately \$17.8bn in debt and concluded that the NFIP is “not actuarially sound²³”. A 2010 report by the New York University Law School concludes that the NFIP is at odds with climate change adaptation and that the programme’s deficit is “likely dwarfed” by its harmful impacts on natural areas vulnerable to construction²⁴.

What is causing these problems? Primarily the programme offers insurance at below market rates, at an estimated discount of \$1bn a year. Also flood plain management plans are often not enforced. The FEMA flood plain maps are desperately in need of an update and designated flood plains need to be expanded. Since the NFIP is constrained by statute in its ability to cancel policies or raise premiums once they are set, an estimated 25% to 30% of claims paid are for repeat losses on homes that are most prone to flooding.

The last long term authorisation of the NFIP expired on 30 September 2008 and has been extended on a temporary basis several times and currently expires 30 September 2011. Given the NFIP’s worsening debt and other problems, Congress is considering the renewal and reform of the programme, including the possibility of modifying the NFIP structure to include increased participation by private insurers.

The concept of linking provision of flood insurance to risk mitigation is critical. However, the problems of the NFIP illustrate the danger of premium rates being unresponsive to real risk levels.

Flood Insurance in the UK

The UK Government has entered into a voluntary Statement of Principles²⁵ with the Association of British Insurers ('ABI') which is due to run until 2013. Under these principles, the government has committed to actions to reduce flood risk and implement measures to bring high-risk customers into a lower-risk category. Actions include the provision of grants to at-risk properties to encourage flood risk mitigation (these measures are referred to as 'resistance and resilience') and the provision of data and maps, as well as permitting a level of cross-subsidy between policy holders to make insurance affordable for all.

In exchange, the private insurance companies agree to continue to provide coverage to the high-risk customers for a limited period until their risk rating has been lowered. The basic concept is that the government takes the lead by requiring or funding risk mitigation measures, enabling the insurance industry to continue to provide coverage. Under these principles insurers provide cover to almost all properties at risk.

It looks like this agreement will not be extended when it expires in June 2013. Some within the insurance industry argue that this is because the government has not planned for or put in place the necessary risk mitigation measures. Some industry commentators also feel that the agreement has caused two principal distortions in the private market. First, since the agreement applies only to insurers who were providing flood insurance to residential and small business customers as at July 2008, new flood insurers are not required to provide insurance in areas of high risk. They can "cherry pick" their customers to include only those at lower risk. Secondly, insurers think it is inhibiting the development of the specialist high risk market by obliging the offering of flood risks across the board as part of the conventional homeowners market.

However, this is an approach worth exploring. The government does not insert itself directly in the insurance market and compete with private companies, but rather it supports the continued provision of coverage and risk based insurance premiums by mitigating risks.

California Earthquake Authority

The California Earthquake Authority (CEA) is a publicly managed and, in large part, privately funded residential earthquake insurance provider. It was established in 1996 by the California legislature following the Northridge earthquake of 1994. At that time insurance companies, representing approximately 93% of the market, no longer wanted to provide residential earthquake coverage, leaving the market severely restricted or not covered.

Full residential coverage is not offered by the CEA, but instead a reduced coverage, or "mini" policy, that covers dwellings only (and omits swimming pools, patios and out buildings) is intended to reduce premium costs.

The state of California is not liable for the CEA nor does it provide the CEA with any funding. The CEA is not allowed to go bankrupt and if it cannot pay claims, then the claims are prorated or provided in instalments to policyholders. The CEA does not pay federal income tax. It is financially sound with an A- (excellent) rating from A.M. Best. It sells its insurance through private insurance companies representing more than two-thirds of the California residential market. Nevertheless, the CEA insures little more than 12% of the residential market.

The high cost of earthquake insurance is the main reason for its lack of uptake. The CEA's goal is to double the current number of insureds in five years. It recently adopted a building code for retrofitting existing structures to withstand earthquakes. It is trying to develop a financial incentive rebate programme, which would rebate a portion of retrofit costs and therefore provide an incentive in addition to the lower premiums resulting from the retrofits.

One reason for the high cost of earthquake insurance in California is the cost of reinsurance required by the CEA. The CEA is actively lobbying in Washington to reduce its reinsurance requirement, so as to be able to lower the cost of its insurance.

The Norwegian Natural Perils Pool (Norsk Naturskadepool)

Norwegian law requires all fire policies to include insurance against natural catastrophe perils unless those perils are covered by another insurance, for example, motor or hull insurance. It also obliges all non-life insurance companies that cover natural catastrophe damage in Norway to be members of the Natural Perils Pool (the Pool).

As at 31 December 2010, the Pool had 85 member insurance companies. Its functions are to settle claims. The Pool also buys reinsurance cover, currently to the tune of NOK12.5bn (approximately \$2.5bn). The Pool is organised as a distribution pool which means that insurance companies deal directly with their

policyholders. The pool's function therefore is to equalise losses in the market.

All members have a two-fold role in the Pool. First, their premium contributions pay for the reinsurance programme. Insurance premiums are collected by each insurance member when writing fire insurance. The premium is based on the fire insurance amounts. Second, members may also act as reinsurer for part of the programme up to a limit of their share of the pool.

The average annual claims payments for the years 2000-2010 are NOK273m (approximately \$49m). In 2010, total claims caused by natural perils amounted to NOK180m (approximately \$32m).

APPENDIX 2: CLIMATE CHANGE ADAPTATION PLANNING IN THE UNITED STATES

Climate change adaptation planning, in its earliest stages, is being carried out mainly at the local level in key cities including New York City, King County (Seattle), San Francisco, Chicago, Miami-Dade County (Florida) and Grand Rapids (Michigan) and in states including New York, Massachusetts, Florida and others. Regional initiatives are underway in Southeast Florida and the San Diego area.

Municipalities must first determine what the near and longer-term impacts of climate change are likely to be in their localities and then assess how these impacts may damage infrastructure and what preventative measures may be needed. Global climate models must be evaluated and results for these models linked to the physical characteristics of infrastructure and topography. The process is uncertain and requires flexibility in adjusting plans over time as more information on future climate change becomes available.

At a municipal level, New York and Chicago's resilience planning is specifically geared to climate change. Measures to reduce greenhouse gas emissions are included in these two cities' climate change initiatives.

Chicago's climate action plan includes a goal of 80% carbon emission reduction on 1990 levels by 2050. It has five components: energy efficient buildings, clean and renewable energy, transportation options, adaptation, waste reduction and industrial pollution. New York's Climate Change Adaptation Task Force is part of PlaNYC, a sustainability plan for the city through to 2030. The Adaptation Task Force includes representatives of government and private companies that operate critical infrastructure in five areas: energy, transportation, water and waste, natural resources and communications. New York has an emissions reduction target of 30% below 2005 levels by 2030. The City recently announced a Green Buildings Plan requiring buildings of more than 50,000 square feet to upgrade lighting, undergo energy audits and track energy use. The City intends to spend \$1.5bn over the next 20 years on infrastructure, such as green roofs, porous parking lots, rain barrels and underground storage tanks to capture storm water before it overflows the sewerage system. These measures will help absorb and contain water to prevent flooding from heavy precipitation events.

APPENDIX 3: INSURANCE INDUSTRY AND LLOYD'S RESPONSE TO CLIMATE CHANGE

In recent years, the US and European insurance industries have come forward with research on climate change impacts, how to incorporate these in catastrophe models for valuation purposes and how to approach cost benefit analysis for risk management measures. The industry has begun to aid climate change adaptation planning with risk evaluation tools, to look for insurance solutions to support adaptation and to support government efforts with cooperative research.

Lloyd's has undertaken considerable work in better understanding and addressing the impacts of climate change. In 2007 Lloyd's was one of the founding members of the ClimateWise Initiative (www.climatewise.org.uk) and signed up to the ClimateWise Principles, which provide a framework for insurance companies worldwide to set out how they will build climate change into their business operations.

Lloyd's believes that action needs to be taken now to address the current and future impacts of climate change and, in addition to signing up to the ClimateWise Principles, Lloyd's is participating in many climate initiatives both within and outside the insurance industry.

ClimateWise Principles

The six ClimateWise principles to be adhered to by companies who have signed up, including Lloyd's, are outlined below:

1. Lead in risk analysis – including supporting and undertaking research on climate change, supporting more accurate forecasting, and sharing research with other relevant groups in society.
2. Inform public policy making - including working with policymakers to help them develop an economy that is resilient to climate change and promoting and actively engaging on public debate on climate change.
3. Support climate awareness amongst our customers – including encouraging our customers to adapt to climate change and increasing the proportion of repairs carried out sustainably following a loss or claim.
4. Incorporate climate change into our investment strategies – including encouraging disclosure on climate change from the companies we invest in and communicating our investment strategy on climate change to our customers and shareholders.
5. Reduce the environmental impact of our business – including seeking to reduce the environmental impact of our operations, disclosing our direct carbon emissions, and engaging our employees on our commitment to address climate change.
6. Report and be accountable – including incorporating climate risk into our business strategy and planning, and publishing a statement as part of our annual reporting detailing the actions that have been taken on these principles.

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