



# SC1 Risk Management

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## The Climate Change Challenge

by Andrew Dlugolecki

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### Abstract

This article distills the key messages of the 400-page third report on climate change and insurance “published” by the Chartered Insurance Institute on their website in February 2009. Climate change brings several dangers to insurers. Firstly, it increases the risk of extreme events in an insidious way by generating conditions that are more conducive to their appearance. Next, it increases the possibility that the severity of such events will reach unmanageable levels. Thirdly, it creates the possibility of widespread social and economic stresses, which would undermine insurability. To cope with such problems, insurers will need to overhaul their procedures for risk assessment, underwriting, claims-handling and reinsurance, and reconsider their product design. On the other hand, there will also be new opportunities, due to the increased need for insurance against weather impacts and the growth of clean technologies. The underwriting risks and opportunities are paralleled by risks to assets, from both climatic impacts, and from greenhouse gas mitigation policies, but those are not considered in any great detail here.

Awareness-raising is a critical task in managing climate change. Clients are confused, complacent or burdened by other urgent problems. Insurers themselves have not understood the scale of the implications of global warming. Policy-makers have prioritised greenhouse gas reduction policies over adaptation and have generally been reluctant to inject meaningful funding into climate change measures. Indeed often policies have compounded risk, or undermined risk transfer processes. Therefore a major task for insurers is to intensify their own actions, and engage their customers and policy-makers to ensure that the necessary changes can be implemented.

**Keywords:** climate change, insurance, risk transfer, micro-insurance, weather derivatives

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### 1. Introduction

This paper addresses five tasks under the umbrella of climate change and insurance. The focus is on underwriting, rather than asset management or corporate social responsibility. The underlying material for the analysis is contained in Dlugolecki *et al.*<sup>1</sup> However, that study has not been published publicly, and also is rather large, at around 400 pages, so the present paper opens the findings to a broader audience. Section 2 describes the major risks, some of which are already present. Section 3 outlines the various actions that insurers can take to deal with those issues. As well as risk, there will be opportunities for insurers to provide services and products relating to climate change, and these are discussed in Section 4. Section 5 considers how insurers’ clients are responding to climate change, since that will affect their attitudes and proposes actions by insurers and policy-makers to address the issues. The paper concludes by setting out the actions that insurers need to take in section 6 and the enabling actions which are required from policy-makers in Section 7.

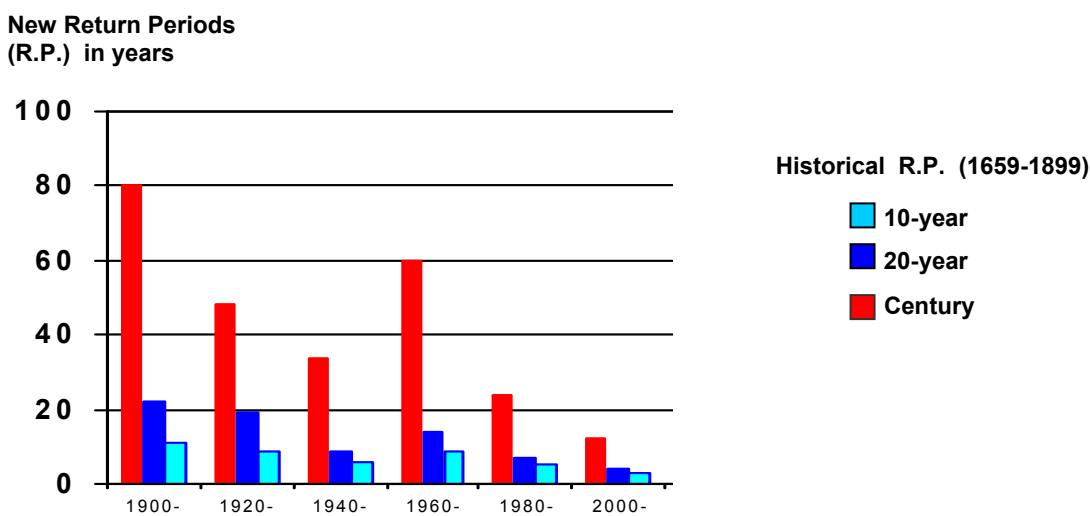
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<sup>1</sup> Dlugolecki *et al.* (2009).

## 2. Risks

The most direct risk to insurers from climate change is that the probabilities of loss are changing quickly. It is not easy to identify this by looking at extreme events themselves, since they are infrequent. A global trend has been identified but it is weak, and regional trends are unclear.<sup>2</sup> An alternative approach is examining trends in temperature level, since it is fundamental to many extreme events, such as windstorms, convective storms, droughts and rainfall. Higher temperatures can be expected to produce more extreme conditions. Figure 1 shows the frequency of hot months in Central England. Three levels are shown: 10-year, 20-year and century level events. The baseline for defining the return periods is 1659-1959. Figure 1 shows clearly that the frequency of hot months has been increasing. In the present decade, 10-year events are happening every three years, 20 year events are coming every four years, while 100-year months happen every 12.5 years i.e. their probability has risen from 1 per cent to 8 per cent. This phenomenon is typical of a shifting distribution; the more extreme the event, the faster the relative change in its behaviour. It is likely that the 1,000 year event now has a return period of just 83 years, and should therefore be within the remit of contingency planning.

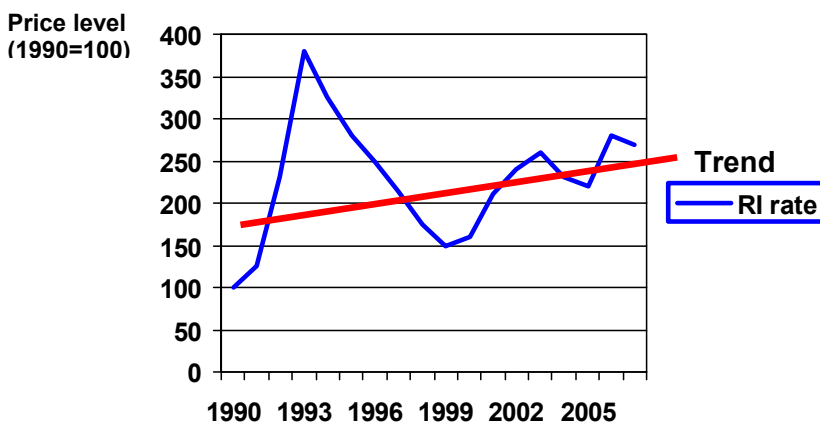
**Figure 1. Changes in the Frequency of Hot Months in the U.K.**



Author: Andrew Dlugolecki

It may be difficult to perceive the trend, but reinsurers seem to believe it. Figure 2 shows that there is an upward trend in reinsurance rates for catastrophe risks. Progress may be erratic, but insurers should be prepared for further increases, and plan accordingly.

**Figure 2. Reinsurance Rates 1990-2007**

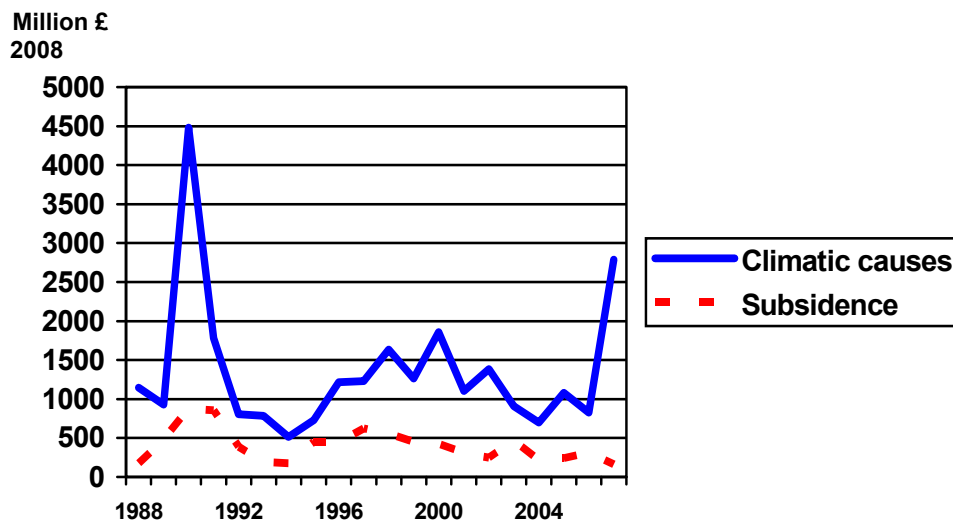


Source: Based on Guy Carpenter (2008).

<sup>2</sup> Miller et al. (2008).

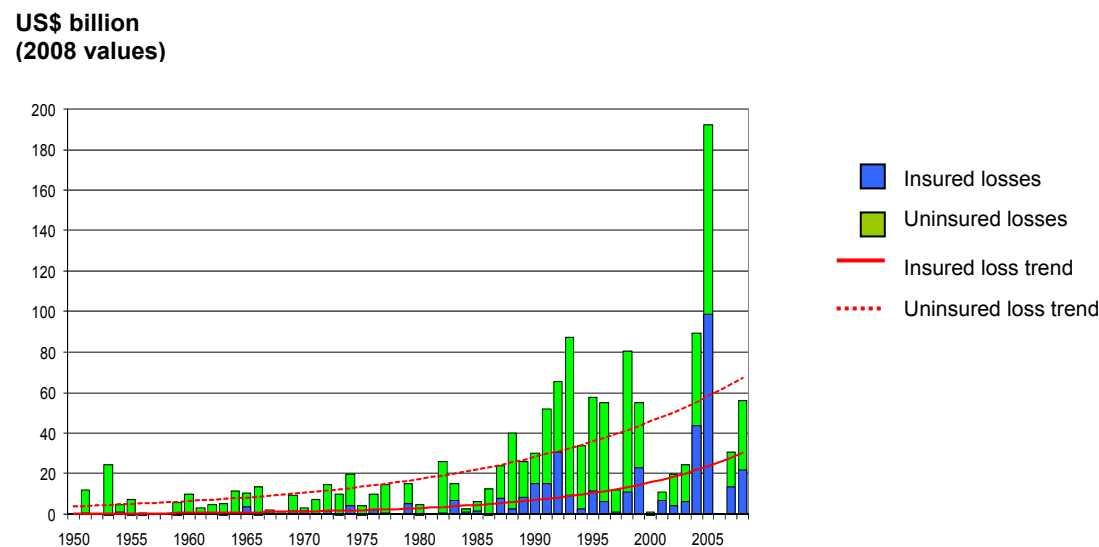
Along with the difficulty of meeting the financial burden of the rising cost of disasters, comes the problem of handling the claims. Hurricane Katrina showed how an extreme event can lead to the collapse of the emergency services, and can overstretch the construction industry, with a consequent multiplication of repair costs, and permanent dislocation for many residents and businesses. Reports on the floods of 2007 in England stated that disaster had been narrowly escaped, and that the emergency services would not be able to handle a more extreme event.<sup>3</sup> The erratic appearance of disasters makes it hard to plan for them. Figure 3 shows that in the U.K. weather costs between 1988 and 2007 were dominated by two spikes: floods in 2007 and storm and subsidence in 1990. What is not shown is that there were 3 million storm claims in 1990, but well under 100,000 flood claims in 2007. It is likely that the U.K. insurance industry (and the construction industry) would be overwhelmed by a repetition of the 1990 storms, since companies have been reducing staff numbers, but there are even more properties at risk. The U.K. had a narrow escape from the European storms of 1999 and 2005, but it can only be matter of time before another series of storms arrives.

**Figure 3. U.K. Weather Costs**



Author: Andrew Dlugolecki  
 Source: Association of British Insurers

**Figure 4. Great Weather Disasters 1950-2008**



Source: Munich Re

<sup>3</sup> Pitt (2008).

The same “peakiness” prevails even at the global level. Great disasters seem to appear in clusters: Figure 4 shows that one year in three, the costs are 50 per cent higher than the trend-line. In fact they were more than double the trend value in 1992, 1993 and 2005. Making allowance for such clusters, and for the inclusion of all societal and opportunity costs, it seems very likely that there will be a “peak” year that will record costs of over 1 trillion U.S. dollars before 2040. In fact, since so much development is taking place in coastal zones, the figure may arrive considerably before 2040.<sup>4</sup>

A more insidious risk for insurers is the international effects of climate change. Increasingly it is clear that many millions of people in developing countries could be deprived of the basic necessities of life, such as land, food and clean water. This could lead to large-scale social disorder, which would not be confined to those regions, because of migration, commodity price effects and rising crime and inter-state violence. This threat is already a high priority for security analysts in the U.S. and E.U. If such disruption were to occur, it would clearly undermine economic stability and insurability.

Some environmental activists argue for climate change liability, arguing that the problem has been caused by wealthy countries and nations, and that they should pay for the “clean-up”. While one might accept there is some truth in this logic, the reality is that there are many barriers in the way of using liability as a weapon, such as proving causation. More importantly, the legal process is slow and uncertain, and action on climate change is needed soon. In practice, the finance for adaptation and mitigation will come from wealthy countries, but using liability as an argument will hinder negotiations, since blame is not a constructive approach to solving shared problems. This paper therefore concludes that climate change liability is not a critical risk for insurers.

Besides the underwriting issues, climate change has implications for insurers as investors. Extreme events will disrupt entire countries and government policies to limit greenhouse gases will affect companies and economic sectors differentially. Such issues have been examined in numerous studies, and are not discussed here.

### 3. Managing the risk operationally

To address the certainty of higher disaster costs, insurers will need to overhaul their procedures for risk assessment, underwriting, claims-handling and reinsurance, and reconsider their product design.

A fundamental element of risk assessment is the availability of high quality data. Often this is costly to acquire, or even does not exist. Currently for example, insurers in the U.K. have realised that they are exposed to several types of flood risk. For two of these, dam breakage and drainage system overflow, data and predictive models are inadequate, although good progress has been made in dealing with riverine and coastal flood risk, by private and public sector initiatives.

The next step in the process is modelling the risk better. In view of the complexity of the hazards, and the insured exposures, catastrophe models can only be approximations to the underlying processes and impacts. This leads to quite large differences among the model results. This is compounded by the differences between models of future climate, and the fact that such GCM's (general circulation models) are much less detailed, so that they need to be interpreted. Faced with such uncertainty, insurers must not rely on a single model, and should cross-check their findings by looking at historical events and small samples where underwriters can compare the predictions with expert opinion. One promising avenue is the development of seasonal models, in which present conditions are used to forecast broad deviations from the historical norm over the forthcoming year or so. These already function quite well in tropical and subtropical regions for *El Niño* conditions, and have been helpful with hurricane forecasting at a broad level, but they do require massive computing power.

To give a feeling for the scale of the effect that insurers might expect climate change to have upon their MPL (maximum probable loss), the Chartered Insurance Institute (CII) study suggests two rules-of-thumb for flood and storm risk. For flood it suggests that the peak value could be 50 per cent greater than without climate change, and for storm 30 per cent. These are for general guidance only, and the actual factors could vary considerably. They reflect several factors: climate change is already happening, rainfall is becoming more intense, storms are wetter due to the fact that warm air carries more moisture, drainage systems are at capacity, and emergency and construction services are also under-resourced.

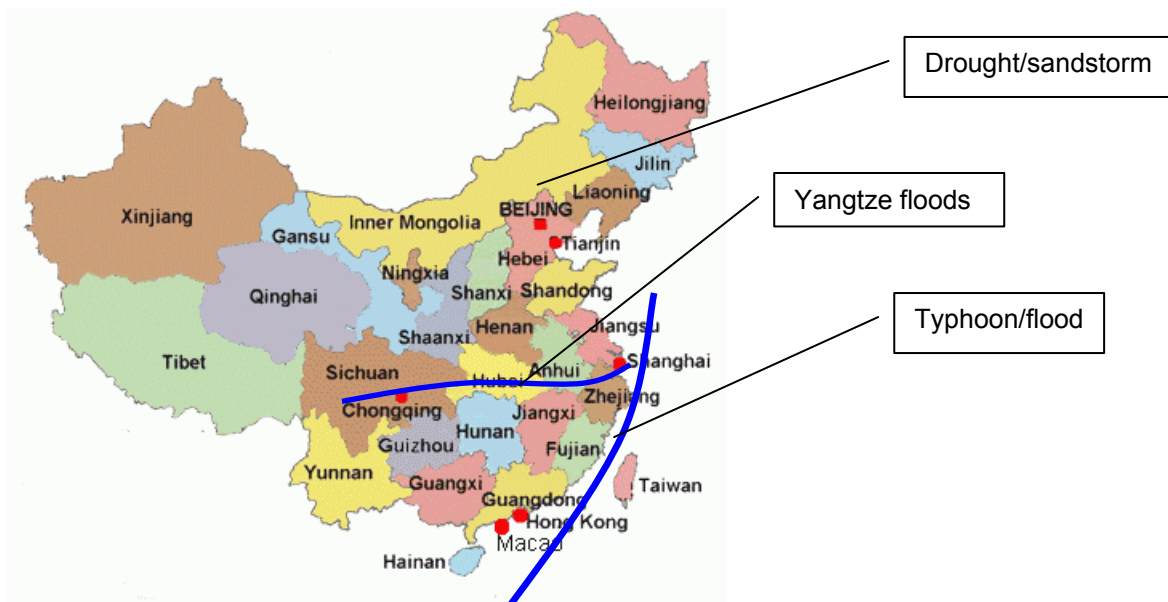
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<sup>4</sup> UNEPFI (2006).

As noted earlier, the U.K. in particular has been fortunate in its recent claims history, with no major storms since early 1990. This cannot last, and insurers should review their ability to cope with large volumes of storm claims during unfavourable conditions, particularly since there have been many changes in the way companies operate since 1990.

Modelling has focused on regions with high insured values. However, large exposures are developing rapidly in emerging economies. Figure 5 shows that China, which is now a major location for most global companies, is exposed to significant climatic hazards. These are expected to worsen with climate change, due to stronger typhoons, more variable rainfall, desertification and the disappearance of Himalayan glaciers, which are the prime source of water in Southeast Asia. By 2050, around 80 per cent of China’s GDP will emanate from three deltaic areas, vulnerable to flood, storm and water shortages. At the same time, surveys of local companies have shown a much lower level of risk management than in comparable “Western” plants. This should ring alarm bells for insurers: a poorly understood, growing, ill-managed exposure located at the start of the supply chain, with little stock in hand could lead to large losses in the originating country, as well as business interruption losses in the destination markets.

**Figure 5. Climatic Hazards in China**



Author: Andrew Dlugolecki  
 Source: CII Study “Coping with Climate Change”

Three important innovations in the product range have taken place in the last decade. First, catastrophe bonds are an accepted alternative to reinsurance, and can provide access to new sources of capital and longer tenor than conventional products, albeit with the drawback of basis risk. Second, micro-insurance is now providing simplified cover to 90 million families in the developing world, with distribution through informal networks and non-insurance organisations. Thirdly, weather derivatives have been used for some of those micro-insurance schemes, in order to provide cover to the rural sector in the event of abnormal, but not extreme, conditions. These innovations are still unfamiliar to most insurers and regulators, but they could be very useful in extending the reach of insurance.

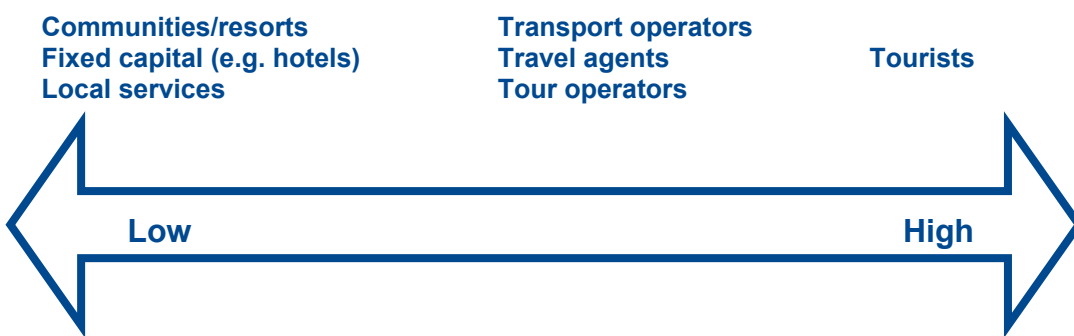
In the conventional product range of indemnity-based cover, insurers have been slow to recognise climate change as a factor. As the risks increase and knowledge of them improves, weather exposure can be expected to be seen as a significant underwriting variable, with primary insurers making greater use of features such as warranties, deductibles and premium discounts or loads. In high-hazard areas, there will be more attention to the physical nature of individual risks, much as happens in the U.K. for subsidence, where even individual trees are considered. Risk management advice and assistance, such as easy finance for portable flood protections could become a key element of the insurance transaction. Where major changes are necessary, such as in the market’s provision of storm or flood cover, it is important that insurers communicate the problem and their solution clearly and in good time, to avoid consumer backlash and regulatory delays.

There is also increasing interest in providing insurance products that reward or encourage emissions reduction, such as more efficient vehicles or energy-conserving driving styles, but this is still at a low level overall.<sup>5</sup>

#### 4. Opportunities

As well as risks, climate change opens up opportunities for the insurance sector due to the greater need for cover against climatic impacts, and also the rise of new industries and attitudes. Many economic sectors are vulnerable to weather variability, e.g. farming, energy, health, transport, water, real estate, and tourism and leisure. Often turnover and profitability can suffer even when there is no physical damage, which means that conventional insurance products would not respond to the situation, whereas weather derivatives could. Within sectors, it is important to consider who is really at risk. Most insurers think of Travel Insurance when tourism is mentioned. However, as Figure 6 illustrates, the traveller is not the person who is most at risk to climatic variability, because usually the decision on a particular destination can be delayed, or the tour operator can supply an alternative. Similarly, tour operators and transport providers usually have “back-up” facilities to cope with unusual conditions, and can soon make a return to “business-as-usual”. Those really at risk are the destinations and those who work in them or service them, but need is often overlooked or underestimated by those at risk.

Figure 6. Adaptability in the Tourism Industry



Author: Andrew Dlugolecki  
 Source: CII Study “Coping with Climate Change”

The need to halve greenhouse gas emissions globally by 2050 while maintaining economic development can be achieved by adopting three strategies: arresting deforestation, improving energy efficiency, and “clean energy”.<sup>6</sup> Insurers can play a role in each of these, by providing novel insurance products as part of a package of forest management and development services.<sup>7</sup> This is becoming feasible because of advances in remote observational systems and alternative risk transfer (ART). At the same time long-term insurance funds could exploit natural forests as potential assets. However, political risk could prove a major obstacle, since the regulations on living carbon are undecided and could change, and many of the forests are located in unstable countries. Energy efficiency products do not in themselves appear to contain any significant underwriting difficulties, but should be of great interest to insurers as investors, since they have above-average growth potential. However, clean energy technology installations present many novel challenges to underwriters because often the technology is untried, and the conditions in the operational site are extremely hazardous or even unknown. Again, many of the projects may be located in unstable countries where repair facilities are scarce. Specialist insurance products such as delayed start-up (also known as “advanced profit” cover), and breakdown cover would be very helpful in the development of this sector, since financiers prefer to see as little operational risk as possible, and manufacturers wish to use their capital for expansion, not as a guarantee against product failure. Since often the energy availability is dependent on weather conditions, the possibility of providing weather derivative cover looks promising. Western markets have already developed technology-specific covers, and these could be introduced to emerging markets with advantage, since often the local insurance market simply lumps energy risks in with generic property. One issue that is uninsurable is the long-term

<sup>5</sup> Mills (2007).  
<sup>6</sup> Stern (2006).  
<sup>7</sup> Silver and Dlugolecki (2009).

storage (sequestration) of carbon dioxide geologically, since the timescales are well beyond commercial transaction tenors, and the liability for escape could be very large. In that case, insurers would need to transfer the risk to the public sector. As with energy efficient products, alternative energy is a potentially high growth area, and so should be of great interest to insurers as investors, with the caveat that new industries and start-up companies are often more variable in performance.

Research into the impacts of climate change has revealed that there are important segments of national and international society which do not have access to insurance. Among these are small and medium enterprises (SME), residents in social housing, developing countries, and in particular farmers in those countries. There are several issues: education about the risk, so that consumers are willing to purchase, product design so that the cover is comprehensible and easy to claim on, and distribution so that insurance is affordable and accessible. In particular, insurance penetration in developing countries has been very low compared to OECD markets. There are several reasons for this, including the low availability of financial services, the high administrative costs of conventional insurance, and the availability of alternative funding such as disaster relief and emergency loans.

Now the successful piloting of micro-insurance weather derivatives has shown that the technical difficulties can be solved and schemes can operate commercially without the need for operational subsidies. At state level, the successful operation of the Caribbean Catastrophe Risk Insurance Facility (CCRIF) also bodes well. Although here subsidies are inescapable for the poorest countries, insurance provides a superior disaster funding mechanism than post-event emergency aid.<sup>8</sup>

Public attitudes to consumption are changing with greater emphasis on sustainability. This resonates with the need to reduce emissions. Insurers can play an important role here since they procure over US\$1 trillion in replacement goods and repairs each year, and also occupy and own very large volumes of real estate.<sup>9</sup>

## 5. Climate change and the insurance purchaser

Insurers face a significant barrier in providing appropriate products for climate change in that the market is not risk-aware. Clients are confused, complacent, or burdened by other urgent problems. The media have a heavy responsibility in this regard, since they delight in staging “debates” or “challenges to the establishment view”, in which naturally the tiny minority of climate change sceptics are delighted to participate. This leaves consumers with the impression that scientific opinion is seriously split on the issue of global warming, which is completely wrong. Another factor which undermines a risk-responsive approach is the constantly repeated message that “best buy = cheapest offer” which is heard too often from consumer grounds and government agencies. When buying a product that is going to perhaps replace one’s car or house, this is not a sound approach.

Corporate clients are also not well prepared. Figure 7 shows how the largest companies in the world and a comparable sample in the U.K. approach the issue of climate change. (The data is taken from the Carbon Disclosure Project, the largest such exercise, which has been running since 2001). The chart shows that 80 per cent of these companies recognise that climate change presents them with risks and opportunities, or openings. However, when it comes to setting targets for in-house emissions, U.K. companies are less advanced in their preparations, both for the largest quoted firms (FT100) and the next tier (FT250). When asked how strategically they managed climate change, just over 60 per cent of the global sample placed it a board level, just over 50 per cent of the FT100 did so, and only just over 20 per cent of the FT 250. This progressive downgrading with size of firm is confirmed by a report on SME attitudes to climate change and insurance in the U.K. Most of the companies did not recognise it as serious threat, did not buy business interruption cover, and many even under-insured their property assets.<sup>10</sup> All levels of company are exposed; large ones through the supply chain, and their frequent reliance on one-site operations for economies of scale, and small ones because they lack the resources to recover from an unexpected impact.

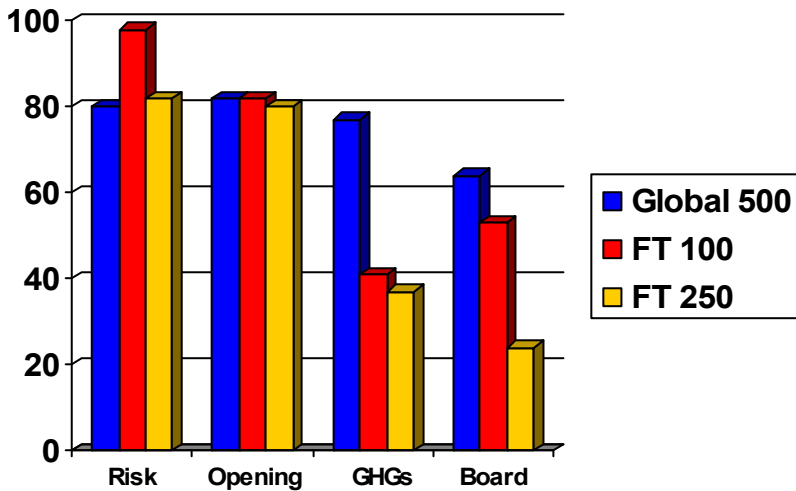
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<sup>8</sup> UNFCCC (2008).

<sup>9</sup> UNEPFI (2007).

<sup>10</sup> Crichton (2006).

Figure 7. Large Corporates and Climate Change



Source: Data from Carbon Disclosure Project

### 6. Actions by insurers

Insurers need to take action at three levels: collectively, as companies and as individuals.

#### Industry

- Engage in the policy-making process

Awareness of the urgency of climate change is weak among clients and politicians. The insurance industry needs to engage in the policy debate nationally to ensure that risk management is given proper attention, but also internationally. The level of global policy-making within United Nations Framework Convention on Climate Change (UNFCCC) is particularly important, because that is where the key decisions on emission targets are set, and that is where the frameworks for adaptation and mitigation policies are determined. Other industrial groups lobby effectively, often to the detriment of precautionary measures, but so far the finance sector has failed to make the same commitment. Potentially there are two nuclei that could serve for this purpose, either the United Nations Environment Programme Finance Initiative (UNEPFI), which includes banks and investors, or The Geneva Association, which is a loose group of the 80 largest insurers in the world. Working with other sectoral groups, or at only national level will not work, because the unique messages from insurers will be diluted and will not reach the key negotiators.

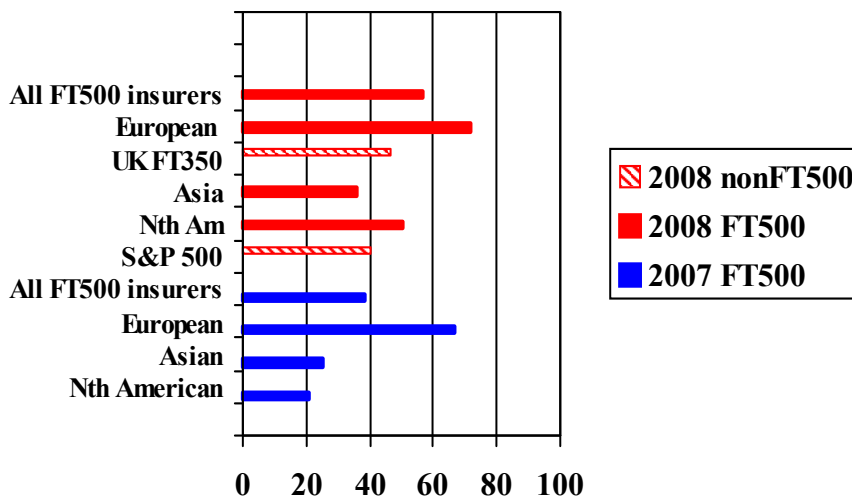
- Enhance professional education

There are still too many staff who do not fully understand the relevance of climate change to their work and for their clients. This can be overcome to some extent by improving the content of professional education in examinations and continuing professional development, to ensure that climate change is embedded in “the way we think”.

#### Companies

Figure 8 shows that many insurance companies are still not “up to speed” in terms of climate change preparedness. The data shows the score out of a possible 100 that the Carbon Disclosure Project (CDP) awarded to the largest insurers in the world based on their responses to the annual CDP climate change survey. The scores have been averages by region for the latest two years (2007 and 2008), and also show the 2008 scores for the next tier down of insurers. The scores in 2008 were all better than in 2007, but there were major disparities between European insurers, with an average score of over 70, compared to around 50 for North America, and 35 for Asia (which was a mixture of high scores for Japanese insurers, and low scores for Chinese ones). What is also apparent is that the second tier in the U.K. and U.S. (FT 350 and S&P 500 insurers who did not rank in the world’s top 500 listed companies) was significantly lower than their “big brothers”.

Figure 8. Climate Change Disclosure by Insurance Companies



Source: Data from Carbon Disclosure Project

- *Review extreme risks urgently*

The priority for insurers must be to re-assess their vulnerability to extreme risks, in the light of the dynamic hazard distributions. This could affect their product pricing, capital adequacy and claims-handling capability.

- *Opportunities and risks*

Next, insurers should review climate change as an issue that might affect all of their operations and assets, and prepare strategies for the less urgent risks and also for the many opportunities which will arise.

- *Mainstream climate change in all processes*

Finally, insurers should ensure that climate change is treated as a given fact which should be routinely considered in daily operations and business planning.

Where necessary, companies may feel it necessary to engage a consultant, or to liaise closely with government advisory services and/or their trade association in order to develop a climate change strategy to overcome the initial resistance to change.

**Individuals**

During its recent study on climate change, the CII surveyed its members for the third time (the previous surveys were carried out in 1993 and 2000, as part of the previous studies). The results were encouraging in that 87 per cent of the 5000-plus respondents believe that man-made climate change is real, 78 per cent are taking action by consuming less energy, and 68 per cent believe the industry should actively campaign in favour of emission reductions. The responses to other questions indicated that CII members did not see climate change so much as a problem for insurers, who would react in order to manage the risk, as for clients who would retain the risk. However other financial sector professionals seem less aware: the CII survey also covered mortgage advisors, who scored less well than insurers, and separate surveys of actuaries and investment managers also score less well, sometimes even poorly, on climate change.<sup>11</sup>

- *Climate change awareness*

Individuals should ensure that they have access to the best available information on climate change as it affects their work, and ensure that they apply that knowledge with colleagues and clients.

<sup>11</sup> Dlugolecki et al. (2009).

## 7. Action by government

Public policy could be better designed to involve the insurance industry more effectively in addressing climate change under both mitigation and adaptation.

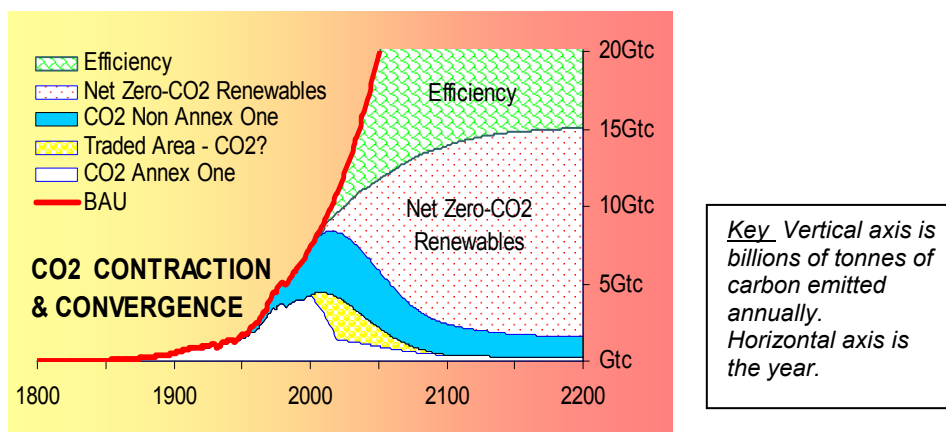
### Mitigation

This is the more important area, since if emissions are not constrained sufficiently, the risks associated with climate change will become overwhelming.

- *Global emissions reduction (contraction and convergence)*

From a risk management perspective, the costs of being too lax about emissions could be very high, due to a breakdown in the climate system. It therefore makes sense to aim for tough limits, which can be relaxed later if appropriate. There is ample guidance from scientific sources on this. Many scientists believe that an atmospheric level of 450 ppmv (parts per million by volume) of carbon dioxide should be the initial target for prudence; already we are at 380. For long-term allocation, the “Contraction and Convergence” model (C&C) seems appropriate (see Figure 9). This consists in choosing (1) a “safe” global annual emissions level and (2) a date at which it will be shared out globally on a per capita basis at national level. The other element is (3) a start date from which time the actual, unequal per capita emissions that currently exist at national level start to move towards their final, equal per capita levels. The name C&C reflects the facts that the annual emissions contract to a safe level, and the national per capita allowances converge to become equal.

**Figure 9 Contraction and Convergence**



Source: Global Commons Institute

In Figure 9, the solid line “BAU” (business as usual) shows the path that emissions will follow on historical patterns. The “CO<sub>2</sub>” segments of the chart show how actual emissions could develop under C&C. The gap between BAU and actual emissions would be solved by energy efficiency and resource efficiency (RE). In the short run, since the C&C emissions allocation is based on equal per capita allowances, that gives the developing world a surplus of emissions credits which they can trade with countries who have an under-allocation of emission credits, because developing countries have lower per capita emissions generally.

This elegant policy has been recommended to policy-makers by numerous bodies, including the Church of England, the World Council of Churches, the Royal Commission on Environmental Pollution, and the German Scientific Advisory Committee to Government (WBGU), and was commended by UNEPFI in 2002. It has the advantages of simplicity and fairness, gives long-term confidence in emissions reduction, and in the short-term can accommodate a variety of “fixes” as well as facilitating the flow of funds to developing countries.

Establishing a clear global emissions strategy will kill the “wait and see” mentality among companies and investors. It will give confidence to institutional investors that want to channel capital to those companies

which are willing and able to seize the opportunities of the carbon-light economy. This could be reinforced by guidelines to the corporate sector on their climate change risk disclosure, which is still very patchy, and so hampers asset managers. It should really be viewed as a reportable risk under corporate governance.

- *Clean energy*

Insurers could also play a stronger part in the expansion of new energy technologies if the public sector removed early-stage barriers. Strategically, the energy sector has been deprived of public sector R&D funding, other than for nuclear power. The private sector views that stage of technology development as too risky, but would be willing to support later phases like scaling up and deployment. Secondly, underwriters will be reluctant to accept liability for long-term storage of gases under carbon capture and storage (CCS). The public sector needs to frame a liability system for CCS as soon as possible.

### **Adaptation**

Policy-makers have prioritised greenhouse gas reduction policies over adaptation and have generally been reluctant to inject meaningful funding into climate change measures. Indeed often policies have compounded risk, or undermined risk transfer processes.

- *Risk management*

Regarding adaptation, the public sector can prevent risks becoming uninsurable through risk-attentive regulations in areas like land development, building design and repair work. Too often economic development has occurred without regard for climate risk, reducing the insurability of assets.

- *Information*

It is vital that there is an open-book policy for basic risk-related information such as weather data, so that stakeholders, including insurers, are not deterred by the high price of data, as happens currently.

- *Market regulation*

Insurers would prefer to see minimal political interference with actuarially determined rates and conditions, and reasonable profit levels and taxation. Such a framework would encourage them to offer products for climatic risks. Transparent prospective pricing is to be encouraged, i.e. with a stated allowance for recent and near-future climate change, since it will help to sustain insurability as climate change progresses.

A flexible approach should be adopted to permit unconventional insurance products like multi-year contracts, weather derivatives and catastrophe bonds to compete on a level playing field. It is regrettable that international regulatory principles have made the establishment of internal corporate catastrophe reserves unattractive.

Other ways that public policy can foster a dynamic insurance market are by avoiding the temptation to “crowd out” the private sector by supplying insurance substitutes in the form of disaster relief, or acting as “insurer of last resort” for risks which could be placed on the international reinsurance market.

- *Developing countries*

The insurance industry has a minimal presence in developing countries, due to the weakness of the financial sector in those countries. Basic risk assessment and loss prevention projects are a priority for public sector funding, followed by training and education for local insurers, intermediaries and at-risk parties. Flexible regulations are needed to promote innovation through indexed insurance and micro-institutions. Financing these enabling activities should be a high priority under the UNFCCC’s National Adaptation Plans of Action process. Developing countries need to open their markets to foreign capital, to allow insurance companies to import climate-relevant knowledge and practices, and also provide access to international risk transfer markets.

In connection with developing countries, forests are a potential future asset class, with valuation dependent on a range of eco-services and carbon storage. If public policy can create a viable regulatory and risk management focus, insurers could engage in this area as underwriters, and also as long-term asset managers.

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