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**CONFERENCE ON  
CLIMATE CHANGE, EXTREME EVENTS, AND COASTAL CITIES:  
HOUSTON & LONDON**

**Insurance and Climate Change**

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## **Abstract**

*This paper examines climate change mitigation and adaptation from an insurance industry perspective, with particular reference to London and the USA. It illustrates how British insurers are increasingly shaping public policy and using new technology to manage the risks from climate change impacts and makes a plea for society to make more use of insurance expertise in future decision making. The industry is a “sleeping giant” much bigger and potentially more powerful than the fossil fuel industry in shaping the future through financial incentives and disincentives. The insurance industry has much to contribute, and increasingly would welcome a greater dialogue with the academic and political community. The paper has a “further reading” section, which includes two recent UN reports which illustrate the need for greater dialogue between experts in the USA and the UK. Hopefully this conference will help to create such a dialogue.*

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## **Explanatory Note: Great Britain**

*Great Britain is a collection of over 400 islands off the coast of the continent of Europe. According to the CIA website, it is about the size of the State of Oregon in the USA. Despite its size, it is the fourth largest economy in the world. Some of the examples in this paper relate to insurance activities in Great Britain (GB), and it may be useful to explain that Britain is made up of the two kingdoms of England and Scotland together with the Principality of Wales. It is wrong therefore to say “England” when referring to Britain as a whole. Indeed, Scotland accounts for 40% of the land area of Britain and 9% of the population. One county in Scotland is bigger than Belgium, while another has a longer coastline than France.*

*Scotland has its own established church, and separate legal and educational systems. It also has its own banknotes and language (Gaelic) although this is spoken only by a minority. The Shetland Islands, while within Scotland politically, have a separate legal system and language, and a measure of local autonomy. Since devolution in April 1999, Scotland has had its own elected Parliament, which has legislative powers over internal affairs.*

*Wales has its own language, church and elected Assembly, but this has no legislative powers so in terms of legal and political organisation is similar to England. For some of the issues considered below, it is necessary to distinguish between England and Wales on the one hand, and Scotland on the other, because the approaches are significantly and increasingly different, especially with regard to local authority matters such as land use planning and building standards.*

*The United Kingdom consists of Great Britain, plus the Province of Northern Ireland. The “British Isles” is a geographical term rather than political, and consists of the UK, plus the Republic of Ireland, and the UK Crown Dependencies of the Isle of Man and the Channel Islands.*

## CLIMATE CHANGE

### Mitigation

This is the term originally used by the White House to mean reducing greenhouse gas (GHG) emissions to slow down the rate of climate change.

While the word “mitigation” is still used around the world, it is interesting to see how many US scientists feel that the White House has lost its “leadership” of the climate change debate. After the Kyoto Protocol comes into force on the 16<sup>th</sup> February 2005, the developed countries in the world will be able to make progress towards reducing carbon emissions without waiting for the White House. Developing countries are also making efforts to reduce emissions with the help of organisations such as the Global Village Energy Partnership<sup>1</sup>. Most GHG emissions are from fossil fuels, such as coal and oil. There are plentiful stocks of coal in the USA, China and Australia, but most oil comes from the Middle East, and dependence on oil is a security issue as well as a climate change issue. Frank Gaffney, president of the Center for Security Policy in the USA has been quoted<sup>2</sup> as saying in January 2005, that a policy of denying oil revenue to some oil exporters would help “*erode the grasp of tyrannies round the world*” that use oil revenues to “*oppress their people and threaten us.*” He added: “*This is ... an incipient national security emergency and must be addressed as such.*”

It is reassuring to see that many individual states, cities, and businesses in the USA have made good progress without any Federal intervention<sup>3</sup>. 37 states have completed GHG inventories, and 19 have completed action plans to reduce emissions with eight more in progress. There are numerous imaginative and effective schemes working to reduce emissions and promote renewables such as biomass and wind power. Georgia has had a “no till” scheme for farmers since 1987, New York has a “Green Building” tax credit and a clean fuel bus programme. Texas has the “STAR” programme for energy efficiency in public buildings, Utah is financing and installing solar energy technologies, and Washington State has had a commute trip reduction programme since 1991 to encourage the use of public transport and car pools.

The 6 New England states and the Eastern Canadian Provinces have adopted action plans to reduce GHGs to 1990 levels by 2010, and 10% below 1990 by 2020. New York, California, and Oregon have similar plans. New Mexico, Arizona and Colorado are in the process of drafting plans. It could well be that it will be individual States, cities and businesses which will be the key to reducing GHGs within the USA, rather than the Federal government, as it is mainly buildings and coal that will fuel global warming and buildings are a local issue<sup>4</sup>. The insurance industry could have a key role in encouraging more sustainable buildings through research and premium incentives.

An international report<sup>5</sup> published in January 2005, warns that the current level of 379 parts per million (ppm) of CO<sub>2</sub> in the atmosphere is rising by more than 2ppm per year and could reach 400ppm within ten years. This would be enough to generate a 2

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<sup>1</sup> See <http://www.gvep.org/>

<sup>2</sup> Financial Times, 28<sup>th</sup> January 2005.

<sup>3</sup> For details, see: [http://www.energy.ca.gov/global\\_climate\\_change/summary.html](http://www.energy.ca.gov/global_climate_change/summary.html)

<sup>4</sup> Edward Mazria, personal communication. See also [www.mazria.com](http://www.mazria.com)

<sup>5</sup> The International Climate Change Taskforce, 2005. “*Meeting the Climate Challenge*”. Institute for Public Policy Research, the Centre for American Progress, and the Australia Institute. ISBN: 1860302645 . For details see [www.ippr.org.uk](http://www.ippr.org.uk) .

degree centigrade rise in global temperature from pre industrial levels. Many experts now say that this is the point of no return when feedback effects will lead to runaway climate change and the prospect of significant rises in sea level in the lifetime of our grandchildren. The report argues that all G8 countries should set a lead by adopting national targets to generate at least 25 per cent of electricity from renewable energy sources by 2025 and mandatory cap-and-trade schemes for emissions, like the EU scheme. In the US, this could happen through the Climate Stewardship Act, proposed by Republican Senator John McCain and Democratic Senator Joseph Lieberman. This could provide a path for US re-entry into a global climate change agreement after the Kyoto Protocol's first phase ends in 2012, but will this be too late? According to a detailed analysis by Mark Clayton of the Christian Science Monitor<sup>6</sup>, based on coal power plant current construction programmes, by 2012, China, India, and the United States alone are expected to emit as much as an extra 2.7 billion tons of carbon dioxide per year. This does not include coal burning furnaces in individual buildings. In contrast, Kyoto countries by that year have undertaken to cut their CO<sub>2</sub> emissions by only 483 million tons.

China in particular is developing since markets were given an element of free enterprise, and it is now the World's largest user of steel and copper.

For example, in the three years from 1999 to 2002, in China there has been<sup>7</sup>:

- 30% increase in colour TVs
- 130% increase in air conditioning units
- 86% increase in cars (+100% by 2003)
- 528% increase in motorway/freeway lengths
- 70% increase in exports of manufactures

This sort of growth is not fully taken into account in climate change models, nor the fact that many of these exports are sent by air freight, resulting in even more GHGs.

Results from the biggest ever study of climate change were published in January 2005. This project<sup>8</sup>, run from Oxford University in Britain, involves distributed computing. Rather than using a supercomputer to run climate models, people can download software to their own PCs, which run the programs during downtime. More than 95,000 people have registered from more than 150 countries, and their PCs have between them run more than 60,000 simulations of future climate, far more than the 128 scenarios the supercomputers at the British Met Office can run in a year. Each PC runs a slightly different computer simulation examining what happens to the global climate if levels of carbon dioxide in the atmosphere double from pre-industrial levels - which may happen by the middle of the century. This project has found that temperature rise could be very much higher than any previous simulations have shown: an average temperature increase which, in the worst case scenario, could be over 11 degrees Centigrade, rising to a 20 degree increase in higher latitudes. (This compares with the top level of 5.8 reported by IPCC in 2001.) Such a world would be very different, and the changes would be irreversible.

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<sup>6</sup> Clayton, M., 2004 "New coal plants bury 'Kyoto'" The Christian Science Monitor, December 2004. Available from <http://www.csmonitor.com/2004/1223/p01s04-sten.html>

<sup>7</sup> Rio Tinto Review, October 2003

<sup>8</sup> See [www.Climateprediction.net](http://www.Climateprediction.net)

Time is short, and it is no wonder that many governments feel they can no longer wait for the USA to catch up. The author has personal experience of the actions of US fossil fuel industry lobbyists in UN FCCC conferences and can only admire their expertise and stamina in delaying and filibustering. After all, they have been doing it for over ten years now. He was not surprised when in Kobe, Japan on January 19, 2005, the US delegation to a global conference on disasters wanted to purge a UN action plan of its references to climate change as a potential cause of future natural calamities despite the fact that most scientists in the rest of the world now recognise that climate change is the single most important threat to the planet's survival. The US fossil fuel and motor industries have done a remarkable job in protecting their own interests, but there are other interests to consider, namely the powerful financial sector of insurance, banks and other institutional investors.

### **The Financial Sector (insurance, pension funds, banks and investment houses)**

This sector has been acting on three fronts:

#### Lobbying governments

200 major companies in the financial sector around the world have signed up to the UN Environment Programme Financial Institutions' (UNEP FI) Statement of Environmental Commitment<sup>9</sup>. It is ironic that hardly any of the signatories are US companies, despite the fact that they may well suffer more than most from the impacts of climate change. Some commentators have blamed pressure from the fossil fuel and power generating industry. The UNEP FI's Climate Change Working Group (CCWG) has always had a strong presence at the annual Conference of the Parties (COP), part of the United Nations Framework Convention on Climate Change, and 2004 was no exception. The working group held a side event at COP 10 in Buenos Aires, where it launched its latest CEO Briefing<sup>10</sup> titled "*Finance for Carbon Solutions: The Clean Development Mechanism - The Financial Sector Perspective.*" The side event highlighted what the financial sector can offer in terms of carbon solutions, with a focus on the Clean Development Mechanism (CDM), and, more specifically, the risks and opportunities associated with the CDM as viewed by the financial sector.

#### Lobbying Big Business interests

95 institutional investment companies with assets of \$10 trillion, have so far signed up to the Carbon Disclosure Project<sup>11</sup> (CDP). They ask businesses to disclose investment-relevant information concerning their greenhouse gas emissions. Their website provides the largest global registry of Greenhouse Gas Emissions from public corporations. Over 300 of the 500 largest companies in the world now report their emissions on this website, recognising that institutional investors regard this information as important for shareholders.

#### Lobbying Institutional Investors and Oil companies

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<sup>9</sup> see [www.unepfi.net](http://www.unepfi.net) ..

<sup>10</sup> The briefing and presentations are available online at

<http://www.unepfi.org/events/2004/cop10/index.html>

<sup>11</sup> <http://www.cdproject.net/>

The Investor Network on Climate Risk<sup>12</sup> (INCR) is another body of institutional investors which is taking an active role. The purpose of the network is to promote better understanding of the risks of climate change among institutional investors. INCR encourages companies in which its members invest to address any material risks and opportunities to their businesses associated with climate change and a shift to a lower carbon economy. Climate risk includes financial, fiduciary and liability risk ensuing from climate change. As a coalition of stockholders, they are actively lobbying individual companies in the oil industry in particular to adopt more climate friendly policies, with some notable successes.

Together, companies in the financial sector have much bigger assets than the combined might of the fossil fuel industry and they control over 30% of the world's stocks and shares. Most major banks and insurance companies now recognise that whatever the fossil fuel companies might say, climate change is here, and its impacts are happening now. European insurers are already geared up to underwrite emission trading contracts, derivatives and hedging products, wind and biofuel crop guarantee covers for renewable energy, and other new financial products which will help Kyoto to work<sup>13</sup>. Insurance companies and banks work at a global level, and if insurance and loans are to be available at reasonable terms in the future, society has to mitigate its carbon emissions and adapt its infrastructure to cope with these impacts. Much progress has been made by financial institutions to develop micro finance and micro insurance for developing countries which will be the worst hit by future severe weather, for example the work of the British Commonwealth Disaster Management Agency, and the UNEP FI Asia Pacific Task Force (APTF). (The latter is due to start operating later in 2005.) The need for more such initiatives has also been recognised within the USA<sup>14</sup>, and it is to be hoped that the finance sector can mobilise on this as effectively as they have done on investment management.

In Europe, the need to reduce greenhouse gas emissions is now widely accepted. The European Parliament, along with Africa, China and India, all accept the concept of "Contraction and Convergence"<sup>15</sup> which is consistent with the basis of the UN Charter that everyone in the world should have equal rights. It is also consistent with the principles of "Utilitarianism" as propounded by Jeremy Bentham, the founder of University College London. The basis of Utilitarianism is "the greatest good for the greatest number".

C&C starts with the premise that everyone should have equal rights to emit carbon pollution. The concept is so eminently fair that it has been endorsed by the Quakers and the Church of England. It has also been recommended by the British Chartered

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<sup>12</sup> <http://www.incr.com/>

<sup>13</sup> Dr Hendrik Garz, Volker Kudzusz, and Claudia Volk of WestLB Equity Markets, 2004. *Insurers & Sustainability - Playing with fire.* WestLB Equity Markets, Dusseldorf, Germany. Available in English from WestLB AG, Woolgate Exchange, 25 Basinghall Street, London EC2V 5HA

<sup>14</sup> Mills, E. 2004. "Insurance as an adaptation strategy for extreme weather events in developing countries and economies in transition: new opportunities for public-private partnerships." Lawrence Berkeley National Laboratory Report No. 52220. California, USA. See [http://eetd.lbl.gov/EMills/PUBS/Insurance\\_Emerging\\_Markets.html](http://eetd.lbl.gov/EMills/PUBS/Insurance_Emerging_Markets.html)

<sup>15</sup> Meyer, A., 2000. "Contraction and convergence. The global solution to climate change" Green Books Ltd, Devon, England. For more information see: <http://www.gci.org.uk/Conferences/GAP.pdf>

Insurance Institute report on climate change<sup>16</sup>. However if everyone had an equal allowance on a per capita basis to stabilise emissions to a safe level, this would involve limiting carbon emissions to 0.3 tonnes per person per year – about the amount emitted per passenger on a New York to London return flight<sup>17</sup>. Currently, per capita carbon emissions average 20 tonnes in the USA, 10 tonnes in Britain and 1 tonne in India. The average US car alone emits its own weight in carbon every year.

Indeed, one of the first things that strikes the visitor to the USA is the number of motor vehicles, out of 500m vehicles in the world, 200m are in the USA. However, motor vehicles can easily be converted to run on ethanol, a carbon neutral source, and Henry Ford's preferred fuel until Prohibition came along. Ethanol can now be produced very cheaply and locally not only from biomass crops, but from anything organic, including waste paper and other organic waste, thanks to new catalysts developed at the University of Florida<sup>18</sup>. In countries with a healthy farming industry, this could make all the gasoline refineries redundant. No wonder the fossil fuel companies do not like to talk about it. Even BP, which recently renamed itself "Beyond Petroleum" and which is the biggest owner of solar power patents, has shown little public interest in ethanol. From an insurance and environmental point of view ethanol is very attractive. Motor insurers should certainly be encouraging it. Not only is it carbon neutral, if spilled, it dissolves in water or evaporates, so pollution is no problem. It is much less likely to catch fire or explode in a motor accident, compared with a vehicle propelled by gasoline, propane or hydrogen, so is intrinsically safer. As for performance, it has a higher octane than gasoline and is the standard fuel for motor racing cars. It is also, so far, the only possible non fossil fuel alternative for aviation. It may not be possible to produce enough biofuel for power stations, but there should be enough for transport in many countries. With ethanol, you can keep your SUVs, and forget about the insecurity of two thirds of the world's stocks of oil coming from the Middle East.

In Brazil, the availability of sugar cane has meant that many vehicles have been running on ethanol for some years. Flex-fuel cars that run on gasoline, ethanol or any combination of the two make up 30 percent of all new car sales and are expected to take half the market soon. Most major car manufacturers in Brazil, like General Motors, Volkswagen and Fiat, already produce flex-fuel cars, and others like Ford are planning to introduce flex-fuel models, with at least one analyst predicting that in three years flex-fuel cars will make up 100 percent of all new car sales in Brazil. Ethanol/gasoline mix fuel has been common in the prairie areas of the USA and Canada for many years. In Australia, the government is now actively promoting ethanol fuel.

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<sup>16</sup> Dlugolecki, A. (ed), Agnew, M., Cooper, M., Crichton, D., Kelly, N., Loster, T., Radevsky, R., Salt, J., Viner, D., Walden, J., Walker, T., 2001. "*Climate Change and Insurance*." Chartered Insurance Institute Research Report, London 2001. (Available on [www.cii.co.uk](http://www.cii.co.uk))

<sup>17</sup> Hillman, M., and Fawcett, T., 2004 "*How we can save the planet*". Penguin Books Ltd, London.

<sup>18</sup> Senator Richard Lugar and James Woolsey, 1999, "*The New Petroleum*" "Foreign Affairs" magazine, New York, USA, January/February 1999

The real problem is not motor vehicles, but buildings. Buildings are much less easy to adapt and account for more than 50% of carbon emissions. A noted US architect, Edward Mazria in Santa Fe points out<sup>19</sup> that:

*“...building sector emissions in the U.S. have increased about 28% since 1990. This sector’s emissions are projected to increase dramatically as the U.S. continues to add 5 billion square feet of building to its existing stock each year. The building sector is also the major global greenhouse gas emitting sector accounting for 50% of global GHG emissions and energy consumption annually. Additionally, buildings have a long lifetime and energy consumption pattern that lasts for 50 to 100 years. Even with all the talk these days about sustainability, the energy consumption per square foot of building stock in the U.S. is actually increasing slightly each year. This means that what we construct today exceeds the average in their appetite for fossil fuels. To complicate matters, developing countries are emulating the U.S. in their rush to build infrastructure.*

*“With oil and natural gas resources limited, coal is becoming the fossil fuel of choice; it’s plentiful, cheap and dirty. The building sector is poised to fuel the world’s rush toward climate change on the back of coal. Clean coal technology is decades away, as is CO<sub>2</sub> sequestering and disposal. And, this doesn’t include the cost of these technologies or the feasibility of carbon disposal. The United States alone is also projected to add 22 million fossil-fuel burning mini-power plants in buildings over the next 20 years. The new buildings we construct each year not only consume electricity produced at a central power plant, but they also directly burn fossil fuel in boilers, furnaces and hot water heaters. Currently, 58% of the energy consumed in a building is burned at the site. The most ambitious programs of electricity generation from renewables (solar, wind, biomass and geothermal) put forth by environmental groups would supply only a fraction of the projected increase in U.S. and global demand.”*

A Pentagon report suggests that at current growth rates, in 20 years time the USA alone will be using more resources than the whole world can produce<sup>20</sup>. In Europe, much work has been done to re-educate architects to design more eco friendly and more resilient buildings, which not only have lower carbon emissions, but are more resistant to floods and storms<sup>21</sup>. Unless the public is prepared to accept wide spread expansion of nuclear power<sup>22</sup>, it is architects and the construction industry generally we should be concentrating on, not motor manufacturers.

The insurance industry is very well placed to use financial penalties and incentives to architects, builders and property owners to produce buildings which help to mitigate

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<sup>19</sup> Edward Mazria, personal communication. Quotation reproduced with permission. See also [www.mazria.com](http://www.mazria.com)

<sup>20</sup> Marshall, A., 2004. 'An abrupt climate change scenario and its implications for US National Security'. Pentagon Office of Net Assessment. USA.

<sup>21</sup> Roaf, S. Crichton, D., and Nicol, F. (2005) “*Adapting Buildings and Cities for Climate Change*” 361pp Architectural Press and Elsevier Press, London. ISBN 0 75065 9114

<sup>22</sup> James Lovelock the “patriarch” of the green movement believes that alternative energy such as solar, wind or wave power will not be enough to replace fossil fuels without drastic reductions in lifestyle, reductions which people are not prepared to accept. Without alternative sources of energy or worldwide lifestyle changes, nuclear is the least worst option, if only as a temporary measure. The side effects will be as nothing compared to the impacts of climate change. For example, a 1 m rise in sea level will make 55 million people in India homeless and there is nowhere for them to go.



GHG emissions. Many new buildings are owned by institutional investors and in Europe, insurance investment managers are setting up green portfolios in answer to demands from policyholders. Globally, a process to develop “Principles of Responsible Investment” is moving ahead quickly. Convened by UNEP and the UN Global Compact, this process will bring together a group of the world's leading pension funds and foundations with the goal of developing a set of principles for responsible investment, focusing on the practices of large institutional investors. The goal is to develop principles that reflect best practice in the area of institutional investor responsibility and then develop concrete action plans to allow investors to share resources and work together to apply the principles<sup>23</sup>.

Casualty insurers are concerned about possible litigation against companies responsible for excessive GHG emissions, and property insurers are concerned about future uncertainties in weather damage losses<sup>24</sup>. In addition, energy saving measures can reduce risk of property damage directly, for example cool running low energy lighting can reduce fire risks<sup>25</sup>. However, it is in the field of adaptation where insurers are most active, and have most to contribute.

### Adaptation

It is now too late to avoid some of the impacts of climate change, particularly sea level rise, and increased storminess due to warming oceans. The solution to this is adaptation, and this will be considered in more detail later in this paper.

In the developing world, sea level rise will have a catastrophic effect, and the Asian tsunami may be just a taste of floods to come. No doubt billions of dollars will be spent rebuilding the homes of the victims of the tsunami, but much of this could be wasted if sea level rise is not taken into account both in the location and type of construction of such buildings.

There are three elements of risk: hazard, vulnerability and exposure<sup>26</sup>. Adaptation measures can be applied to each of the components (see table).

Table: The elements of risk

	Flood adaptation	Windstorm adaptation
Hazard	Engineered and soft defences. Warning systems	Wind breaks, e.g. trees. Warning systems
Vulnerability	Resilient construction and design	Resilient construction and design
Exposure	Re-locate away from flood hazard zones	Avoid areas exposed to wind damage

<sup>23</sup> For more information contact: [investment@unepfi.org](mailto:investment@unepfi.org)

<sup>24</sup> Dlugolecki, A. 2004. “A Changing Climate for Insurance” Association of British Insurers, London. Available from [www.abi.org.uk/climatechange](http://www.abi.org.uk/climatechange)

<sup>25</sup> Vine, E., E. Mills, and A. Chen, 1999. “Tapping Into Energy: New Technologies and Procedures that Use Energy More Efficiently or Supply Renewable Energy Offer a Largely Untapped Path to Achieving Risk Management Objectives,” Best’s Review-Property-Casualty Insurance Edition, May 1999: 83-85.

<sup>26</sup> Crichton, D. 1999 The Risk Triangle, in *Natural Disaster Management*, Ingleton, J., (ed), Tudor Rose, London, England.

## EXTREME EVENTS

One particular type of extreme event is already becoming much more frequent, and that is the failure of dams.

The British Society of Dam Owners has decreed that its members will keep all dam condition reports secret. Maps showing which areas would be devastated if a dam failed are also secret. As a result, planning authorities are allowing people to build in such areas. Having had access to some of this secret information, the author is particularly concerned about dam safety in Britain. There are 2,500 large dams in Britain, most over 100 years old. The author is aware of a dam in Britain<sup>27</sup>, for example, where the condition of the core (constructed 150 years ago) has not been checked, nor the condition of the surrounding hillside, which is vulnerable to landslip. Safety recommendations dating back 12 years have never been implemented by the owner, and yet the dam is still functioning. Not only that, but a recent housing development means that 400 people are now living directly under the dam wall, with a further 5,000 in the path of flooding from a failure in the dam. There are plans to build a new hospital and school directly in the path of the inundation. Yet apparently because of the fear that people might panic if they knew the facts, all this information is kept secret even from the local planning authority and emergency services. There are no warning sirens, designated escape routes or evacuation plans, and dams are exempt from government safety laws for major industrial installations. Now that Britain has a Freedom of Information Act, the position may change, but it is too early to say as this only came into force in January 2005. If such information does become available, it may affect insurance for those properties which have been built in the hazard zones.

Engineers keep saying that the chances of a dam failure are remote, but consider the statistics:

In 1959 when the Malpasset dam in France failed, 421 people died, and in 1963, overtopping of the Vaiont dam in Italy caused by a landslide resulted in 1,189 deaths, even though the dam itself remained intact. In 1972, a dam in West Virginia, USA failed causing 125 deaths. In 1976, the Teton dam in Idaho, USA, failed during its initial filling, killing at least 11 people. The worst dam disaster was the failure of the Banqiao Dam in China which collapsed in 1975 during a typhoon. 85,000 people were killed, and a further 145,000 died from the subsequent epidemics and famine. (30,000 reservoirs in China have serious safety problems, according to the Chinese government. Between 1954 and 2003, 3,484 dams collapsed in China.)

Dam failures are increasing<sup>28</sup>:

- In May, 2004, a coffer dam collapsed in China, killing 14. It had been built by the same company which is building the Three Gorges Dams.
- In June 2004, after heavy rain, the Camara Dam in Brazil burst. It killed five people and left 3,200 homeless. It had only been completed in 2002.
- In July, 2004, heavy rainfall destroyed 13 small dams in New Jersey in the USA. 19 dams have burst in New Jersey alone since 1999. (According to the US

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<sup>27</sup> In order to protect the identity of the engineer who provided this information to the author he is not prepared to reveal the location of this dam.

<sup>28</sup> Bosshard, P., and Switkes, G., 2004. "Rash of Dam Failures Raise Safety Concerns" World Rivers Review Vol. 19 No. 4, p7. August 2004. International Rivers Network, Berkeley, California, USA.

Association of State Dam Safety Officials, the US needs to spend \$10billion on the most dangerous dams.)

Climate change will certainly increase the chances of dam failure<sup>29</sup>. Statistics for Britain are kept secret, but in the USA where information is more readily available, it is known that there are more than 2,000 communities that have been identified as being at risk from dams which are believed to be unsafe. Meantime, British dam engineers say there is no chance of a dam failure in Britain. Under the circumstances might this be construed as complacency?

There has been a lot of interest in tsunami events recently and while these are not directly caused by climate change, they could become more severe as sea levels rise. It has been argued by some scientists (though by no means all), that as the seas become heavier due to glacier melt, underwater seismic events could be more frequent as more water is forced into sea bed fissures or the increased weight changes stresses on tectonic plates<sup>30</sup>.

The La Palma volcano in the Canary Islands is already splitting. The experts say that not only is collapse inevitable, it is geologically imminent<sup>31</sup>, that is, some time in the next 10,000 years. A minor eruption will cause a chunk of volcanic rock the size of London to fall into the ocean. This “chunk” is already slipping towards the sea at a rate of a centimetre a year. The resulting 100m high tsunami could devastate the eastern seaboard of the USA. The volcano is still not being monitored for movement and such a tsunami would have very little warning.

Apart from tsunami, there are other extreme events to worry about. Even though they are not climate change related, when global economies are sufficiently weakened by sea level rise, droughts, floods and storms, imagine the effect of the inevitable major earthquake, asteroid strike<sup>32</sup>, meteor shower<sup>33</sup>, or super volcano<sup>34</sup>. They will happen, sooner or later. Many insurance companies will go bankrupt, but that will be the least of society's problems.

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<sup>29</sup> Babtie Group and the Centre for Ecology and Hydrology, 2002. “*Climate Change Impacts on the Safety of British Reservoirs*” Report commissioned by the Department of the Environment, Transport and the Regions (DETR) now DEFRA, through their reservoir safety research programme. Available from <http://www.defra.gov.uk/environment/water/rs/01/index.htm>. Incidentally, publication of this report was delayed by the government for over a year and released very “quietly”.

<sup>30</sup> McGuire, W. J., Howarth, R. J., Firth, C. R., Solow, A. R., Pullen, A. D., Saunders, S. J., Stewart, I. S. and Vita-Finzi, C. 1997. “*Correlation between rate of sea-level change and frequency of explosive volcanism in the Mediterranean.*” *Nature* 389, 473-476.

<sup>31</sup> McGuire, W., 2002 “*Raging Planet*” Apple Press, UK ISBN 1-84092-359-8

<sup>32</sup> Atkinson, H, Tickell, C, Williams, D 2000. “*Report of the Task Force on potentially hazardous Near Earth Objects*” HMSO, London. . An asteroid the size of a cricket ball or baseball could destroy a city, and such objects hit the Earth every 30 to 100 years. They are too small for astronomers to be able to provide any useful warning, let alone count them. In 1908, one such asteroid destroyed 2,000 square km of forest in Siberia. In 1931, another small asteroid landed in the Brazilian rainforest, resulting in a blast equal to 4 to 8 Hiroshima bombs and destroying 1,300 square Km of forest. What are the odds of the next one hitting a city instead of a remote area? In 1800, only 3% of the world's population lived in cities. Today there are over 200 cities which have over a million inhabitants.

<sup>33</sup> Hausler, B. 1998 “*The Leonid meteor shower. A risk for space operations?*” Bayerische Ruck, Munich.

<sup>34</sup> The frequency of super volcanic eruptions is one every 50,000 years on average, the last one was Toba in Indonesia, 73,500 years ago. Currently, the only active super volcano is also the biggest, namely Yellowstone, in Wyoming, USA. It has had three super eruptions in the last 2.1m years, the last was 640,000 years ago, and was a thousand times more violent than Mount St Helens. A thick layer of ash from Yellowstone has been found in sea cores in the Caribbean. For more details, see McGuire, W., 2002 “*Raging Planet*” Apple Press, UK ISBN 1-84092-359-8

Little can be done about such events other than to be ready with monitoring, warning and evacuation procedures. For example, in California, the earthquake risk has been reduced by strict construction codes and education programmes to reduce vulnerability.

In general, however, society is still as yet little prepared for extreme events. The UN ISDR programme<sup>35</sup> is a good start, with national “platforms” being established by many countries. But the UN programme still does not have an annual budget, and is dependent on only 14 staff who do not know from month to month whether they will be paid or not. The USA State Department established a national platform in 2004. Britain has had a national platform since 1999, called the “Advisory Committee for Natural Disaster Reduction” but this exists solely on the goodwill of individual experts who give up their time on a *pro bono* basis. It includes insurance experts who realise that insurance has an important part to play in the debate. Society needs to develop a culture of prevention and preparedness, rather than just react to events after they happen.

The insurance industry used to be like this: they would simply react to a loss and pay the claims. Now they are increasingly realising that premium incentives and advice for reducing risk makes good business sense. In Britain they are even influencing public policy and funding research and data collection to reduce societal losses<sup>36</sup> as will be seen below, because that makes sound business sense as well.

## COASTAL CITIES

The collapse of Antarctic ice shelves could allow land ice to slip into the sea more quickly and there are signs that Antarctic glaciers have speeded up since the Larsen B shelf collapsed in 2002. The Antarctic is warming faster than most of the planet and holds enough ice to raise sea levels by many metres which would be disastrous for all coastal cities. Given this situation, it is essential that we adapt, especially in large coastal cities such as Houston and London. In both cities there is not only the risk of loss of life and property from storm surges and flooding, there is also the prospect of consequent fire and explosion from damage to petrochemical installations and storage facilities. Oil and propane gas float on water and can be driven inshore by wind resulting in terrible loss of life, damage and pollution<sup>37</sup>.

### London

Climate change will have a major impact on London<sup>38</sup> in terms of social, economic and political changes as well as a much increased risk of property damage. London is

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<sup>35</sup> See [www.unisdr.org](http://www.unisdr.org)

<sup>36</sup> Crichton, D., (2005) “*Flood risk and insurance in England and Wales: are there lessons to be learnt from Scotland?*” Technical Paper Number 1, Benfield Hazard Research Centre, University College London. Available for free downloading from [www.benfieldhrc.org/SiteRoot/activities/tech\\_papers/flood\\_report.pdf](http://www.benfieldhrc.org/SiteRoot/activities/tech_papers/flood_report.pdf)

<sup>37</sup> For a well researched but fictional account of such a scenario, see Doyle, R. (2002) “*Flood*” Century, The Random House Group, London. Also in paperback by Arrow Books, 2003. See also [www.floodlondon.com](http://www.floodlondon.com)

<sup>38</sup> Entec UK Ltd, Kings College London, Tyndall Centre, Metroeconomica, and Crichton, D. (2003) “*London’s warming: the impacts of climate change on London*” Greater London Authority, London. See [www.london.gov.uk](http://www.london.gov.uk)

potentially very vulnerable to flood, for example. The Thames Barrier protects 150km<sup>2</sup> of London that lies below the high tide level. Overall in London the value of property in the floodplain is around £80 billion<sup>39</sup>. The Thames Barrier alone protects property worth around £30 billion. In other words the exposure is very high. Hazard has been reduced by the Thames Barrier, but if the Barrier were to be put out of commission by accident, terrorism or sabotage, London could be at risk of flooding, although there are many precautions taken to prevent this happening.

The Barrier will protect London against the 1,000 year flood until 2030, but it will have to be deployed more often. Since its completion in 1982, up until August 2001, it was closed 63 times. Most of these events have been in recent years: in the winter of 2000/2001 alone, it was closed 24 times, mainly in response to unprecedented freshwater flows.

As at January 2003, the Barrier had been closed a total of 82 times following its use in a record 14 consecutive tides to help to alleviate fluvial flooding in the Thames catchment, when flows in the Thames reached their third-highest value, a more-severe event than in Autumn 2000 (when it had been closed for seven consecutive tides). By 2030, due to sea level rise and other factors, it has been estimated that it will need to be closed 30 times a year on average<sup>40</sup>. It seems to be generally accepted that further protection will be needed at some point in the next 30 to 50 years. The Environment Agency has therefore extended its planning horizon by 70 years to the year 2100, and has started a project called "Planning for Flood Risk Management in the Thames Estuary" to develop a strategy for the tidal Thames from Teddington to Sheerness/Shoeburyness. Preliminary estimates of the cost of providing a 1,000 year standard in flood defences up to the year 2100 produce a figure of £4,000 million which will need to be spent in the next 40 years.

Upstream, along the non tidal stretch of the Thames, some 12,000 houses are within 500 metres of the river bank, and their riverside location adds £580m to the value of these properties<sup>41</sup>. Along the tidal stretch of the Thames, 800,000 people live within a ten minute walk of the river.

London's infrastructure is near full capacity, yet the growing demand for houses means that many more houses are to be built. According to the Thames Gateway web site, for example<sup>42</sup>, the Planning Framework estimates that in due course Thames Gateway might provide over 110,000 new dwellings, with 70,000 anticipated by the year 2006. Of these, it was revealed at a recent conference in London, some 86,000 could be built in the Thames floodplain by 2015.

Local authorities have been asked to "...give priority to the redevelopment of vacant and under-used urban sites before the release of green field land, and to foster sustainable relationships between homes, workplaces and community facilities" Nevertheless, most of the new housing will lie in certain major sites, including the Royal Docks, Barking Reach, Thamesmead, Chafford Hundred and Chatham Maritime, together with, in due course, Greenwich Peninsula, Kent Thames-side, and Havering Riverside.

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<sup>39</sup> Parker, D., and Penning-Rowse, E. (2002), "*Disaster Transformation and Management issues in London*" Proceedings of the 2002 London's Environment and Future (LEAF) conference at University College London.

<sup>40</sup> "*The Thames Barrier Flood Defence for London.*" Environment Agency, 2001.

<sup>41</sup> McGlade, J., (2002). "*Thames navigation and its role in the development of London.*" Proceedings of the 2002 London's Environment and Future (LEAF) conference at University College London

<sup>42</sup> <http://www.thames-gateway.org.uk>

One aspect which may really cause insurers problems is that in the Thames Gateway area it is planned to have a high concentration of dwellings: around 120 dwellings per hectare compared to a normal level of around 30 dwellings per hectare even in Southeast England. Therefore, while the Thames flood hazard may be low because it has the best standard of protection in Britain, the exposure is set to increase enormously, threatening insurers' ability to carry such a high concentration of risk in one location, especially in the light of current rules from the British Government's insurance regulator about exposure management for insurers.

While London may be well protected from coastal and river flood, there is still a problem with pluvial flooding from severe rainfall events. On 7th August, 2002, an inch of rain fell in central London in 30 minutes during the evening "rush hour", resulting in the closure of five mainline railway stations, and considerable disruption. London's Victorian drainage infrastructure is too old and overloaded to cope with such events. More than 50% of drainage and sewage overflow problems in England take place in London<sup>43</sup>.

## INSURANCE

In recent years, various organisations have tried to engage the global insurance industry in the climate change debate, after all, global insurance income is more than \$2 trillion dollars. Their efforts have met with little success mainly because of a lack of knowledge about how insurance works, and the range of risk management tools and catastrophe models which insurers can use. Above all, the industry consists of a large number of very competitive companies, each with their own opinions and perspectives but all more interested in short term results than long term strategies. For various reasons, there are remarkable differences between the activities of US and non-US insurers<sup>44</sup> and there is not enough space to go into these here. Perhaps, however the non US insurance industry is more prepared to speak with one voice on the issue of influencing public policy regarding climate change and its impacts. In any event, insurers and indeed society as a whole is indebted to the thousands of scientists around the world who have worked so hard and so long on predicting the impacts of climate change.

Some vested interests have argued that the impacts of climate change will be good for business because more people will pay more for insurance, so why should insurers care?

The main problem with this argument is that the increases in losses are unlikely to be steady and predictable. If the climate is changing, the numbers of attritional losses are likely to grow, but there will also be an increasing number of "sideswipes" due to catastrophic losses<sup>45</sup>. Because the extreme events that cause catastrophic losses are rare, it is much harder to quantify the risk in terms of probability, but all the General Circulation Models built by respected scientists around the world seem to suggest that

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<sup>43</sup> Crichton, D., (2005) "Flood risk and insurance in England and Wales: are there lessons to be learnt from Scotland?" Technical Paper Number 1, Benfield Hazard Research Centre, University College London. Available for free downloading from [www.benfieldhrc.org/SiteRoot/activities/tech\\_papers/flood\\_report.pdf](http://www.benfieldhrc.org/SiteRoot/activities/tech_papers/flood_report.pdf)

<sup>44</sup> Mills, E., Lecomte, E., Pears, A. 2001. "US Insurance Industry Perspectives on Global Climate Change" Lawrence Berkeley National Laboratory, MS 90-4000, US Department of Energy, University of California, Berkeley, California, USA. LBNL 45185.

<sup>45</sup> Dlugolecki, A. (ed), Agnew, M., Cooper, M., Crichton, D., Kelly, N., Loster, T., Radevsky, R., Salt, J., Viner, D., Walden, J., Walker, T., 2001. "Climate Change and Insurance." Chartered Insurance Institute Research Report, London 2001. (Available on [www.cii.co.uk](http://www.cii.co.uk))

the risk is growing. In a letter to “Nature”, Palmer and Rälsänen<sup>46</sup> for example reported how they have made a probabilistic analysis of 19 global climate model simulations - in effect, a “poll of polls” - and have concluded that winter precipitation in the UK could increase five-fold in the next 100 years.

Climate change will have particularly severe impacts in the USA and on the US insurance market, according to a comprehensive report<sup>47</sup> on the subject. The USA has been carrying out its own climate modelling, for example at the federally funded National Center for Atmospheric Research (NCAR)<sup>48</sup> at Boulder, Colorado, and at NOAA's Geophysical Fluid Dynamics Laboratory (GFDL) as part of the US Climate Change Research Initiative (CCRI). GFDL conducts fundamental and applied oceanic and atmospheric research on a variety of problems of importance to society and central to NOAA's mission.

For the purposes of this paper, the author will concentrate on the insurance aspects of climate change in Britain. The main impacts of climate change in Britain will be:

- Warmer but wetter winters
- Drier summers, but with more severe isolated convection storms with intense rainfall
- More severe storms, with storm tracks moving from the north of the country where buildings are resilient, to the south of the country where buildings are less resilient due to lower building standards.

Thomas Jefferson, the author of the USA's Declaration of Independence, said “*The care of human life and happiness, and not their destruction, is the first and only legitimate object of good government*”<sup>49</sup>. Many countries in addition to the USA have the ethos of “solidarity” in which the government helps citizens who suffer from natural and other disasters. This ethos is not so deep rooted in Britain, indeed a government minister<sup>50</sup> went so far as to say in connection with government compensation for flood damage: “*That would not be a wise or sensible position for any government to take.*”<sup>51</sup>

In the absence of government compensation, one of the results is that there is a public perception that insurers have a “social duty” to provide cheap cover for everyone<sup>52</sup>. There is a high take up of private insurance in Britain, which has meant that the insurers are financially strong and technically sophisticated in managing risks.

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<sup>46</sup> Palmer, T.N., and Rälsänen, J. (2002) ‘Quantifying the risk of extreme seasonal precipitation events in a changing climate’ *Nature*, Vol 415, pp.512-514.

<sup>47</sup> Mills, E., Lecomte, E., Peara, A. 2001. “*US Insurance Industry Perspectives on Global Climate Change*” Lawrence Berkeley National Laboratory, MS 90-4000, US Department of Energy, University of California, Berkeley, California, USA. LBNL 45185.

<sup>48</sup> <http://www.ncar.ucar.edu/>

<sup>49</sup> Thomas Jefferson's speech in 1809 to the citizens of Washington County, Maryland, USA.

<sup>50</sup> Nick Raynsford, MP, the then Minister for Planning, emphasised this point in his evidence to the House of Commons Select Committee Inquiry into the autumn 2000 floods. See “*The Environment Transport and Regional Affairs Select Committee Report on the Autumn floods in 2000*”. Published on 20th December 2000. HMSO, London.

<sup>51</sup> The Environment Transport and Regional Affairs Select Committee Report on the Autumn floods in 2000. Published on 20th December 2000. HMSO, London.

<sup>52</sup> Clark, M., Priest, S. J., Treby, E. J., Crichton, D., 2002 “*Insurance and UK Floods: a strategic reassessment.*” A Research Report for TSUNAMI. University of Southampton, Southampton.

## Technology

British insurers have access to sophisticated catastrophe models and geographic information systems and databases which enable them to assess risk at individual address level. Many might be surprised to learn that until very recently the biggest British insurance companies each had much better flood maps than the British government or its agencies can afford. (In the case of coastal flood, they still do.) One British insurer has spent £5m on an airborne survey of the whole of Britain using synthetic aperture radar to map the whole country at a much higher resolution and accuracy than the government's own mapping agency. In 2004 it handed over the results to the government's environment agencies to help them produce better river flood maps for publication in the hope that it will reduce the growing number of houses being built in flood hazard areas.

There is tremendous potential in the use of Earth observation satellites<sup>53</sup> and several British insurers use optical and synthetic aperture radar (SAR) data, which can provide detailed coverage of ground conditions regardless of the weather or darkness. There are currently three satellites providing SAR data, one Canadian and two European (Canada is due to launch another satellite soon). This is an incredibly powerful tool. SAR techniques have been used to identify the location of freak waves (and potentially tsunamis). They have even been used in Britain to track the wash from drug smugglers' speedboats, resulting in successful arrests and convictions. The author is working with insurers in Britain on a new technique developed in Italy called PS InSAR, (Permanent Scatterer SAR Interferometry)<sup>54</sup>, which can identify sub millimetre vertical or horizontal movements of buildings and the ground. This can give advance warning of subsidence or the collapse of buildings, bridges, dams or reservoir embankments anywhere in the world. It can provide a record of subsidence going back for 12 years, which will help insurers to charge appropriate premiums for subsidence prone areas. It can give warning of movement of volcanoes and record in detail the areas affected by earthquakes or floods. The USA for some reason appears reluctant to use such techniques; presumably this has nothing to do with the fact that it does not have any civilian SAR satellites of its own?

## Storms

Climate change will have major impacts across Europe<sup>55</sup>, and hail storms and windstorms will be a particular problem. Underwriters should be concerned that climate change may result in winter storm tracks moving south<sup>56</sup>, as happened with

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<sup>53</sup> Committee on Earth Observation Satellites, 2003. "The Use of Earth Observing Satellites for Hazard Support: Assessments and Scenarios." National Oceanic and Atmospheric Administration, Dept of Commerce, Maryland, USA.

<sup>54</sup> For details, contact Tele-Rilevamento Europa - T.R.E. s.r.l., Via Vittoria Colonna, 720149 Milano, Italia. tel.: +39.02.4343.121 fax: +39.02.4343.1230  
e-mail: [fabrizio.novali@treuropa.com](mailto:fabrizio.novali@treuropa.com), web: [www.treuropa.com](http://www.treuropa.com)

Do mention the author's name.

<sup>55</sup> European Environment Agency, 2004. "Impacts of Europe's changing climate" EEA (European Environment Agency) OPOCE (Office for Official Publications of the European Communities). ISBN: 92-9167-692-6. Available from [http://reports.eea.eu.int/climate\\_report\\_2\\_2004/en](http://reports.eea.eu.int/climate_report_2_2004/en)

<sup>56</sup> Dronia, H., 1991. "Zum vermehrten Auftreten extremer Tiefdruckgebiete über dem Nord-atlantik." Die Witterung in Übersee, 39(3), 27. Cited in Parry, M.L. (Editor), 2000 "Assessment of Potential Effects and Adaptations for Climate Change in Europe: The Europe ACACIA Project." Jackson Environment Institute, University of East Anglia, Norwich, UK, 2000, 320pp.



the very damaging storms of 1987, 1990 and 1999. Fortunately so far England and France have escaped a storm of the severity of the Braer storm which hit Shetland in 1993. This storm nearly broke the European record for low pressure with atmospheric conditions similar to a category 5 hurricane. Not only that, it lasted 22 days. Despite its severity, the buildings in Shetland are constructed so well that there was very little damage. If such a storm were to hit highly populated areas of England and Wales, there would be widespread devastation and loss of life, due to much lower building standards. Already, the number of winter storms crossing the UK mainland has doubled in the last 50 years<sup>57</sup>.

Little can be done about the hazard or exposure sides of the risk triangle for storms, so it is important to concentrate on the vulnerability side. As the 1993 Shetland storm showed, if buildings are sufficiently resilient, they need not suffer damage from storms. The question is whether architects, the construction industry and government can be persuaded of the need to consider more resilient construction methods. Meanwhile the EU Construction Products Directive seeks to “harmonise” standards in Britain with those in much less stormy continental Europe. There is a real chance that for “harmonise” the authorities will read “level down”. (The position is different in Scotland<sup>58</sup>.)

Insurers could help by pooling statistics on storm claims to help to identify which parts of buildings fail, and the author is trying to get the modest funding needed to enable this. So far only a pilot study has been done, but that has found that modern buildings are much more vulnerable to damage than older ones, mainly because older buildings were “over engineered” while modern ones are built to building standards and codes which are not sufficiently resilient, at least in England and Wales. One problem is that architects and the construction industry are under pressure to produce quantity rather than quality, as demand exceeds supply. For the cost of an average new house, a rich source of data from insurers could be collected and analysed to show precisely what changes are needed to building standards, and thereby significantly reduce storm damage losses in the future.

## Floods

Climate change is already increasing the number and severity of floods across Europe. Britain is one of the few countries in the world where most of the population have private flood insurance, but this may change as insurers adopt new strategies. Many people welcome the “natural look”, of rivers and coasts and so long as cheap insurance has been available, people have been prepared to live in flood hazard areas and put up with occasional flooding in order to have the amenity which a river or beach offers. There have even been a number of cases where residents in England have refused flood defences because it would spoil their view of the river, - for example in Bradford upon Avon (which subsequently suffered from serious flooding).

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<sup>57</sup> Hadley Centre, 2003. “Climate change observations and predictions: Recent research on climate change science from the Hadley Centre”, UK Met Office, December 2003

<http://www.metoffice.gov.uk/research/hadleycentre/pubs/brochures/2003/global.pdf>

<sup>58</sup> Crichton, D., (2005) “Flood risk and insurance in England and Wales: are there lessons to be learnt from Scotland?” Technical Paper Number 1, Benfield Hazard Research Centre, University College London. Available for free downloading from [www.benfieldhrc.org/SiteRoot/activities/tech\\_papers/flood\\_report.pdf](http://www.benfieldhrc.org/SiteRoot/activities/tech_papers/flood_report.pdf)

In the upper reaches of the Thames, waterfront property values are on average £48,000 higher than comparable properties elsewhere<sup>59</sup>. This desire for the amenity value of living by a river is quite understandable, so long as such people do not expect to be subsidised by cheap flood insurance rates.

In 1961, the insurance industry in Britain voluntarily agreed with government that they would guarantee to offer affordable flood cover for all households regardless of risk. This “insurance guarantee” has distorted the market for forty years, and is no longer sustainable, at least in the South East of England, owing to the high demand for housing and the shortage of suitable land, leading to an enormous growth in floodplain development. It has meant that government in England and Wales has taken it for granted that flood insurance will be available, and has not felt the need to consult the insurance industry before going ahead with major developments in flood hazard areas such as the Thames Gateway for example. However, those who take insurance for granted are in for a shock as will be shown later.

### **The USA flood insurance system**

The system in the USA is unique and has not been copied by other countries. Nevertheless there are parallels with the system in Britain. According to Swiss Re, a National Flood Insurance Program (NFIP) was set up in 1968, and is the only Federal insurance scheme for natural disasters in the USA. NFIP just provides basic cover, and additional cover is available from private insurers. It only applies to eligible communities where the flood risk has been assessed and a program for loss mitigation has been established. Such loss mitigation programs generally involve expensive structural defences, and recent research has suggested that some of these can actually increase the risk of flooding<sup>60</sup>.

Premium levels are high, and before the 1993 Mississippi floods, penetration in flood hazard areas was only 15-20%. This increased by about 50% after the floods. Cover cannot be refused, so adverse selection is a big problem. Properties with recurring flood losses represent only 2% of the NFIP policies, but accounted for 40% of the losses between 1978 and 1995. Poor risks are subsidised by the Federal Emergency Management Agency (FEMA) and the NFIP is currently heavily in debt to FEMA. No reinsurance is purchased on the international markets to spread the costs outside the USA economy<sup>61</sup>.

The NFIP uses private insurers to settle claims on their behalf because of their claims handling expertise, but there is anecdotal evidence that because the private insurers recover their costs from the NFIP, the claims costs are higher than they would be under a private insurance scheme.

On the other hand, the potential flood losses in the USA are now so severe due to the numbers living in the danger zone and the growing hazards from climate change that it is doubtful if any private insurer would be prepared to consider the risk.

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<sup>59</sup> McGlade, J., (2002). “Thames navigation and its role in the development of London.” Proceedings of the 2002 London’s Environment and Future (LEAF) conference at University College London

<sup>60</sup> Criss, R.E., & Shock, E.I., (2001) ‘Flood enhancement through flood control’ *Geology*: **v29, no 10**, pp. 875-878

<sup>61</sup> Swiss Re, 1999. “Natural catastrophes and man made disasters 1998” sigma No 1/1999, published by Swiss Re Economic Research & Consulting.

## Correcting the problems in Britain and the USA

So for both the British insurance guarantee, and the USA's NFIP, the system is subject to considerable adverse selection<sup>62</sup> and it encourages people to live in flood hazard areas. It is only recently that measures have been taken to remedy the situation.

### Britain

In Britain the insurance industry cancelled the guarantee in 2002, and since then premiums for properties in high hazard areas where the risk of flood exceeds the risk levels shown in the "insurance template" (see below) have increased by around 250% with excesses of around £20,000 becoming common. More increases and withdrawal of cover altogether seem inevitable in many areas.

The "Insurance Template" devised by the author<sup>63</sup> in 1997, is based on actuarial calculations and has been adopted by the British insurance industry generally. It shows risk levels in the form of return periods where insurers are prepared to offer flood insurance at normal premium levels.

- Hospitals, senior citizen homes etc                    1,000 year
- Hotels, hostels, children's homes etc                    750 year
- Basements    750 year
- Single storey homes without roof escapes            500 year
- Near rivers which can flood suddenly                    500 year
- All other residential    200 year

After the insurance guarantee was cancelled, the industry offered a limited interim guarantee<sup>64</sup> until 2007, but only for properties where the risk is less than a 75 year return period. Renewal of the interim arrangements is dependent on the government taking action to reduce floodplain development and spend more on flood defences. Meantime, in 2003, there were over 600 new building projects, mainly residential estates, given planning permission against the advice of the Environment Agency in England and Wales due to fears of the flood hazard. Some 200,000 homes are already potentially uninsurable even with the limited guarantee, and if it is withdrawn in 2007, that figure will certainly increase substantially.

Until recently, public perceptions of flood risk have been reduced by subsidised insurance premiums, and as these perceptions of risk increase, along with higher premiums, problems in obtaining insurance, and consequent reduced property values, there is likely to be more demand for engineering flood defence solutions because they are quick and visible. Yet such solutions are expensive to build and maintain. According to the Foresight research, an investment of £52,000million may be needed just to manage the additional risks of climate change this century<sup>65</sup>. The position has

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<sup>62</sup> Adverse selection occurs where an insurance portfolio of risks attracts high risk policyholders due to inadequate premium or lack of underwriting control.

<sup>63</sup> Crichton, D. 1998 "Flood Appraisal Groups, NPPG 7, and Insurance" , in Faichney, D., and Cranston, M., (eds), pp 37-40. *Proceedings of the "Flood Issues in Scotland" seminar* held in Perth in December 1998. Scottish Environment Protection Agency, Stirling, Scotland,.

<sup>64</sup> ABI, September 2002. For details, see:

[www.abi.org.uk/Display/File/78/Statement\\_of\\_Principles.doc](http://www.abi.org.uk/Display/File/78/Statement_of_Principles.doc)

<sup>65</sup> see [www.foresight.gov.uk](http://www.foresight.gov.uk)

already been reached where the flooding problems in England and Wales are going to get a lot more costly unless some drastic action is taken.

By contrast, measures taken in Scotland over the last ten years are proving effective in preventing any significant increase in exposure to the flood hazard, while at the same time an increasingly active and effective flood management programme using cost effective sustainable non structural solutions as well as engineering solutions is reducing the hazard itself<sup>66</sup>. Fundamental to the Scottish Executive policy since 1995 has been that local planning authorities should consult with local stakeholders and the insurance industry on their planning strategies and individual development proposals. As a result, local authorities representing 98% of the Scottish population now consult with the insurance industry and follow the “insurance template” in their strategies. The new Scottish Planning Policy<sup>67</sup> published in 2003, contains a risk framework which is consistent with the template. The stakeholder groups have been very effective in helping to balance the profit motives of the housing developers with environmental and wider economic issues, not least the future availability of insurance, and the health and safety of local citizens. As a result there is virtually no more building in flood hazard areas in Scotland.

Insurers have pooled their flood claims details, which has enabled the publication of figures<sup>68</sup> for average costs of flood claims by depth and type of property. The British National Flood Insurance Claims Database is the biggest of its kind in the world, but again needs some modest funding to maintain it. Individual insurance companies have taken it in turn to fund it, but funding really needs to be put on a firmer footing. Data from this database could help to change building standards so that buildings are more resilient to flooding, thus reducing the costs of flood events.

## USA

In the USA, it also appears that the system is changing, with a stricter approach being applied. The new approach has some similarities with the approach first developed in Canada<sup>69</sup> in 1964. For example, consider the case of Grand Forks<sup>70</sup>. In 1997, the Red River flooded the city of Grand Forks in North Dakota, USA. Almost immediately after the flood, the city identified the properties damaged by the flood, and began to purchase them and demolish them. Around 100 were demolished even before the official purchase had been completed, in order to prevent them being re-occupied. The USA devotes special federal funds to purchase a property that has been damaged by flooding, and this is subject to a “green clause” which requires that the land be left

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<sup>66</sup> Crichton, D., (2005) “Flood risk and insurance in England and Wales: are there lessons to be learnt from Scotland?” Technical Paper Number 1, Benfield Hazard Research Centre, University College London. Available for free downloading from [www.benfieldhrc.org/SiteRoot/activities/tech\\_papers/flood\\_report.pdf](http://www.benfieldhrc.org/SiteRoot/activities/tech_papers/flood_report.pdf)

<sup>67</sup> Crichton, D. 2003 Scottish Planning Policy 7: Planning and Flooding. *Scottish Planning and Environmental Law Journal* 98, pp 85-86, August 2003. Glasgow, Scotland.

<sup>68</sup> Black, A and Evans, S (1999) “Flood damage in the UK: New insights for the insurance industry.” University of Dundee. ISBN 0 903674 37 8. Dundee, Scotland.

<sup>69</sup> In Ontario, no new development is allowed in the floodplain, and existing residents can only sell their property to the municipal authorities who will then demolish it. See Brick, J., and Goldt, R., 2001 “City of London Flood Plain Management”. Upper Thames River Conservation Authority, London, Ontario, Canada

<sup>70</sup> Pepper, A., Stonecipher, C., and Vein, K. A. (2002) “Flood management: lessons from a US city.” Municipal Engineer, 151, pp 295-304. London, England.

vacant in perpetuity, in order to prevent future damage and to provide flood storage. In all, the city has purchased over 800 homes and 42 commercial properties since 1997. Many of these properties were jacked up and loaded onto trucks to be taken to safe areas, in a process called “managed relocation”. Where this was not possible, or where properties were badly damaged, they were demolished. The city has also made many of the remaining properties flood resistant, and has embarked on new flood defence works behind the area of demolished properties. The total cost of the project is \$580 million. Actions of this type should help to reduce the number of properties exposed to flood, although it is an extreme solution.

## BIODIVERSITY

There are implications not only for humans and their property, but also wildlife<sup>71</sup>. The UK has 15,000 km of coastline with 106 internationally important sites for wintering waterfowl, 10 per cent of which have been identified as under threat from climate change, with a further 10 per cent vulnerable. English Nature estimate that at least 13,000 hectares of English shoreline, much of it vital wildlife habitat, will disappear in the next 20 years. Mudflats could decline by around 10,000 hectares; in the winter three million wading birds rely on the UK’s mudflats as breeding grounds. Saltmarshes will decline by 2,750 hectares by 2020, with two thirds of the loss in southeast England. Ten percent of saline lagoons are expected to disappear, along with many rare species.

The UK Parliament recently published a report on sustainable development<sup>72</sup>, which argues that the existing UK Strategy has not had the impact expected, and that the concept of sustainable development has not displaced the priority accorded to economic growth. The Chairman of the Environmental Audit Committee, Peter Ainsworth MP, was quoted as saying:

*“We have yet to appreciate the full impacts of our global assault on biodiversity and ecosystems. In the case of global warming, for example, we now understand that there are limits we must not transgress. But equally there are limits to the extent to which the world can tolerate biodiversity loss, soil erosion, land cover changes, and acute water stress. The concept of environmental limits is fundamental to sustainable development – and the Government’s new Sustainable Development Strategy must reflect that. We appreciate the difficulties the Government has, both domestically and internationally, in adopting a more radical approach. But if the new Strategy is to be more effective than the last, we must see the Prime Minister and Secretaries of State playing a far more decisive role in promoting and implementing it than they have done so far. The consequences of failure are potentially catastrophic, and our descendants will not thank us if we do not take action now.”*

The insurance industry is also becoming concerned about the threats to biodiversity, because of the possible impact on companies from adverse public reaction towards

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<sup>71</sup> WWF, 1998. “Keeping the seas at bay” WWF, Surrey.

<sup>72</sup> House of Commons Environmental Audit Committee, November 2004. “*The Sustainable Development Strategy: Illusion or Reality?*” House of Commons publication HC 624, London. Available from <http://www.publications.parliament.uk/pa/cm200304/cmselect/cmenvaud/624/62402.htm>

businesses which abuse the environment. Investment managers of insurance companies now increasingly take the environment credentials of companies into account before investing in them<sup>73</sup>.

## **FUTURE ACTIONS**

It has been suggested that the most sustainable solution for the US is to move to Canada, and the most sustainable solution for London is to move it to Scotland. Clearly sustainability must be tempered with practicality. The first priority must concern the location and design of future buildings and cities. Locations should be in areas least exposed to severe weather and sea level rise, and buildings should be designed to minimise carbon emissions and vulnerability to the elements, including damage to infrastructure such as transport and power supplies. If this were done now, then there would be fewer problems for future generations. Insurance and reinsurance companies have the risk management, computer modelling and GIS skills, together with the data to help to reduce risk, and they also have the economic power to create financial incentives to encourage it to happen. Some consultation with insurers, combined with very simple and cheap measures by government could bring a huge amount of insurance expertise to the table to reduce problems in the future. A good example is the system of stakeholder participation to be found in Scotland, both for land use planning and building standards, or the work of the Institute of Business and Home Safety in the USA. Such participation and partnerships could and should be expanded.

At the same time, architects and the construction industry should also be considering various measures, for example:

1. Build in solar photo voltaics in every new building, for example solar slates on the roof, and solar panels for facades. In new build the cost is insignificant, but it not only reduces the need for power stations, it also gives the building independence from an increasingly vulnerable national grid supply.
2. Design roofs so that they can provide a good reflective signal for radar satellites, enabling the building to be monitored for movement using PS InSAR techniques.
3. Reduce the amount of glazing on the walls and fit external shades, to reduce solar heating gain and therefore the need for air conditioning.
4. Increase insulation levels to reduce artificial heating and cooling costs.
5. Use low energy cool running light fittings which save power and reduce the risk of fire.
6. Make buildings much more resilient to floods and storms.

Most 'modern' highly glazed buildings need air-conditioning to prevent extreme summer over-heating even today. What happens when the temperatures over the next decade or two, rise two or three degrees and the power fails? When power failed in New York in July 2003, many people had to evacuate their buildings, some within minutes, because there was simply no longer the power to keep the indoor climate habitable. One solution is to have smaller, shaded, windows that open, so that even when the power fails the building does not over heat and it can be naturally ventilated

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<sup>73</sup> F&C Asset Management (formerly ISIS), 2004., "*Is biodiversity a material risk for companies?*" 55pp. Available free from Governance and Socially Responsible Investment Unit, ISIS Asset Management, 100 Wood Street, London EC2V 7AN or email [eve.crush@isisam.com](mailto:eve.crush@isisam.com)

by opening the windows during warm periods. This is a particularly good idea for hospitals where often the emergency generators are not powerful enough to run lifts and air conditioning.

As for resilience in existing buildings, one option is to apply a system of compulsory resilient reinstatement or relocation for buildings damaged by severe weather. Prompted by the insurance industry, the government in Scotland has recently passed legislation to give itself such powers<sup>74</sup>.

There are many ways in which the insurance industry can help to advise and encourage mitigation and adaptation on issues such as energy and buildings<sup>75</sup>, sustainable energy systems, planning, floods in urban and coastal areas, climate change in urban areas, prediction techniques for environment and climate, health issues in urban areas. The author has already been involved in some of these issues in other parts of the world, and is often invited to address architectural students and land use planning students to help to get the message across.

The author would recommend a new book<sup>76</sup> called "*Adapting Buildings and Cities for Climate Change*" which covers the ground in much greater detail.

One final point, in the "further reading" section there are descriptions of two recent reports produced for the United Nations. These exemplify the need for greater liaison and discussions between academics on each side of the Atlantic as well as greater discussion between academics and insurers. Hopefully this conference will help to facilitate such discussions in the future.

## CONCLUSIONS

*"1,000 more Americans died in motor vehicle crashes between October-December 2001 than the same three months the year before the airplane attacks of 9/11, plausibly because they were afraid of flying, even though motor vehicle travel is much riskier. Approximately 7,000 Americans a year die of melanoma from sun exposure, and yet fear of the sun is relatively low because it is a natural risk, a sort that evokes less concern than risks which are human-made"*<sup>77</sup>.

It is hard to persuade the public that they need to fear climate change. It is important that the public are not misled into thinking that "global warming" is a good thing, just because the word "warming" sounds like quite a pleasant prospect.. It is well established that human perception of risk is often not related to the actual risk<sup>78</sup>. For

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<sup>74</sup> Buildings (Scotland) Act 2003.

<sup>75</sup> Edward Vine, Evan Mills and Allan Chen, Environmental Energy Technologies Division, Ernest Orlando Lawrence Berkeley National Laboratory, California, USA. "*Energy - efficiency and renewable energy options for risk management and insurance loss reduction: an inventory of technologies, research capabilities, and research facilities at the US Department of Energy's National Laboratories*" US Department of Commerce, August 1998.

<sup>76</sup> Roaf, S. Crichton, D., and Nicol, F. , 2005. "*Adapting Buildings and Cities for Climate Change*" 361pp. Architectural Press and Elsevier Press, London. Price £27. ISBN 0 75065 9114

<sup>77</sup> Statement made in 2004 by the Harvard School of Public Health, Boston, MA.

<sup>78</sup> Slovic, P., 2000. "*Perception of Risk (Risk, Society and Policy Series, ed Ragnar Lofstedt)*" 473pp. Earthscan Publications Ltd, London. ISBN 1 85383 528 5. For example, young drivers tend to think

example, many people fear nuclear power, but not coal, yet the coal industry has caused many more deaths and health problems, as well as being a major contributor to global warming.

The author often illustrates to students the power of implied value judgements from certain words with the following example:

Example

*One of the main greenhouse gases is di-hydrogen monoxide. This gas escapes from nuclear power stations, is fatal if inhaled, and can cause severe burns to the skin. In its liquid form, it causes severe corrosion to iron and steel. The Australian Green Party has decided it should be banned. Do you agree?*

If you agree, did any of the words underlined below have a particularly strong influence on you?

*One of the main greenhouse gases is di-hydrogen monoxide. This gas escapes from nuclear power stations, is fatal if inhaled, and can cause severe burns to the skin. In its liquid form, it causes severe corrosion to iron and steel. The Australian Green Party has decided it should be banned. Do you agree?*

The author would welcome comments to the email address shown below.

The greatest risk we face as a society is not terrorism, but climate change<sup>79</sup>. How can we educate our society to realise this?

Perhaps the global insurance and banking sector might have a part to play. They have the skills and data needed to identify the issues and solutions, they have the power to apply economic incentives and disincentives, and above all they are the industry sector which will suffer the most from a failure to act before it is too late.

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they don't need motor insurance, but experienced drivers are prepared to pay whatever it costs for their insurance. That is how insurance companies make a profit.

<sup>79</sup> King, D A, 2004. - "Climate Change Science: Adapt, mitigate or ignore" Science, Vol 303, January 2004. (Professor Sir David King is the UK Government's chief science advisor.) See also Marshall, A., 2004 'An abrupt climate change scenario and its implications for US National Security'. Pentagon Office of Net Assessment. USA.



### **Further reading**

Crichton, D., February 2005. “*Flood risk and insurance in England and Wales: are there lessons to be learnt from Scotland?*” Technical Paper Number 1, Benfield Hazard Research Centre, University College London. Available for free downloading from

[www.benfieldhrc.org/SiteRoot/activities/tech\\_papers/flood\\_report.pdf](http://www.benfieldhrc.org/SiteRoot/activities/tech_papers/flood_report.pdf)

#### Comments:

*This report was first published on the internet in January 2003, with an updated and expanded version released in April 2003, in response to the high level of interest from the insurance industry. A further updated and expanded edition will be published in February 2005.*

*Comments on the report include:*

- *‘The industry should welcome the report from the Benfield Greig Hazard Research [Centre] into flooding and take time to study it carefully’. Clive Bolton, Director, Norwich Union, UK.*
- *“...a fascinating and excellent analysis, with many relevancies to the United States.” Jacquelyn Monday, Association of State Floodplain Managers, USA.*

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Crichton, D. January 2005. “*The role of private insurance companies in managing flood risks in the UK and Europe.*” In *Urban Flood Management*, eds. A. Szöllösi-Nagy & C. Zevenbergen. ISBN 04 1535 998 8, 2004, 160 pp. Balkema, Leiden, Holland.

#### Comments

*This follows a meeting in Holland of experts and government officials from around the world, along with representatives from UNESCO, to discuss urban flood issues.*

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Crichton, D., 2002. “*UK and Global Insurance Responses to Flood Hazard.*” *Water International* Vol 27, 1. Pp 119- 131. Illinois, USA

#### Comments:

*A review of insurance approaches around the world and illustrations of the importance of insurance as a means of adapting to increased flood risk.*

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European Commission, 2004. “*Flood risk management Flood prevention, protection and mitigation.*” Brussels, 12.07.2004 COM(2004)472 final. Communication From The Commission To The Council, The European Parliament, The European Economic And Social Committee And The Committee Of The Regions.

Can be downloaded from:

[http://europa.eu.int/comm/environment/water/pdf/com\\_2004\\_472\\_en.pdf](http://europa.eu.int/comm/environment/water/pdf/com_2004_472_en.pdf)

#### Comments:

*This short (12pp) paper contains useful statistics, information, and sources on European flood. It sets out the case for concerted European action, given the likely increase in frequency and severity of floods due to climate change, combined with increase in people and assets in flood hazard zones. It refers to sources of funding for flood management projects, and emphasises the importance of changing agricultural practices and promoting biomass crops through the common agricultural policy. Flood risk mapping will receive greater priority, using satellite systems such as GALILEO. More international cooperation is being introduced for transboundary rivers and the EU recognises it has an important role to play in this regard. The paper proposes a coordinated action programme involving member states, the Commission and other stakeholders, and invites member states to support the Commission and agree the steps which need to be taken.*

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Kumar, A., Burton, I., Etkin, D., 2002. “*Managing flood hazard and risk. Report of an independent expert panel.*” Office of Critical Infrastructure Protection and Emergency Preparedness, Government of Canada. See [www.ociepc-bpiepc.gc.ca](http://www.ociepc-bpiepc.gc.ca)

Comments:

*A very astute and thought provoking piece of work with applications around the world.*

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Roaf, S. Crichton, D., and Nicol, F., January 2005. “*Adapting Buildings and Cities for Climate Change*” Architectural Press and Elsevier Press, London.. ISBN 0 75065 9114. Price £27.

Reviews

**1) Stephen Tindale, Executive Director, Greenpeace, UK. 12/10/04**

'A timely and fascinating book on the crucial issue of energy use in building which accounts for half of our total energy use.'

**2) Edward Mazria, architect, author and educator living in Santa Fe, New Mexico. 21/11/04**

We are at the crossroads of the most significant crisis of modern times. Two profound, life changing events are converging to create this crisis – the warming of the earth's atmosphere by burning fossil fuels, and the rapid depletion of global petroleum and natural gas reserves. As these events intensify over the coming years, they will dramatically change how we live and how we relate to the natural world. These changes can cause the human race great pain and suffering or they can inspire a historic transition to a kinder and gentler world.

Sue Roaf, David Crichton and Fergus Nicol in their new book *Adapting Buildings and Cities for Climate Change*, dissect these events and rightly conclude that at the center of this crisis stands the architecture and building community. They clearly illustrate that this community, unknowingly, is chiefly responsible for precipitating this crisis and argue for nothing less than a building design revolution to address the problem.

What makes this book so important is that it not only outlines the issues and science behind climate change, but details the steps necessary to alleviate future large scale

dislocations and hardship. Ms. Roaf identifies the key players in this struggle, their roles, and the actions needed to spark this revolution. She makes it crystal clear that there is no technological fix looming on the horizon, and that if the architecture and building community do not step forward and lead, there is little hope for meaningful change to take place.

This book contains the framework for beginning the critical dialogue necessary to confront humanity's greatest challenge.

Comments (From dust jacket)

Providing an insight into the real changes that are necessary to give our modern day built environment both 'sustainability' and 'survivability' this book is:

- A unique text that reassesses the fundamentals of sustainable design
- A discussion and design guide providing you with the full picture of true sustainability
- Includes case studies supporting the argument that challenges orthodox architectural design

From Sue Roaf, the author of the bestseller *Ecohouse*, with the internationally renowned co-authors and academics David Crichton and Fergus Nicol, this provocative and exciting book is based on the premise that climate change is happening around us today, and its impacts on our lives will be far worse than commonly acknowledged. It argues that many modern buildings are not only 'unsustainable', but are also having a catastrophic effect on the global climate. In a uniquely frank argument, the book illustrates that the only way we can hope to survive the following century, with our societies intact, is if we begin to radically reduce CO2 emissions from our buildings, to stop building climatically disastrous 'modern' buildings and to develop a new generation of 'resilient', regionally appropriate, low impact, buildings, powered by clean renewable energy, in which we can survive comfortably, in a warming world and in the Dark Cities of the future.

Sue Roaf is a Professor at the School of Architecture, Oxford Brookes University, UK.

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United Nations International Strategy for Disaster Reduction, 2004. *“Living with Risk, an international review of disaster reduction initiatives”* United Nations publications

CH-1211, Geneva 10, Switzerland. [unpubli@unog.ch](mailto:unpubli@unog.ch)

On sale at US\$95 plus p+p. ISBN 92-1-101050-0 in two volumes.

Comments

*Despite the title, the original draft of “Living with Risk” did not mention insurance at all. Following representations and contributions by the writer, this has been rectified to some extent in the 2004 edition, published in July 2004, but it still has a long way to go to do the subject justice. For example it has information on the USA flood insurance scheme, which only survives due to massive US government subsidy, and has not been copied by any other country in the world, yet omits reference (at least in the index) to the insurance industry supported Commonwealth Disaster Management Agency Scheme, which is aimed specifically at developing countries. It has numerous mentions of the World Bank “Provention” initiative, created in the USA, even though this has had little success in attracting support from insurance companies (as opposed*

to USA broker houses). On the other hand the highly successful UNEP Finance Industry initiative (see [www.unepfi.net](http://www.unepfi.net)) which is supported by many major insurers outside the USA is not mentioned in the index. So some people might regard this book as rather "USA centric". Nevertheless, there is a lot of good information gathered here, for example a useful section on the Self Employed Women's Association micro insurance scheme in India. (page 355)

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United Nations, 2004 "Guidelines for Reducing Flood Losses" United Nations, Geneva, April 2004. 83pp. Available in hardcopy or for downloading from [www.unisdr.org](http://www.unisdr.org)

### Comments

*This report was produced jointly by the UN Department of Economic and Social Affairs (DESA), the UN Inter-Agency Secretariat of the International Strategy for Disaster Reduction (UN/ISDR) and the National Oceanic and Atmosphere Administration (USA NOAA). It aims to represent the results of three international workshops, one in Honduras in April 1999 just after Hurricane Mitch, the second in Brasilia in November 1999, and the last in Bangkok in 2001. It is basically a superficial overview from a particularly USA perspective of flood forecasting and warning systems, data collection systems, flood plain management practices, land use planning and integrated social and economic measures for sustainable solutions. It could be a useful starting point for those new to the subject, so long as they bear in mind that the USA perspective is far from being the state of the art in the field, compared with the work being done in Europe, Australia and Canada. It contains some useful global statistics, however. For example, over 90% of all deaths from natural disasters are water related, and 99% of deaths from flood from 1975 to 2001 (over 250,000 people) were from low income groups. In the richer countries, total disaster losses are less than 2% of GDP, while in poor countries the figure is nearly 14% from 1985 to 1999.*

*The report calls for international standards for the assessment of flood losses for comparative purposes, and advocates the greater use of insurance and regional collaboration. The report was clearly written from the point of view of the main sponsor, NOAA, and it is typical of such reports that it seems to advocate the US insurance approach despite the fact that no other country in the world has adopted that system due to the widely recognised defects in it, some of which the report acknowledges. There is a mention of the German system, but no mention of much more successful approaches elsewhere in the world. It also ignores the huge contribution which can be made from SAR satellites operated by Canada and Europe, perhaps because, surprisingly, the USA still has no such satellites available for civilian use. It also ignores important, non-US initiatives such as AlertNet, the CDMA, or NEDIES, which are leading the world. It even ignores the important Disaster Management Constellation charter of Europe, Canada and India, which provides free near Real Time EO Data from ESA, CNES, or RADARSAT as appropriate in the event of a disaster to assist relief agencies.*

*It seems to give (no doubt unintentionally) the message that if it is not a US initiative, it is not worth mentioning, and this should be borne in mind when reading what is otherwise an excellent report.*

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