Climate Change and Mounting Financial Risks: What are the Options?

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Summary

Man-made climate change is now well established scientifically, and projections indicate a number of potentially serious risks to society and the Earth system. The experience of the insurance industry suggests that even rich countries are at risk from moderate climate change, due to the increasing vulnerability of modern economies. The time to choose a strategy to manage this risk is limited, because weather patterns are changing quickly already.

Conventional property insurance will not be able to deal with the scale of the damage, and the notion of applying a " polluter pays" regime also will not work. The only real option is to adopt a sustainable energy strategy based on renewables. This would help to engage the investment sector. They are vulnerable to unplanned fuel substitution, but are willing to steer corporate management in the direction of a sustainable economy. The financial impacts of climate change could then be handled through a public/private partnership to exploit the resources and skills of both sectors. To get commitment from the finance sector to address these longterm risks, rather than dealing with more urgent ones, policymakers need to conclude an over-arching framework to manage the risk of climate change through " Contraction and Convergence".

Climate change - the outlook

The greenhouse effect

Human activities (industrial production, transportation, agriculture, dwellings) produce a number of long-lasting gases as byproducts, several of them in large quantities. Many of these gases retain the sun's energy, thereby warming the planet. The principal greenhouse gases (or GHG's) are carbon dioxide (CO2) , methane (CH4), nitrous oxide (NO2) and halocarbons (a wide range of very powerful synthetic gases). The current atmospheric concentration of CO2 at 370 ppm (parts per million by volume of the atmosphere) is 31% higher than in 1750, and possibly has not been exceeded for 20 million years. Methane has increased by 150% since 1750, and halocarbons and their ozone-friendly replacement gases (which are still GHG's) are obviously increasing even faster from a zero base. There are other short-term influences which affect the rate of warming, such as volcanic eruptions and variations in solar activity. However, if anything, these factors have REDUCED the rate of warming over the last 20 years.

Evidence of climate change

Evidence continues to accumulate that the world is warming, with consequent changes in the climate system:

- The global surface temperature has increased by about 0.6 oC over the 20th Century. In the Northern Hemisphere, the 1990's are likely to have been the warmest decade in the past millenium. (Comparable information is not available for the Southern Hemisphere).
- In the last 50 years, snow cover has reduced by 10%, mountain glaciers are retreating, and Arctic sea-ice has diminished rapidly.

- Global sea-level has risen by up to 20cm during the 20th Century , due mainly to thermal expansion as the oceans warm.
- There have been persistent but so far small shifts in average and extreme rainfall in many regions.
- In the past 30 years, El Nino events have been "more frequent, persistent, and intense". (Footnote-several experts predict another event will commence in 2001).
- On the other hand, there are no clear trends over the 20th Century in storm intensity or frequency, though there has been an upward drift in some regions in the last 50 years.

At the same time, objections to the science have been systematically examined and dispelled. The contention that the warming was simply an "urban heat island " effect is clearly incorrect; a discrepancy between satellite and terrestrial records has also been resolved; and the influence of the sun is now incorporated in the latest models.

"Most of the warming observed over the last 50 years is attributable to human activities" **IPCC , 2001**

The future path of climate change

To project future climate, six scenarios or story lines about future society and in particular energy usage, were developed. These cover a wide range of possibilities, but <u>in every case atmospheric concentrations of CO2 increase significantly</u> , within a range of 540 ppm to 970 by 2100, or from 90 to 250% above the pre-industrial level. This would clearly be aggravated by likely increases in other GHG's. These scenarios were used by the climate models, (General Circulation Models or GCM's) to yield the following findings:

- The global surface temperature will increase by 1.4 to 5.8 oC between 1990 and 2100.(This is significantly higher than the IPCC Second Assessment Report stated, due to the expected reduction in sulphur dioxide emissions , a serious local pollutant which produces acid rain, but cools the atmosphere for a short while.) At the high end of the range, this is similar to the increase in temperature at the end of the last Ice Age, but compressed into a century.
- Northern landmasses will warm more than average, which in turn will release methane trapped in the permafrost, causing a positive feedback.
- Precipitation will become more variable in many regions, with more intense events.
- Drought will become more prevalent in the continental interiors. This could start a serious feedback , because the Amazonian rainforest may die back, leading to the loss of a major "sink" for CO2.
- Storm and El Nino activity is uncertain, because many of the GCM's are not detailed enough to generate this type of information. However , increased activity is likely in some areas.
- Sea-level will rise by between 9 and 88 cm between 1990 and 2100.
- Oceanic currents (thermohaline circulation or THC) will weaken, and

"beyond 2100 the THC could completely and possibly irreversibly shut down.."
This could result in an abrupt climate change (see box)

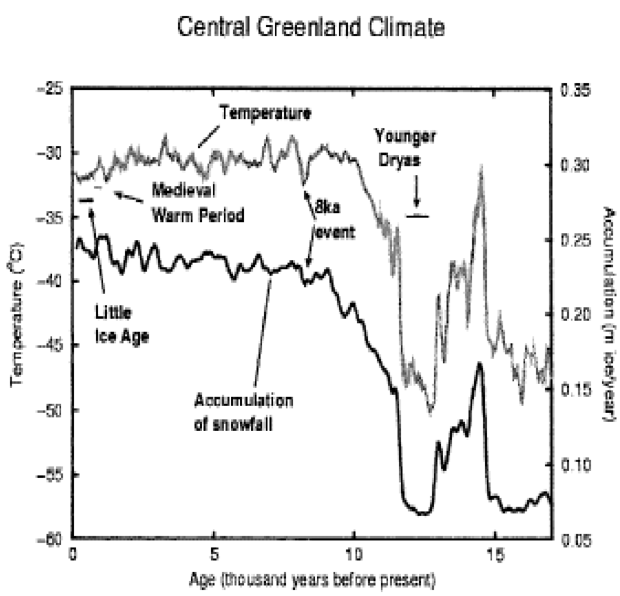
- The major icesheets will remain stable until 2100, but beyond then, the Greenland icesheet could decline irreversibly under high emission scenarios, with a consequent gradual but pronounced rise in sealevel of several metres.

Box 1 Abrupt Climate Change (ACC)

Projections of climate change assume smooth, gradual acceleration in temperature and precipitation. However, prehistoric data shows that at least eight times there has been an abrupt onset of a radical new state, particularly when climate is already unstable. One of the key triggers appears to be failure of The Gulf Stream or thermohaline current (THC).

It results in catastrophic changes in icecover or vegetation, and dramatic shifts in the water cycle, and a sharp drop in temperature for the North Atlantic and all those regions which border it (East Coast USA and Canada, Western Europe). Historically, mild shifts have lead to the collapse of entire civilisations (Maya,Mesopotamia).

The implications would be a huge cost in adapting infrastructure to cope with the new conditions, and much drier conditions in many regions. A ballpark figure of $150 billion for the cost to global farming was suggested by the National academy of Sciences.



The diagram shows abrupt climate change in action.

During the Younger Dryas period, 12000 years ago, the temperature in Greenland collapsed 10C in 10 years, while the annual accumulation of snow doubled inside 3years.

Source : National Academy of Sciences, USA (2001)

The risks posed by ACC are so grave, that the Pentagon commissioned a strategic report (Schwartz and Randall, 2003) on the subject.. The study concluded that "disruption and conflict will be endemic features of life" if ACC occurs, and that "many countries' needs will exceed their carrying capacity" with consequent nuclear proliferation and large population movements.

Costs of impacts

The macroeconomic view
The cost of climate change is hard to estimate, since natural systems are typically "free", and estimates are generally biassed on the low side because richer countries tend to be less affected. Attempts to aggregate the costs at national, regional, or global level are controversial because gains for some are taken to cancel out losses for others. Also the weightings are necessarily subjective, even in monetary terms, owing to the relative non-interchangeability of lifestyles. If we remain at national level the following findings are fairly sound:

Country type	Temperature rise	Cost
Developing	Any	Net economic loss, Rising with temperature
Developed	Up to 2C	Net economic gain
	Between 2C and 3C	Mixed or neutral
	Above 3C	Net economic loss

Table 1 Macroeconomic cost of climate change impacts

<u>In population terms, more people are projected to be harmed by climate change than benefit from it, even for temperature rises less than 2C.</u> This reflects the outlook of adverse water run-off and sea-level rise in many developing countries, and the fact that some crops are already near their maximum temperature tolerance in the tropics. The majority of wealthy, 'Annex 1' countries would benefit under moderate climate change, but there are several reasons why they cannot be complacent:

- Climate change may not remain moderate, due to the "positive feedback " noted earlier
- There is a risk of abrupt climate change, leading to a sharp reversal in some regions
- International effects such as migration and trade problems may cut across borders
- Even within richer countries there will be acute impacts in some sectors and zones
- Climate change will be compounded with other effects (see below)

Current trends of unsustainable development
IPCC 2001 stated that there was "emerging evidence" of damage from flood and drought to human settlements from climate change. The reason for this caution is that economic development has been occurring in an unsustainable way, by ignoring hazards and vulnerability. One good illustration of this is from the statistics gathered by Munich Re about the cost of natural disasters (see Figure 1). As can be seen, the trend in the total cost of disasters is a power curve accelerating at over 10% per year, which began before climate change really started to manifest itself clearly, and which includes also geo-disasters like volcanoes and earthquakes. This reflects a number of factors: increasing wealth and population growth, the greater susceptibility to damage of modern materials, the development of more hazardous areas, and possibly less reliance on local support systems. If this trend continued, it would result in the cost of natural disasters outstripping global GDP around 2065, without any contribution from climate change!

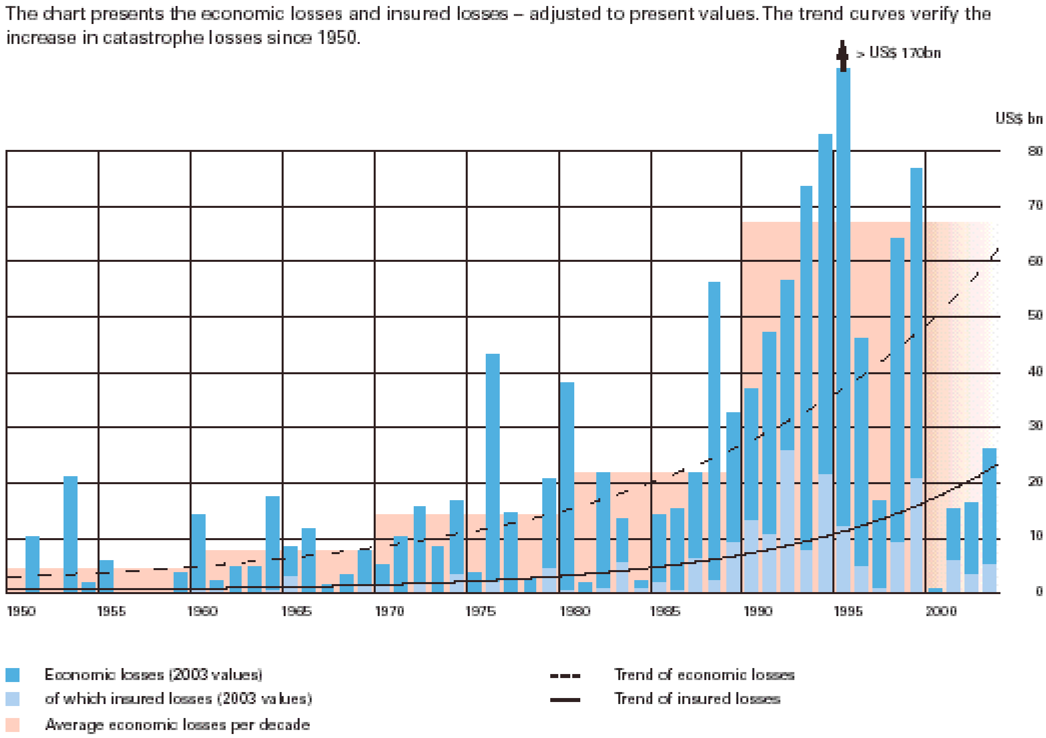


Figure 1 Cost of Natural Disasters 1950-2003 (Munich Re)

The implications of this are important- we cannot just try to project the effect of climate change in isolation- it will be compounded with other factors which will exaggerate the costs. The likely increase in severity of extreme events will exacerbate this, since the damage response to event parameters like windspeed is non-linear: a storm that is 10% faster will do 150% more damage; a hailstone that is twice normal size will create eight times the impact. This effect is shown in Figure 2 below.

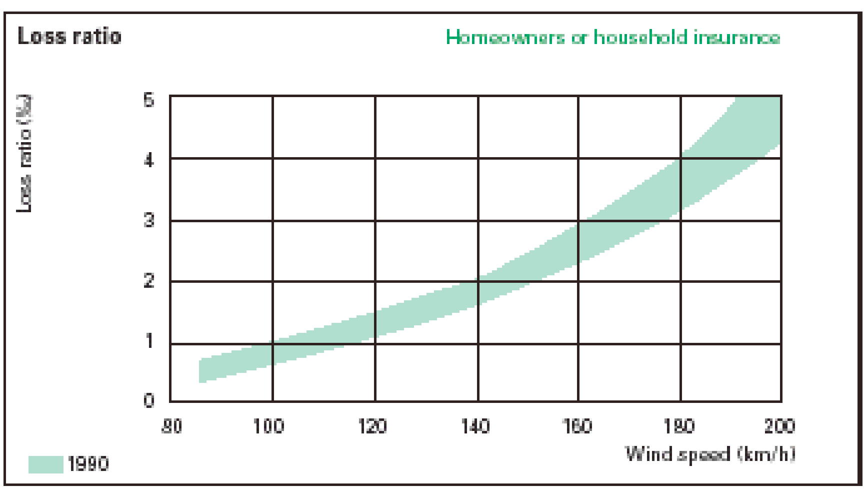


Figure 2 The nonlinear response of damage to windspeed (Source Munich Re)

These problems are not restricted to "hard" socio-economic structures. Figure 3 shows a similar picture for storm damage to forests in Europe (see below). There have been changes in forestry during the period concerned, including the area under plantation, the type of tree, and the harvesting policy, yet there is no doubt that worse storm patterns have also had an effect.

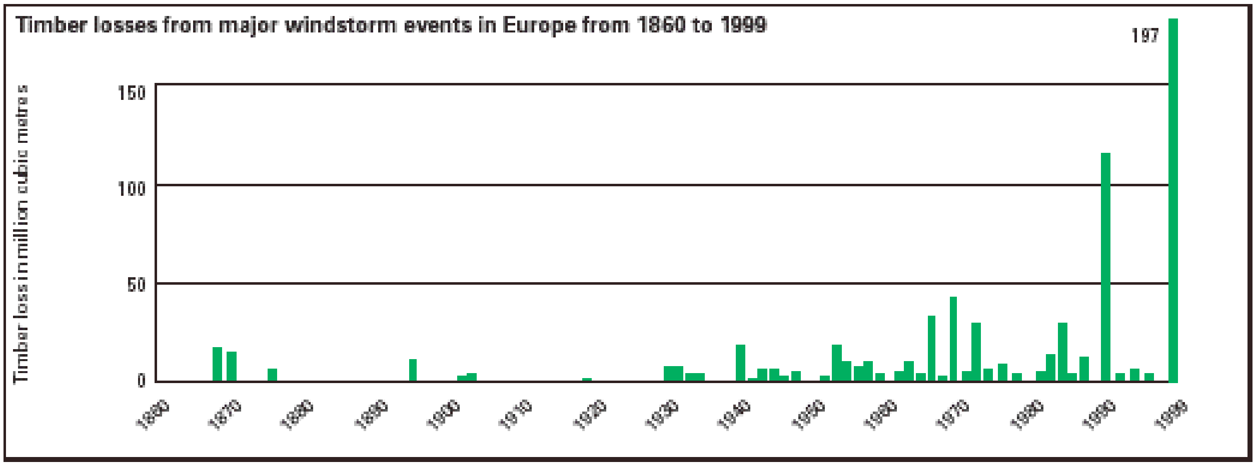


Figure 3 Forestry losses from storm damage in Europe 1860-1999 (Munich Re)

The urgent need for a response strategy

While the effect of climate change on natural disasters is only now "emerging", because it is masked by socio-economic trends, recent evidence from the UK weather indicates that we do not have the luxury of time to plan a response. GCM results are generally geared to a point some decades in the future, and there is considerable uncertainty about the actual sensitivity of the climate system to the "forcing" effect of manmade greenhouse gases. In this situation, it is useful to consider recent changes in the UK weather record, which is the longest continuous instrumental series in the world (1659 for temperature, 1766 for precipitation).

Insurers know from experience that property damage responds to extremes in the weather, not changes in the average conditions (as seen in Figure 2). Although the statistics on individual events and daily conditions are less certain in the early part of the weather records, the monthly figures are reliable, and recent work shows that unusual monthly values are correlated quite well with extreme events eg storms and floods. Thus, we can examine the frequency of high and low monthly values of temperature and precipitation to determine whether the risk of damage has increased significantly. Setting the threshold at 10% frequency for high and low gives a reasonable population of abnormal months- in the long run there should be 12 extreme months in a decade (10% of 120 months). Table 3 shows that the frequency of hot months has suddenly rose to almost three times the expected rate in the 90's, while the proportion of cold months has been below normal for 45 years. There is also evidence of a later shift in rainfall patterns too, towards wetter winters and drier summers, which has been associated with major inland floods in the UK.

In particular, this recent shift in patterns towards warmer winters means more storms, more rain, faster thaws, (but some benefit from fewer frosts). The net effect is a significant increase in property damage, as has already been seen in UK insurance claim statistics.

No/decade 12 expected	60's	70's	80's	90's	00's to March 2004
Hot	10	17	18	34	33
Cold	*5*	7	8	*3*	*0*
Wet	14	11	19	15	26
Dry	10	15	10	15	*2*

Table 3 the Pattern of extreme months in the recent UK record
(red for high value, italic for low value)

Is the cost of climate change insurable?

Conventional insurance is insufficient
A striking feature of the data about the cost of natural disasters in Figure 1, is that relatively little of the cost is insured, in fact only around 20%. This varies between hazards (flood and earthquake are poorly insured, and also between region. Figure 4 illustrates that only the rich countries of the world are insured, so that developing countries do not have the technical Infrastructure to deal with natural hazards through insurance at present.

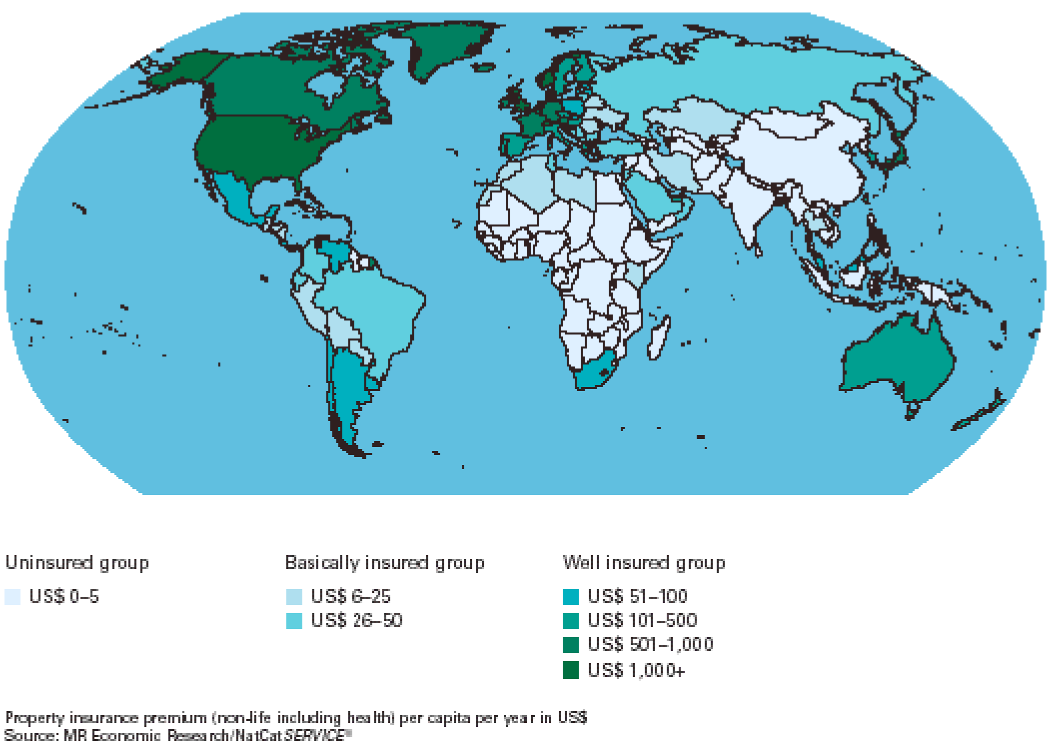


Figure 4 Insurance penetration and wealth (Munich Re)

Even in those areas where insurance is possible today there is a strong likelihood that this will not be so in future, unless there are radical changes in the way that society deals with risk. The reason for this is that risk is usually not evenly- distributed. There are some economic sectors and some geographical zones that are more exposed, particularly to flood. Rapid urbanisation in lowlying coastal areas is greatly increasing the population density and assets at risk. The risk of urban flooding will increase due to outdated drainage and other infrastructure. It is not possible to put an overall figure on the likely damages, but country studies (eg in Egypt, Poland, and Vietnam) have produced estimates of tens of billions $ individually.

It is difficult to apply free market models to this situation, since low-hazard populations will not subsidise the at-risk areas willingly. At the same time the at-risk ones are reluctant to pay an elevated price for insurance, believing that the event is too unlikely, or that in the crunch, someone will bail them out. Public sector "solidarity" models can handle this, and are used at present in several countries (eg France, USA for flood and agriculture, Spain) but the burden on the taxpayer is still a strain, and these systems rely on the private sector to carry out much of the administration for efficiency.

What is not yet clear to policymakers, or the private sector, is that the kind of changes projected by GCM's in the frequency or "return period" of events like floods will make insurance impossible in future because the scale of damages will escalate rapidly.

Box 2 The Escalation of Catastrophic Risk

One of the conditions of insurability is that the premiums must be affordable. In general the premium for insuring property against a range of perils, including fire and storm is under 0.2 % of the value of the property, which is not burdensome. Reinsurers tend to work on more focussed risk portfolios, where the risk premium is considerably more as a fraction of the value insured. The example below illustrates how this will escalate in future and become unacceptable.

Suppose that in 2000 the reinsurer believed there were three possible outcomes, normality (no cost, an extreme event (costing 1$million) and a catastrophe (costing $5 million), as shown in the table below.

Event type	Normal	Extreme	Catastrophe
Cost	0	1	5

If the reinsurer believed that the frequency of these events was 99%, 0.9% and 1-in-a-1000, then it would assess the risk premium as 0.014, as shown in the second table, first row. However, the balance of these events will be disturbed by climqte change, so that the typical distribution of events in 2050 will shift to: 95%, 4% and 1%.

Year	Frequency (% of time)			Risk premium = Frequency x cost
2000	95	0.9	0.1	0.014
2050	99	4.0	1.0	0.09

The reinsurer's assessment of risk rises from .014 to .09, <u>an increase of 540%.</u>

Box 2 illustrates this point with a simple example looking at the typical change in return periods that may occur within the next 50 years in some areas. Steep rises in risk are inevitable, which will lead to the withdrawal of cover as reinsurers and insurers strive to remain solvent by avoiding the danger. This will leave the risk with the victims and the public sector.

Liability as a mechanism

The possibility of blaming emitters of greenhouse gases for causing climate change, and hence seeking compensation from them for the consequent damage, has been proposed eg by the Alliance of Small Island States (AOSIS), and more recently the Climate Justice Group. This approach has a number of flaws, appealing though it may be to lawyers.

- Due to the inherent natural variability of the climate system, it will be impossible to conclusively identify the cause of "an event". This might be less of an obstacle where a trend is concerned eg sealevel rise, or a series of events which might satisfy the "balance of probability" under a civil liability regime.
- Where liability has been used as the vehicle, it has often resulted in disproportionate administrative cost eg in USA for "clean-up" of polluted landfill sites.
- The sums of damage involved are potentially so large (see earlier sections), that the private market would not be a viable receptor of the risk.
- Attributing the responsibility, and allocating the cost will be impossible. The gases causing the damage have been generated over centuries. Assigning liability to deceased parties, or their successors, is pointless or contrary to natural justice, as is blaming parties that were unaware of the consequences of their actions. In addition, much of the gas is emitted in developing countries, even although their percapita emissions are low (see Figure 5). Even if it were agreed that a threshold percapita level was "safe", this is likely to be exceeded as development proceeds (and South Africa probably is above the "safe " level already).

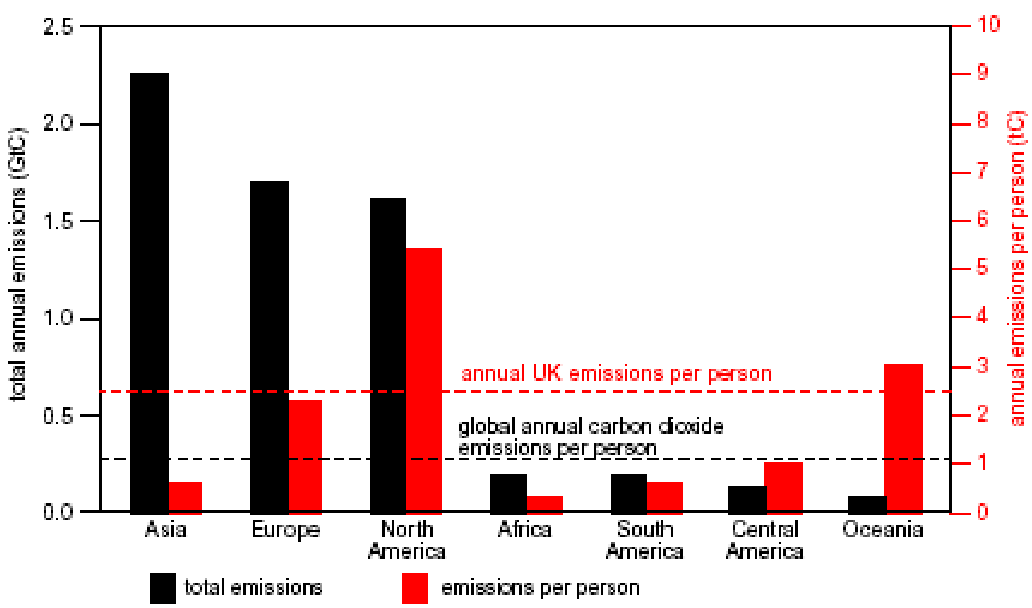


Figure 5 Regional emissions of greenhouse gases , in total and percapita (UK Royal Commission on Environmental Pollution)

- The possibility of using the UNFCCC to deal with the issue is low, because under Article 4.7 compensation for impacts of climate change is linked to compensation for the effect of measures to limit greenhouse gases. Fossil-fuel exporting countries will likely block progress under "impacts" unless they receive compensation also.
- Where damage to ecological systems is concerned, the "costs" are non-monetary, and ownership is unclear, so these are not suitable for reparation under a liability regime.

What are the options for dealing with climate change?

The previous sections have argued that on a business-as -usual (BAU) approach, climate change will generate unacceptable risks , financially and ecologically. Traditional insurance methods will certainly be unable to cope with them. Since energy is a vital ingredient for economic development, and development is a goal to which all nations aspire, it is clear that alternative approaches to the energy economy are required, but in choosing them it is important to avoid creating new unacceptable risks.

A low-risk sustainable energy economy
Improved energy efficiency is an essential low-risk component of any plan. In OECD countries it CAN be a way to reduce emissions. For example the UK Government foresees that its target of a 60% reduction in emissions by 2050 will be largely achieved by better energy efficiency in buildings. For developing countries, better efficiency can reduce the future growth of emissions, but economic growth powered conventionally would simply swamp such measures.

"Clean coal" relies upon “sequestering” carbon dioxide in some way, either directly at the point of combustion or extraction, or indirectly through biochemical processes such as growing trees. Direct purification adds to the process costs and creates a waste product that is potentially damaging and requires managing. Geological sequestration (ie burial under ground or sea) is itself costly, and may be difficult to safeguard over many decades. Liability for escape of waste greenhouse gas would be uninsurable- many insurers incurred large losses due to leakages from underground storage tanks for gasoline, and would not repeat the experience! The option of forest sequestration also faces serious difficulties because forests themselves will be vulnerable to climate change. It is already predicted that Amazonia may begin to die back by the 2050’s due to changing rainfall patterns, and other climate-driven stresses (heat, pests) threaten manmade forests in more temperate latitudes.

Nuclear power is also not a viable option. Decommissioning costs have generally been disguised. The waste products need to be kept stable for many centuries, which is a major constraint on future generations. The likelihood of being able to use the waste as feedstock for nuclear *fusion* remains low. The ability to cool the operating power plant may itself be compromised by climate change, eg due to changes in water availability or sea-level rise as seen in France during the hot summer of 2003. Supplies of the basic uranium itself face natural limits in economically-exploitable forms. Finally, the industry can be the source of proliferation of atomic-bomb technology, as seen recently.

Renewable energy (RE) like wind, solar, and water does not create additional greenhouse gases, and so avoids climate change. The resources of it are enormous. They are widely distributed and come in various forms so they are accessible to the rural poor. (Modern RE technologies for rural cooking are efficient and avoid noxious byproducts). Most countries have ample resources of RE and so this will strengthen their security of supply and domestic currencies, because of the avoidance of hardcurrency imports. While still relatively expensive, RE technology is going up a learning curve rapidly, and costs are falling fast. (see Figure 6).

Although financing R&D in renewables would be riskier than in conventional fuels, because of the difference between creating products as opposed to refining them, it would not require enormous additional capital. In the mid-1990s, worldwide subsidies to fossil fuel and nuclear power totalled $250–300 billion annually, and globally, subsidies for conventional energy still vastly outweigh those for RE. As much as 90% of these subsidies are in the developing world, where the price for energy is often set well below the true costs of production and delivery.

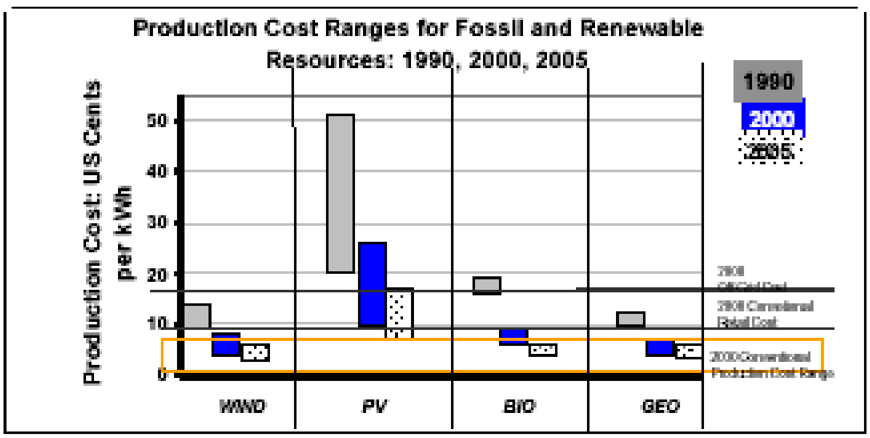


Figure 6 The improving economics of renewables (G8 Renewables Task force, 2001)

Risks to the investment world

Just as continuing with business as usual poses financial risks for society, and insurers in particular, so a switch to renewables could result in the loss of value in investments in the fossil fuel economy. This has been used as an argument by the affected lobbies to deter action on limiting emissions. The cost of mitigation depends crucially on the target level of greenhouse gases that is selected as " safe" and the timing of action. For a level of CO2 around of 550 ppmv (parts per million by volume), which is roughly twice the pre-industrial level, the pure economic costs are at a global level are minimal, and are in fact offset by side-benefits eg cleaner air quality, provided that an early start is made on addressing the problem to avoid locking-in further investment in "dead-end" technologies.

This point becomes more acute at the level of industry sector or individual company, since they are vulnerable to substitution by the new technologies. For example " Changing Drivers", a recent study by World Resources Institute & Sustainable Asset Management of the automobile industry, suggested a range of potential impacts, from +10% for Toyota, to -15% of company value for Ford if emission constraints become significant. Perceptive investors have realised this, and are now beginning to challenge company management to address these issues through a number of initiatives - Institutional Investors on Global Climate Change, Investors Network on Climate Risk, and The Carbon Disclosure Project. What is clear is that European companies are already aware of the issue and have started to plan for a carbon-constrained world, but other regions, particularly USA are lagging behind. This is symptomatic of a second key point, that the commercial world needs clear direction from policymakers about the shape of the future energy economy, and regulations that support this goal efficiently. (These factors apply to other investment media also, such as property and project finance).

Coping with damage
Since conventional forms of insurance will be unable to cope with the impacts of climate change, it is necessary to look at innovative ways of coping with the financial risks , particularly in developing countries. One suggestion is to use a hybrid system , where each sector of the economy is serviced by a type of primary "insurance" appropriate to its needs and financial capacity, and then these primary vehicles feed into wider-based "reinsurance" arrangements, at the country and international level, with a mixture of public and private resources. A scheme along these lines has recently been introdueced for earthquake in Turkey, and the early signs are promising. (see Figure 7).

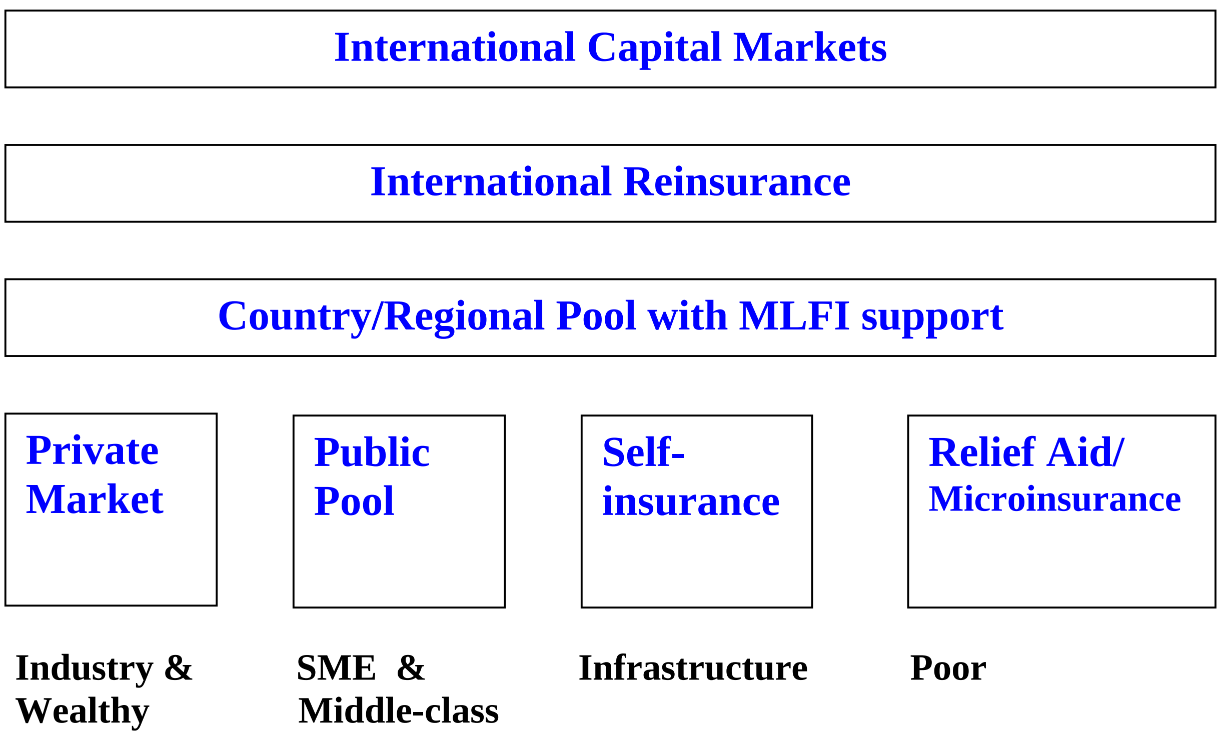


Figure 7 A Layered Hybrid Risk Scheme for Insuring Natural Disasters

The unifying policy : "Contraction and Convergence"
The most important step in reducing the risk of climate change, is to create a common understanding and will to solve the problem. This can only be done with a policy that is simple, fair and effective. The one which offers the best hope of doing this is "Contraction and Convergence", devised by the Global Commons Institute. It is based on the idea of agreeing a "safe" level of atmospheric greenhouse gas concentrations, and allocating the right to emit ghg's equally percapita to all nations. Since we are not at the equal stage currently, with rich countries above the safe level and poor countries below, a future

convergence date has to be agreed also (see Figure 8). The merit of this simple approach is that it is clearly "fair" (equal percapita shares) , pragmatic (allows time to adapt), it avoids "blame" (no retrospective differentiation), but at the same time it creates the possibility to redistribute wealth and transfer technology (emissions rights could be traded between over- and under- compliers), and it provides the incentive to develop RE and more efficient energy applications (by setting a clear direction).

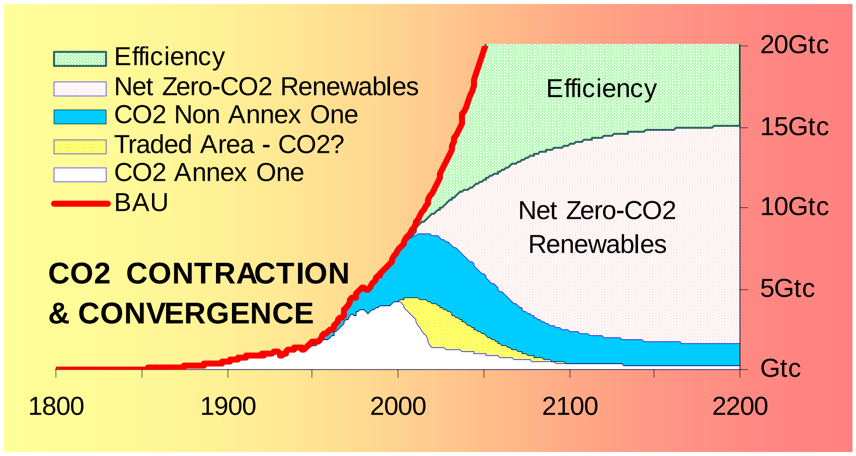


Figure 8 Contraction and Convergence:
the switch to a sustainable energy policy

Without an overarching framework like Contraction and Convergence to operate within, the financial sector will always be rather hesitant to commit its resources to a seemingly distant problem like climate change, when there are so many other urgent issues clamouring for attention.

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