

Response to the Bank of England report:

“The impact of climate change on the UK  
insurance sector – Sept 2015”

**By:**

Kevin Lister BSc, MBA, MSC

**Endorsed by:**

Professor Peter Wadhams, University of Cambridge

John Nissen, Chair of the Arctic Methane Emergency Group

Dr. Alan Gadian, Senior Atmospheric Scientist, University of Leeds.

## Introduction

The report “The impact of climate change on the UK insurance sector” was prepared in September 2015 by the Bank of England.

Since its publication, events have moved at an accelerating rate and in the worst possible direction. The purpose of this work is to consider the implications of these on the conclusions that the report initially came to. These are of such profound seriousness that they either challenge many of the assumptions that the report is based on or in some cases invalidate them. In summary the critical events are:

- There was no legally binding agreement at the COP21 to make the urgent cuts in greenhouse gas emissions that are needed; instead representations were made to keep global temperatures rises below 1.5°C at the end of this century. The only concrete conclusion from the talks was to do more calculations to establish a carbon budget for this. All other agreements are based on “intended” national contributions.
- Arctic heating is continuing to accelerate at an alarming rate and the ice cap is now on a death spiral. Within weeks of the COP talks finishing, the temperatures at the North Pole were at an unprecedented 40°C above normal. There is now a high likelihood of a blue ocean Arctic occurring either this summer or next.
- The single biggest ever increases in temperature and atmospheric CO<sub>2</sub> measurements were made in February confirming the proposition that by all critical measures climate change is now progressing exponentially and is out of control.
- There is increasing agreement in the scientific community that the risk of climate change has been seriously underestimated.
- The cost of damage from, and adaptation to, extreme events has risen alarmingly. Estimated global costs of \$323 billion were incurred 2015.
- Oil, gas and coal production continue to be far above the sequestration levels of the planet and the continuing low prices of these commodities are a disincentive in the move towards a renewable economy.

In light of the above, the global strategy of relying on the development of zero carbon economy as a hedge against runaway climate change is seriously flawed. Without rapid intervention to reverse climate change, adaptation costs will quickly become prohibitive.

We thus contend that the only option is to start an immediate crash programme of climate restoration. This will be based on a combined rollout, but not limited to, the following:

- Marine cloud brightening technologies which will simultaneously increase the planet’s albedo, remove atmospheric water vapour which is a potent greenhouse gas and reduce the intensity of super storms that will emerge in an overheated planet.
- Ultraslow release of ocean fertilisers with the objective of increasing phytoplankton growth leading to increased sequestration of CO<sub>2</sub> and absorption of methane emitted from the Arctic seabed.
- Thicken the Arctic sea ice, to increase Arctic albedo and to trap methane released from the seabed which would otherwise pass into the atmosphere and exacerbate global warming.

There are important caveats to all the above.

- The selected technologies selected must be able to be scaled up rapidly to be commensurate with the scale of the crisis facing us.
- Each of these must be subject to ongoing research along with independent verification such that the effectiveness of each can be assured and optimised.
- By the nature of the problems being addressed by these interventions, they must be started immediately.
- The effectiveness will increase when combined as a co-ordinated suite of interventions.
- The door must remain open to other approaches which could either be complementary or superior.

Today, there is no economic model that will enable the rollout of these climate restoration programmes while simultaneously reigning in fossil fuel production. As such, we believe that the insurance industry is best placed to take the lead on funding these and that they have a legal obligation to ensure that this is done under Solvency II.

The basis of our proposal assumes that high carbon-emitting industries should have high insurance premiums to reflect the third party liabilities their actions cause through climate change. This is analogous to a young driver paying higher insurance premiums for his/her increased third party liability risk. These high premiums can be directed towards funding the climate restoration programme that we propose.

It is vitally important that the speed of events is acknowledged and that this proposal is addressed with all possible haste or a better one is proposed.

We note also that the aim of the COP talks is now to keep temperatures below 2°C at the end of the century. This is a significant relaxation of the previous target that the temperature should never ever rise above 2°C. It condemns to death all higher life forms that may survive into the next century. The responses that we make to the PRA report will demonstrate that this even more relaxed target is impossible to meet under the current COP strategy and that it is more likely the temperature rise we will experience will be towards the worst case scenarios of a 5-6°C temperature increase this century.

Consequently, the strategy of the Bank of England to implement a financial policy that will be commensurate with a 2°C global temperate increase is fundamentally flawed and must be immediately revisited in the short time that is still available to us.

We have commented on selected paragraphs throughout the PRA report (in bold) to demonstrate our concerns with the underlying assumptions and strategic position that it is based on. Some of the comments we make are applicable to other paragraphs of the report and we summarise with the last paragraph of the report.

## Comments by Paragraph

**1.3 The PRA has not developed an independent view on the science behind climate change. To provide context, the report seeks to reflect evidence provided by respected authorities, particularly the Intergovernmental Panel on Climate Change (IPCC). The PRA's areas of judgement are focused on the relevance of scientific evidence to regulated firms, and to our statutory objectives.**

There has been considerable concern within the scientific community for many years about the ability of the climate change models that the IPCC relies on to accurately predict climate change.

To name a few critical failures in the modelling:

- The models do not capture the rate of heat transfer from the oceans to the methane hydrate reservoirs below the sea bed, nor do the models include the risk of large scale methane releases, (ref Prof Jim Kennett, University of California).
- Surface air temperatures are rising in the Arctic which is reducing winter ice growth rates and increasing summer melt rates to the point where the whole ice floe is melting. This is being accelerated by the near-surface ocean heat delaying the autumn freeze-up, (ref Prof Peter Wadhams, University of Cambridge).
- The models underestimate the extent of the climatic dimming caused by airborne particulates, (ref Dr. Alan Gadian, Leeds University).
- The climate change models do not consider economic feedback loops where climate change can cause increased CO<sub>2</sub> emissions due to the adaptation that will be necessary and the insecurity that will result.

Any one of these issues will lead to critical underestimation of the climate change risk; when taken together it means that the critical levels of atmospheric CO<sub>2</sub> are far lower than assumed and the speed of events once these levels are passed will be far higher than currently anticipated.

The extreme weather events of this winter along with the recent record global temperature and CO<sub>2</sub> measurements have led support to our worst case prognosis. The situation is so bad that it is quite likely that we will experience an ice free Arctic this summer, and almost certainly by 2020.

Once we get past this tipping point of a blue Arctic Ocean event, the effectiveness of the climate change interventions that we are proposing to cool the planet will diminish in effectiveness, thus time is of the essence.

We therefore cannot over stress the importance of the necessity to explore all possible ways of proceeding immediately with a climate restoration programme and ensuring that this can be reliably funded.

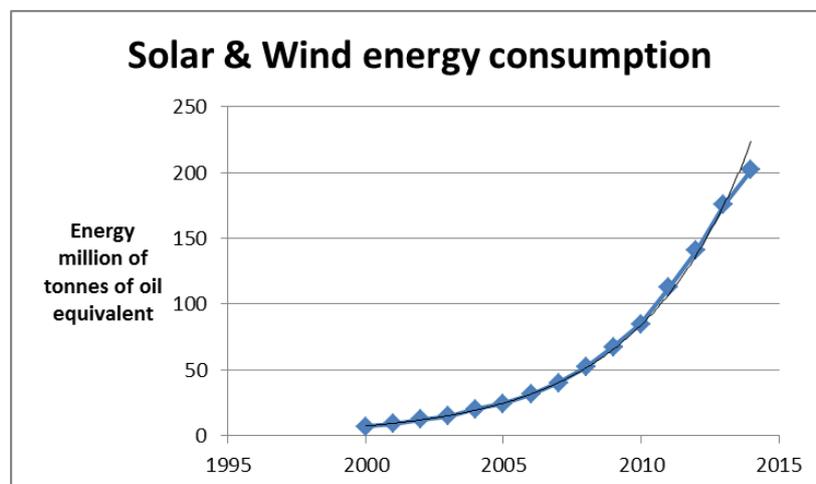
**1.22 The global transition to a lower carbon economy could have an impact on insurance firms through their investments in carbon-intensive assets. This is particularly relevant for two tiers of financial assets: (i) securities of firms that may be impacted directly by regulatory limits on their ability to produce or use fossil fuels, ('Tier 1' – these include coal, oil and gas extraction companies, and conventional utilities); and (ii) securities of firms that are energy-intensive, which might be affected indirectly via an increase in energy costs ('Tier 2' – these include chemicals, forestry and paper, metals and mining, construction and industrial production). Between them, these two tiers of assets account for around a third of global equity and fixed-income assets.**

With reference to (i) above, no regulatory limits were imposed on carbon emissions at the COP21 and the agreement closes the door to any further talks which may result in stringent production restrictions. Instead nations offered their "Intended Nationally Determined Contributions" which are not legally binding. Against the current background of rapid global heating, this is the weakest possible commitment. Yet even these targets set us on track for a warming scenario that will be considerably in excess of the 2°C - potentially as high as 5-6°C.

The essential agreement in the COP21 text is for "the Intergovernmental Panel on Climate Change to provide a special report in 2018 on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways." Reviews are then to be carried out on the progress against the INDC to assess progress in achieving the 1.5°C target in 2020. Unfortunately, the exponential rate of growth in atmospheric CO<sub>2</sub> means by this time it will be too late to avoid these temperature thresholds.

The hope of the COP talks is based on the CO<sub>2</sub> reduction targets being achieved through a successful global deployment of renewable and low carbon technologies. While there is no doubt that significant progress has been made with these, there is equally no doubt that anthropogenic greenhouse gas emissions continue to be emitted at levels well above the sequestration ability of the planet.

Worryingly, the latest BP Statistical review shows that the rate of growth for renewables is showing its first signs of tailing off. This suggests that limitations to the growth of renewables may be closer than we think. The same review shows renewables only contribute 1.81% of primary energy production, making the reduction in the growth rate particularly concerning.

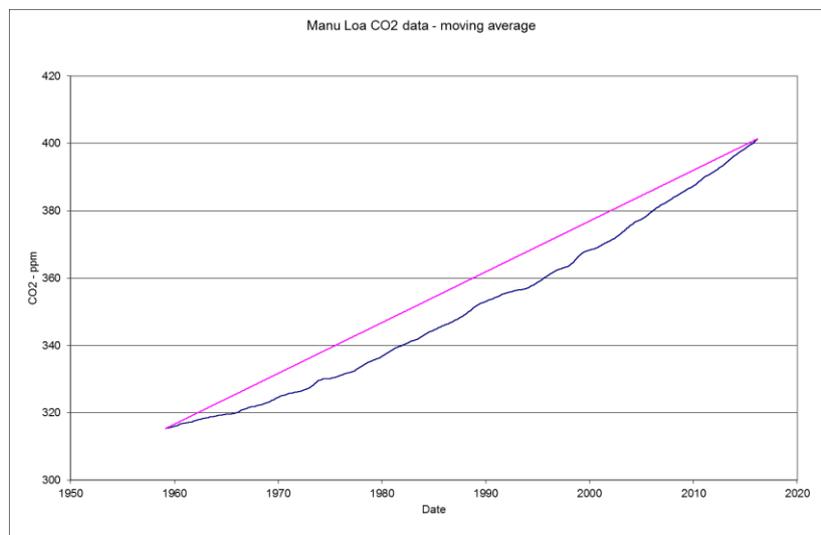


These facts place the insurance industry in the horns of a dilemma. The industry is facing declining returns on their assets in the energy field as outlined in (i) above, but this is not because of regulatory restrictions on production which the report warned. Instead, it is from the polar opposite problem – too much production which is forcing prices down.

It is also not proven that this price reduction is driven by the increasing energy output of renewables as advocates of renewables claim. A much more realistic and disturbing assessment is that prices are being driven down by the inability of the global economy to service its debts under an economy that is facing the combined effects of increasing climate change costs and falling energy return on energy invested, (ERoEI).

We would contend that this is the worst possible situation for the insurance industry to find itself in. The flood of cheap fossil fuel will maintain a high level of greenhouse gases thus exacerbating climate change liabilities. At the same time, the insurance industry's ability to fund these liabilities will diminish from the financial loss on their investments in fossil fuels. This situation impacts liabilities (i) and (ii) simultaneously.

Furthermore there is further evidence that a renewable economy alone will not reverse the crisis of excess atmospheric CO<sub>2</sub>; we note that atmospheric CO<sub>2</sub> has been showing a growth rate faster than exponential since 1957. This trend has continued over the past year despite a claimed slowing of anthropogenic greenhouse gas emissions. This leads to two conclusions. The first, and best case, is that the figures for global carbon emissions are wrong. The second, and more concerning case, is that the claimed emission figures are correct but that the ecosystem has reached such a state of collapse that it is now a source of emissions rather than a sink.



**1.23 These asset-side impacts might be felt across general and life insurers and a range of factors could influence the speed of the transition, including public policy, technology and changing investor preferences and market sentiment. There could also be a separate, probably more limited, liability-side impact on general insurance firms through a potential reduction in insurance premiums from carbon-intensive sectors; the energy sector accounts for around 4% of total UK premiums.**

Unless climate change can be slowed down and reversed, insurance premiums across the board will reduce through the combination of assets becoming uninsurable and resulting economic contraction.

The danger is that a classic reinforcing feedback loop will be set in motion which will transform economic contraction into rapid collapse. Climate change will drive increased liabilities across the board. This will reduce returns on investment and economic growth will fall. With the lower economic growth, less premiums will be recouped and climate change liabilities will be increasingly unpayable by insurance companies. Higher liabilities will lower ROI even further and the cycle will then continue.

The fact that the energy sector is only 4% of total UK premiums suggests that their premiums would not be sufficient to fund a climate change restoration programme of the size needed. We would argue that this level of premium does not reflect the third party climate change risk that they cause and thus should be considerably higher.

Generally, insurance premiums are set based on risk exposure that clients face, which is the product of likelihood and consequence. There are some notable exceptions, such as young drivers paying more for car insurance than older drivers due to their third party liability. It is thus our contention that the “young drivers” model be applied to climate change, such that those companies and organisations that are at the root cause of the climate change and cause higher third party liability should pay a significantly higher premium to reflect this.

Furthermore, in lieu of any regulatory change to stop fossil fuel production as highlighted in the discussion of paragraph 1.22, then it is our contention that by imposing a significant proportion of the climate change restoration costs on the fossil fuel industry through increased third party liabilities it can act as a market based carbon tax. This will enable a managed transition to an economy based on low carbon energy production and will be of benefit to the insurance industry as it tries to manage its liabilities to declining fossil fuel stock prices. This can be further refined by making the premiums a variable cost dependent on the actual volume of oil, gas or coal produced.

**1.24 Discussions with market participants and wider stakeholders identified a range of possible strategies for managing transition risk, as well as a number of public commitments, including divesting from, and engaging with, specific high-carbon sectors. Views from firms included expressing an urgent need to agree a carbon pathway. This would improve transparency of potential exposures to carbon and resource-intensive sectors.**

At present there is no agreed and credible carbon pathway that the world can rely on to get to a zero carbon global economy in the time period available to us.

We contend that embarking on a climate restoration project funded by the insurance industry is the only option in the time available to us. This can only be done by co-ordinated regulatory pressure across all the main markets.

**1.26: Liability risks are those which can arise as a result of parties which have suffered loss from climate change seeking to recover losses from others who they believe may have been responsible. The PRA views this risk as being of most relevance to general insurers through the possibility of increased third-party liability claims.**

We would contend that one of the best options for minimising this risk is for fossil fuel companies to actively support a climate change restoration programme of the form that we are proposing.

We would also warn that once the burden of economic and ecological stress builds up beyond a critical level, then the resulting collapse could be so tumultuous that large class actions may not be able to be brought.

**2.4 The importance of the insurance sector is underlined by the scale of payments made to households and firms by insurers. In 2014, for instance, UK insurers paid out £9.8 billion in motor claims and £4.7 billion in property claims to firms and households. They held assets of £1.9 trillion, and contributed 334,000 jobs and £29 billion to UK GDP.**

It is now a near certainty that climate change will impose liabilities to the insurance industry far in excess of the £1.9 trillion assets that they currently hold. Furthermore, the value of many of these assets may decline due to climate change.

Evidence is now suggesting that sea level rises are likely to be much higher and faster than predicted only ten years ago by climate change models, thus liabilities will increase dramatically.

Much is written about cities being flooded, but almost nothing is written about the consequences of critical infrastructure being flooded. This is likely to be far more significant and will happen at an earlier stage in the climate change transition. It will impact facilities such as nuclear power stations, chemical processing plants, ports, oil refineries and military bases. Worse, is that these critical pieces of infrastructure will be simultaneously destroyed or degraded.

To put this in context, the cost of the Fukushima clean-up is now expected to exceed \$100 billion. In a future scenario with several Fukiishimas happening simultaneously around the world and where the recoveries must be done on accelerated timelines imposed by sea level rises, then the costs are likely to rise significantly above those that Japan is experiencing today.

**2.6 The traditional business model of insurance rests on the underwriting of large diversified pools of policyholder risks. The ‘pooling of risk’ and diversification benefits arising from unrelated events from a range of risks is essential to the concept of insurance and relies on a number of fundamental assumptions, including:**

- **the risks being pooled are unforeseen (arbitrary) and not sufficiently frequent or costly to make insurance premiums unaffordable;**
- **the frequency and severity of claims resulting from the pooled risks are similar to those experienced in previous years or, if changing, are doing so in a way that can be reasonably predicted and incorporated into financial plans and premium rates (although it is worth noting that some firms do specialise in taking on new, less predictable risks); and**
- **risks are sufficiently independent, or ‘uncorrelated’, so the aggregate results for a portfolio of risks benefits from diversification.**

Climate change invalidates each one of these assumptions. It creates a common mode risk across all portfolios; it will cause the frequency and severity of claims to increase exponentially; the frequency, severity and cause will all be correlated.

**2.7 The insurance business model has several important characteristics:**

#### **The inverted production cycle**

**Generally, insurance business models differ from other businesses in that an insurance premium is paid up-front, and any benefits become payable at a later date.**

This is a fundamental reason why a dialogue should be opened on a business model driven by the insurance industry.

By contrast, governments are funded by debt and this will be increasingly difficult to pay-off as climate change reduces the prospects for economic growth while imposing increasing demands on public spending. The result being that as climate change intensifies, governments will be increasingly less able to fund the interventions needed. Furthermore, to do so would require several years of negotiation through the COP frameworks to agree on an equitable arrangement. As there are relatively few regulatory bodies overseeing the global insurance market and also fewer insurance companies with less competing interest than there are countries, then the chance of success will be higher than with the current strategy.

This is not to say that the proposals we present can be easily implemented; instead it is to say that it offers a glimmer of hope that is not currently available with the current strategy of hoping the world’s economies will collectively move entirely towards renewable based energy production in the timescale needed.

**2.15 The European Union has established a risk-based capital regime known as Solvency II (Box 2A). With effect from 1 January 2016, all insurers operating within the European Economic Area (EEA) are required to carry out their own self-assessment of risks and hold a level of capital that is in line with their defined risk appetite. Solvency II requires insurers to be sufficiently capitalised to withstand the losses of a 1 in 200 year event, over a one-year time horizon. However, insurers must also consider risks beyond this one-year time horizon as part of their Own Risk and Solvency Assessment (ORSA); this would include the potential impact of climate change.**

Our proposals are consistent with the objectives of Solvency II, which is to, *“better identify, manage and mitigate risks that an insurance company is exposed to,”* by providing the only option to proactively manage the risks.

In fact, given the rapidly worsening situation on climate change, insurance companies would be in violation of this requirement were they not to support the programme that we propose.

**2.30 While RCP scenarios will therefore impact upon individual risk factors in different ways, one could consider all scenarios presenting an increase in the overall level of risk relative to the present day. As discussed in Chapter 3, there are indications existing levels of warming (around 0.85°C over the period 1880 to 2012) are having an impact on insurance firms (for example, increased losses as a result of sea level rise). As shown by the dark blue line in Chart 2d, RCP 2.6, a stringent mitigation scenario, still presents a risk of human-induced warming exceeding 2°C. The impact of potential non-linear changes is also important to consider, and there are a range of views as to when these non-linear effects can occur.**

It is now irrelevant to discuss RCP 2.6. We are already well on the RCP 8.5 pathway despite 21 years of climate change negotiations.<sup>1</sup> Without immediate and successful climatic interventions, a violent non-linear change is a certainty.

We should also consider the discussion of avoiding a 2°C temperature rise or ensuring financial policy is set to adapt to a 2°C temperature increase is equally unrealistic. The polar regions must melt for this temperature rise. Once this happens runaway climate change is unavoidable.

The global strategy to climate change can be analogised to the monitoring of a boiling kettle. One would always decide to switch a kettle off before the water level reaches the heating elements. In contrast, one would not decide to monitor the kettle based on the temperature of the elements. If the elements were seen to be warming, it would indicate that the kettle was boiling dry and the slightest delay in turning off the power would result in their destruction. It is the same with our planet. The melting of the ice is equivalent to the water level of the kettle going down and this is what we should have been using to determine economic and political policy towards climate change. Unfortunately, we chose atmospheric temperature as our measurement variable and we continue to do so. This is equivalent to deciding to monitor a kettle by measuring the temperature of the heating elements. Setting global policy on this basis has already had catastrophically dangerous consequences.

---

<sup>1</sup> See for example:

[http://www.nature.com/nclimate/journal/v4/n3/fig\\_tab/nclimate2148\\_F1.html](http://www.nature.com/nclimate/journal/v4/n3/fig_tab/nclimate2148_F1.html)

**3.4 According to Nicholls et al (2015), 'in 2005, there were 136 coastal cities with a population exceeding one million people and a collective population of 400 million people. All these coastal cities are threatened by flooding from the sea to varying degrees and these risks are increasing due to growing exposure (people and assets), rising sea levels due to climate change, and in some cities, significant coastal subsidence due to human agency (drainage and groundwater withdrawals from susceptible soils)'.**

As referenced above, these risks extends to 400 nuclear power stations at sea level. The dilemma is that emergency closure of these will increase CO2 emissions at a time when ceilings on emissions will have to be applied.

**Box 3A: Indirect risks – business interruption from 2011 Thailand floods**

**In 2011, Thailand suffered the worst flooding in five decades, causing US\$45 billion economic damage, and leading to US\$12 billion in insurance claims. Although flooding is not untypical in Thailand, many did not anticipate the severity of this event or consider the knock-on impact to businesses as far afield as Europe and the US**

**Box 3B: Wider implications of climate change**

**Global security and displacement In addressing the United Nations Security Council on the impact of climate change (July 2011), the UN Secretary-General referred to extreme weather events 'not only devastating lives, but also infrastructure, institutions and budgets – an unholy brew which can create dangerous security vacuums'. The IPCC states 'climate change can indirectly increase risks of violent conflicts by amplifying well-documented drivers of these conflicts such as poverty and economic shocks'. The IPCC also highlights that populations with less adaptive capacity, particularly in developing countries, tend to be most exposed to extreme weather events, and points to an increase in the displacement of people.**

It has been our contention that we must immediately commence a climate change restoration programme due to the lead time necessary to secure funding, develop technology, agree regulatory policies and commence manufacturing.

The experiences of the Thailand flooding and the rise in conflict zones across the planet, virtually all of which have climate change at their core, confirm our views. If proposals for climate restoration are left unaddressed any longer, the resulting political and economic instability will make implementing them virtually impossible.

**3.27 The sophistication of catastrophe risk models has developed markedly over the past 20 years. However, they are inherently uncertain and the evolving impact of climate change increases this uncertainty. Catastrophe models are generally built to provide an estimate of today's risk rather than to anticipate climate trends or to extrapolate impact of these trends into the future. An illustrative approximation by Standard & Poor's (S&P) suggests current catastrophe losses could be undervalued as much as 50% at the 1 in 10 and 1 in 250 return periods if the past ten years were representative of a 'new normal'. While this is based on relatively simple analysis, it still provides a useful insight into the potential scale of climate change impacts.**

This assumption of undervaluing risks is confirmed by climate change data that has emerged since the Sept 2015 publication date of this report. The magnitude of this gap will increase in the future by progressively greater factors, as the 'new normal' accelerates away from the 'old norm' of the past 8000 years.

In addition, prediction of risks from the climate change models is inherently risky in itself. As the perturbation to the climatic system we have caused has no past precedent, then there is no information against which to calibrate the accuracy of our models. Likewise the combination of technology, economic and ecosystem risks, where all can interact, is also without past precedent.

In these circumstances, we should have a risk management policy in the same way that all passenger ships were legally bound to carry adequate lifeboats after the Titanic disaster. It is our contention that a climate restoration programme would effectively be our lifeboat and legislation should be put in place to ensure its construction.

On balance, these factors suggest PRA-regulated insurance firms are reasonably well equipped to manage the current level of physical risks; the PRA will continue to monitor firms' approaches in this area.

**3.37 The PRA's general view is that firms are reasonably well equipped to manage the current level of physical risks from climate change; risks to the PRA's objectives would appear to be lower where firms are also:**

- (i) considering multiple perspectives on risk, including the use of stress and scenario testing;**
- (ii) building close links within the academic community, incorporating the latest scientific evidence into their assessment of risk, including the possibility of more sudden and severe changes in climate; and**
- (iii) considering appropriate governance of climate change risks, including discussion at emerging risk committees, assigning senior management oversight and the merits of in-house environment committees.**

On the contrary, there is no supporting evidence to suggest that *"insurance firms are reasonably well equipped to manage the current level of physical risk,"* much less the future level of risk. Indeed, S&P's assessment in section 3.27 of the report supports this assertion.

We would contend that the rate of change in both the evidence of abrupt climate change and its underlying science makes it difficult to determine if the insurance industry is keeping close enough links with the most critical areas of expertise within the academic community. Even if this is proven to be case, the insurance industry would still be faced with the dilemma of having to ignore the scientific evidence to support immediate short term commercial interests.

We would also caution that there is much division within the scientific community on the range of likely outcomes. To make this matter worse, there is extensive evidence of self-censorship by scientists causing the scale of the disaster to be under reported.

#### **Box 3D: Flood Re**

**Flood Re is being created to deliver access to affordable flood insurance for the 350,000 to 500,000 homes and families from across the UK considered to be at significant risk of flooding – the experience of which is devastating and long-lasting**

We would suggest that this is an appropriate business model of co-operation within the insurance market that could be adapted to support our proposed climate restoration programme.

Furthermore, without effective climate intervention programmes such as those that we propose, then initiatives such as Flood Re will face bankruptcy.

**3.65 UK insurance firms are responsible for £1.9 trillion in assets,<sup>54</sup> many of which are invested, and held to maturity, over the long term to match long-dated liabilities. For example, long-term savings and investment policies, such as annuities and endowments, can have terms of multiple decades. Through its insurance objectives, the PRA has a responsibility to 'contribute towards securing an adequate degree of protection for those who are, or who may become, policyholders'.**

This puts the life insurance industry in an invidious position. They must keep selling new life insurance policies to stay in business, but if climate change and carbon emissions continue on their present path, they will potentially have a zero percent chance of paying out.

We would argue that if this situation is left unaddressed, it puts both the life insurance and the regulators in breach in of fiduciary requirements and subject to punitive legal action.

**4.5 Delaying mitigation or failing to co-ordinate measures or deploy key technologies also increases the cost of stabilising climate. Failure to develop carbon capture and storage (CCS), in particular, more than doubles (best estimate) the cost of meeting the 2°C goal. Many of the scenarios that limit warming to 2°C also rely on some form of artificial carbon dioxide removal, combining capture of CO<sub>2</sub> from the atmosphere with CO<sub>2</sub> storage. According to the International Energy Agency (IEA), their modelling has shown limiting the global temperature rise to no more than 2°C is 'technically feasible, but requires a fundamental transformation of the global energy system'.**

CCS has been on the drawing board for nearly 10 years. In this time it has made virtually zero progress towards a largescale global roll out. This is because to make CCS work, the second law of thermodynamics has to be broken. In simple terms, it takes such a proportion of the energy produced to separate and compress the gas that it can never be economic, especially when the energy returned on energy invested (ERoEI) is falling globally. Even if this challenge could be overcome, then it will be impossible to find enough places where the CO<sub>2</sub> can be safely stored on the scale needed.

The COP21 temperature projections take the fanciful idea of CCS a stage further. They assume that CCS equipped power stations will be fuelled by bioenergy and the CO<sub>2</sub> will be sequestered. In a world heading towards climate collapse with 10 billion people to feed and prime agricultural land being lost to sea level rises, it will already be difficult enough to find enough land to grow food. Adding biofuel requirements to this will make it an impossibility.

It is vitally important that policy makers understand that the temperature predictions published by the COP21 based on the INDCs offered by the signatory nations assume the successful implementation of CCS with bioenergy. If this far-fetched assumption is removed, then the planet is on track for a 5 to 6°C temperature rise.

Furthermore, the CO<sub>2</sub> build up in the atmosphere is a measure of how much the photosynthetic ceiling of the planet has been exceeded. This means that the energy reaching the planet from the sun is inadequate to convert CO<sub>2</sub> back into O<sub>2</sub> to maintain ecological stability. This conversion is a function of the energy the planet receives and the biomass that is available to convert that energy into cellulose. By simply replacing fossil fuels by biomass it lowers the planet's photosynthetic ceiling further and will thus do nothing to reduce CO<sub>2</sub> levels.

**4.16 Technology:** technological change is an important contributing factor that may lead to transition risks. One example is falling costs and increased investment in clean technologies such as solar PV (photovoltaic), onshore wind, and others. These technologies are now generally more accessible and can more regularly compete with traditional sources of energy. Over the past ten years, new investment in clean energy has increased by a factor of five, the price of renewables has fallen (over 50% for solar PV since 2010 and nearly 20% for onshore wind), and the world is now adding more electricity capacity in renewable power each year than coal, natural gas, and oil combined. Furthermore, the emergence of disruptive technologies such as solar PV thin-film technology, electric vehicles or the new, potentially game-changing home energy-storage devices have the potential to replace many of the assets in current technologies.

While these numbers are all impressive, as stated in 1.22, the BP Statistical review shows renewables still only accounting for 1.8% of primary energy productivity and the rate of growth is starting to show its first signs of slowing.

It is however desperately important that these developments proceed at the fastest pace possible to move the economy as close to zero carbon as possible, but even in the best scenario these would be inadequate to deal with the cumulative build-up of greenhouse gases that have already occurred.

## Final summary

**6.21 Finally, in light of its analysis, the PRA will be sharing the findings of this report with PRA-regulated insurance firms and will expect them to consider the risks identified.**

**The PRA's review also highlighted a number of climate change-related opportunities for insurance firms. These include new sources of premium growth, such as renewable energy project insurance, supporting resilience to climate change through risk awareness and risk transfer, investments in 'green bonds' and providing financial sector leadership on climate change.**

The world faces a dangerous political vacuum on climate change. This is represented by the ongoing failure of the COP talks to agree to binding CO<sub>2</sub> cuts along with the flawed assumption that getting to a zero carbon economy is sufficient to avoid runaway climate change. This latter assumption takes no consideration of the legacy of cumulative anthropogenic emissions that must be removed from the atmosphere and that past climatic records show no evidence that the earth's ecosystem can ever recover from the size of perturbation that we have caused.

Likewise, there is a dangerous technical vacuum. As fast as new technologies are developed to support a transition to a zero carbon environment, then equal progress is being made in the opposite direction. These moves in the counter direction to that needed will be incentivised by lower fossil fuel prices should renewables ever make a significant contribution to primary energy productivity.

Given these fundamental vacuums, it is absolutely incumbent on the financial sector to take a leadership position in addressing climate change. The financial industry operates across national borders in a way that politics does not and manages expectations in a way that technologists cannot. This leadership will not be an easy load to bear, but the consequences of failing to rise to it will be far worse.

It is thus essential for ecological and economic stability that the industry's regulators look this crisis in the eye and step back from the idealistic assumptions that business as usual will somehow continue and temperature rises will be kept below 2<sup>0</sup>C when the evidence is overwhelmingly clear that this will not be the case. To maintain this belief is dangerous hubris and self-defeating.

We thus contend that "*pursuing expectations for climate-change related opportunities*" is the wrong focus of the financial industry. In sharp contrast, the primary focus of the industry must be to support effective and safe climate restoration strategies that are driven by the best available science. Without these, nothing else will matter.

As well as rapidly coming to terms with this reality, the financial industry must also come to the terms with the speed of events. We are on the brink of a "blue-ocean" in the Arctic. This is occurring as other critical tipping points are being exceeded. Once past these, the effectiveness of the interventions we propose could not just diminish in effectiveness, but come too late to prevent catastrophe. As there is a significant lead time to validate designs, secure funding, scale up manufacturing and ensure processes are in place for governance we must start today with the objective of having solutions in place this summer. Put simply, the clock is ticking and every second now counts.