



Institute  
and Faculty  
of Actuaries

# Intergenerational Fairness Bulletin

From the Institute and Faculty of Actuaries



## Climate change

Resource and  
environment

Informing the debate

Issue 1

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# 1. Introduction by our President

Intergenerational fairness must be a priority for policymakers.

There are many policy issues where a long-term view is essential if we are going to meet today's needs, without putting younger, or future generations at a disadvantage. Over the course of 2017, we will produce a series of bulletins to raise awareness of the risks posed by not considering long-term implications of societal, environmental and technological transformations. We are delighted to welcome you to the first issue, which is focused on climate change.

Today's society faces many complex challenges such as ageing populations, poverty alleviation and responding to catastrophic weather events. It is vital that in meeting these challenges we do not unduly place a burden on future generations. We wish to raise the profile of the debate around what is a fair contract between generations in responding to long-term challenges, so that neither current nor future generations are unfairly burdened.

In this issue, we consider the role of discount rates, financial disclosure and the importance of understanding not just the likely possible outcome, but the worst case scenario when assessing the potential impact of climate change. In particular, this issue addresses the role of long-term institutional investors such as pension funds and life insurance companies.

As well as highlighting the role of actuaries in understanding the long-term implications of this policy challenge, we want to present a broad perspective on the issue, and have invited contributions to this bulletin from a range of important voices in the debate. In this issue, we hear from academia, independent advisers to governments, think tanks and the financial services industry on the specific role that financial services can and should play in encouraging adaptation towards a low carbon economy.

We hope you enjoy our inaugural intergenerational fairness bulletin.



**Colin Wilson**  
President, Institute and Faculty of Actuaries



If you would like to receive future Intergenerational Fairness Bulletin editions, or hear more about our work on intergenerational fairness or climate change, please email [policy@actuaries.org.uk](mailto:policy@actuaries.org.uk).

# 2. Climate change: The past, present and future

Matthew Bell, Chief Executive, Committee on Climate Change

## Global climate change

In September 2016 the monthly value level of carbon dioxide in the atmosphere remained above 400 parts per million (ppm). After a summer of plants growing and extracting carbon dioxide from the atmosphere, September usually witnesses the lowest levels of carbon dioxide in the atmosphere. It indicates that, in all probability, 2016 will be the first year where the world has averaged 400 ppm of atmospheric carbon dioxide since about three million years ago. The greenhouse effect of carbon dioxide is well known and the consequences have included a rise in temperatures of about 1°C and a rise in sea level of about 20cm since the late 19th century. This has led to increased ocean acidity, decreased ice in the Arctic sea and in glaciers around the world, alongside wider effects on species, including humans.

The speed of the changes creates very significant risks. Human civilisation, prosperity and interactions have been built in a world climate that has remained more-or-less as we have known it for the past eight thousand years. Many of the world's most prosperous and dynamic cities are located on coasts, many people live in water-stressed areas and many livelihoods depend on agricultural production based on current climatic conditions – humanity knows how to live and thrive in this world. Human and natural systems can and will adapt to some extent, but the changes in climate seen to-date have already had measurable impacts on those alive today. Adaptation will also impose costs on current and future generations. Those costs are unlikely to be evenly distributed and may fall on the most vulnerable.

Further change is inevitable. The UK Committee on Climate Change has just published the most comprehensive assessment of the risks to the UK from climate change starting today and heading out into the 2080s. It represents the collective analysis of over 60 scientists, economists and other analysts drawing on the latest evidence available. The International Panel of Climate Change has undertaken similar work at a global level.

## Intergenerational fairness

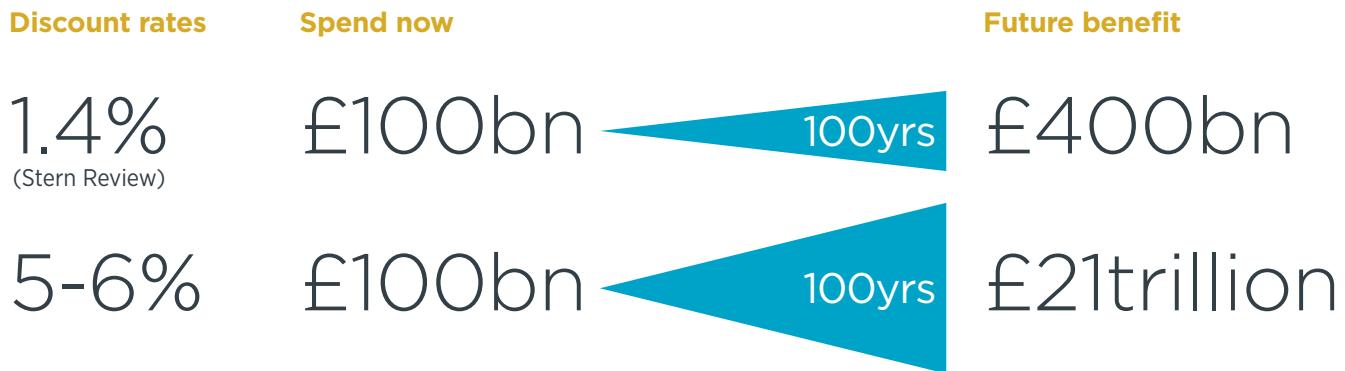
So much of the action that is being taken is with regard to risks faced by the generations alive today. However, it is also clear that those alive today are determining the world that future generations will inhabit. How should those alive today take that into account when considering their actions?

Future generations may have advantages over the current generations in acting against climate change. For example, they may be wealthier and they may have access to new technologies and greater scientific knowledge. At the same time, actions today will have a very large impact on future risks as a lack of action, combined with the non-linear nature of climate systems, may make some future changes irreversible and potentially unmanageable. Whilst particular regions are more vulnerable to climate risk, it poses a risk even for more technologically advanced future generations (e.g. through loss of species, significant sea level rise or water shortages).

## What is the appropriate balance between action now and action in the future?

Actuaries, economists, and many others, have long used discounting to understand the trade-off between acting now and acting in the future. Sustein and Weisbach (2008) noted that, once the scientific evidence is accepted, the main difference between those advocating significant action now and those advocating leaving much more for future generations to tackle will be a different view of the discount rate, which enables us to equate values in the future to values in the present. Those who think more action is needed now, think a discount rate of 1-2% is appropriate, those who leave more for the future tend to use a discount rate of 5-6%. The maths is simple and dramatic.<sup>1</sup> If £100bn is invested today to tackle climate change and produces a benefit in 100 years of £400bn that is equivalent to a discount rate of 1.4%. That is the rate used in the Stern Review. On the other hand, if you think a 5-6% discount rate better reflects the trade-off, then investing £100bn today in the market would generate a benefit in 100 years of £21 trillion to be used to tackle climate change. Put a different way - we could fund the £400bn benefit by using just £2bn today, leaving another £98bn to be spent on other things

1. The mathematical examples here and in the next paragraph are drawn straight from Sunstein and Weisbach (2008), see "Additional Reading" for full reference.



such as hospitals, schools, international aid, skills, defence or any number of other demands. This simple analysis would appear to indicate that if investments yielding much more than about 1.4% exist, current generations should spend less tackling climate than suggested by Stern, and potentially a lot less if rates of 5% or so are achievable.

There are some direct, technical difficulties with the conclusion that the existence of higher rates argues for less action by those alive today. One of the most important difficulties surrounds the uncertainty about the future discount rate. Even if there is a low probability that future discount rates are 1-2%, then much more action today is warranted. Again, it is just a matter of maths. Consider a project that produces a benefit of £1million, 50 years from now, where the discount rate could be 10% or 2% with equal probability. The “expected” future discount rate to use in assessing action is not 6% (the average of 10% and 2%), but the average of the present value of £1million under each of the two discount rates – i.e. 3.4%, which is a much lower value.<sup>2</sup> The greater the uncertainty over future discount rates and the longer the time period under consideration, the lower the appropriate discount rate will be to use for analysis.

However, there are also wider conceptual issues with the “discounting logic” presented above. Stern himself argues that discounting and the discount rate are not appropriate concepts when considering action to tackle climate change. Choices about tackling climate change are strategic decisions about very different paths for the future world. The discount rate exists to allow a comparison between slightly different projects. It is not the appropriate metric (either in theory or in practice)

to use when comparing such different future worlds. In that view, *“implementation will indeed require a strong reliance on markets, entrepreneurship and private investment [mediated by the discount rate] but the strategy has to be drawn on a bigger scale.”* The discount rate is only useful once it is clear what path is being pursued and it is a question of comparing financeable projects that fit within that path. The discount rate is not useful when deciding whether future generations will face global warming of 1.5-2°C, warming of 3-4°C or warming of 5-6°C. The large uncertainties involved in the evolution to a low-carbon society over many decades argue against using discounting to inform the overall approach.

I am often reminded of paddling around in a kayak as a young boy. I would get into the kayak and one of my parents would then push me off from the shore. They would push me out to the left, out to the right or straight ahead. Once they released me I could use my paddle to adjust the course slightly either way, but that initial push determined whether I was going to head off to the East of the lake, the West of the lake or into the middle. Market mechanisms are good at delivering efficient outcomes once that initial push has been delivered – and in most cases that is all we need. However, the decision current generations face in tackling climate change is about in which direction to push.

The discount rate produced by market signals is unlikely to provide clear guidance about what path the world should pursue. Where does this leave the debate about intergenerational fairness? It has to start with the best available scientific evidence. That is the foundation upon which we should decide which path to follow – whether to push my

**Implementation will indeed require a strong reliance on markets, entrepreneurship and private investment [mediated by the discount rate] but the strategy has to be drawn on a bigger scale.**

2. At 10%, £1million in 50 years is worth £8,500 today; at 2% £1million in 50 years’ time is worth £372,000. The average of £8,500 and £372,000 is £190,000, which is equivalent to the actual discount rate that should be used: 3.4%, not the 6% that is the simple arithmetic average between 10% and 2%.

kayak left, right or straight ahead. There is uncertainty in that scientific evidence but governments, businesses and individuals constantly make significant decisions faced with uncertainty and there is no reason for this to be the exception. The Paris Agreement signals a clear path to net zero carbon emissions by 2100 and to holding global temperatures well below 2°C. The UK Climate Change Act also signals a clear path for the UK to reduce emissions by at least 80% by 2050. The question for this and the coming generations is how to use the paddles that we have available given that path.

## Conclusion

In those circumstances, the discussion about intergenerational fairness then falls back on two inter-locking issues:

First, what is the equitable contribution amongst people alive today and what should wealthy countries do as compared to lower income countries? That debate is one of the most fundamental issues we need to answer and it is hard-wired into all of the climate treaties (including the Paris Agreement) through the concept of “common but differentiated responsibility”. They argue that most emissions have been caused by wealthier nations, which have benefited from those emissions to become wealthy, meaning they should act first, hardest and longest. There is a very wide debate and literature about the equitable contribution of nations now given historical behaviours. The Committee on Climate Change provides a brief summary in its publication on the implications of the Paris Agreement for the UK (see “Further Reading”).

Second, what are the benefits (to current and near-term generations) of action now? The simple view that acting against climate change only creates short-term costs is clearly wrong. Action now could, amongst other things, spur beneficial technological progress and learning, improve air quality and wider measures of health and well-being, and help to preserve forests and other natural environments for future benefit. It is not a question of only cost now for benefits to far-off generations. Put differently, it is important to avoid the “dividing up a pie” fallacy. We are not trying to divide up a fixed pie such that if future generations have more, current ones must have less. We are trying to increase the size of the pie to allow both current and future generations to benefit. This does not reduce or eliminate the costs required to achieve the benefits, but does result in a more nuanced discussion about intergenerational fairness.

# 3. The radical implications of tipping points

Professor Henry Shue, Emeritus Fellow, Merton College Oxford

The magnitude of the changes in thinking required by accelerating climate change is difficult to wrap one's mind around. In 2014 two independent studies converged on the conclusion that the melting of the West Antarctic Ice Sheet is already irreversible (Joughin, Smith, and Medley 2014; Rignot, Mouginot, Morlighem, Seroussi, and Scheuchl 2014; Alley, Anandakrishnan, Christianson, et al. 2015). If this is correct, average global sea-level will definitely rise at least three metres over some indefinite but not distant future. Many other physical tipping points for melting similarly lie at unknown but probably not distant points ahead - the even larger Greenland Ice Sheet, the far larger still East Antarctic Ice Sheet [50 metres of sea-level], the methane-holding Arctic tundra, et al. For each tipping point, either it will be passed before climate change stabilizes, or it will not. If it is, matters become considerably worse for humans (and other living things) - and positive feedbacks are likely on other tipping points. If it is not passed, climate may remain more manageable for centuries. The stakes for the intermediate future of how we act in the near future are very high. What are the implications for intergenerational fairness of having such tipping points somewhere in our temporal neighbourhood? Two are especially striking.

Our current conceptions of fairness to future generations are in practice mainly about fairness to our own generation, to be secured by way of discounting the present value of future goods and bads. Because we have considered it reasonable to assume that future generations will willy-nilly probably be better off than the present generation, we have thought that whatever we might do to benefit them would amount to upward re-distribution: redistribution from a poorer generation (ourselves) to better-off generations (the future). Many have been willing, even glad, to help make the lives of children and grand-children better than our own, but we have discounted those future benefits at some rate - the main issue has seemed to be the discount rate, not whether to discount - so that, in effect, we avoid taxing ourselves in order to benefit others who will be better off than we even if we do nothing for them. This has primarily been a matter of fairness to ourselves - not sacrificing too much present consumption in order to make the better-off yet better-off still.

But climate change, and especially the risks of passing various tipping points - points of no return - mean that better lives in the future are no longer a sure thing. There is a non-negligible risk that future generations will be not much better-off, or not any better-off, or even worse-off than we are. So the first radical implication is that the issue of fairness has been transformed from (a) how much we can reasonably be expected to sacrifice in order to improve their lives, to (b) how much we can reasonably be expected to sacrifice in order to try to assure that their lives are not worse - or even much worse (Shue 2016)? Added seriousness is given to the choice by the fact that the source of the danger to their welfare is the carbon emissions from our own affluent - in some cases, profligate - life-style. The threats from which we might save them are threats partly of our own creation.

The second implication, I find, is electrifying. We normally think that one aspect of fairness is that where a burden toward the future is borne by multiple generations, the burden should be divided fairly among the generations who bear it. For instance, if four generations shared the burden of making something available for the fifth and subsequent generations, one might assume that each of those four generations ought to bear 25% of the preparatory burden. In any case, the first generation could not be expected to bear an inordinate share or more than its fair portion. Generational burdens should be roughly comparable.

Wide agreement among climate scientists, however, converges on the idea that the global economy must now be de-carbonized rapidly, that is, we must move promptly to virtually zero net carbon emissions into the atmosphere (Rogelj, den Elzen, Höhne, et al. 2016). Many believe this means reaching peak carbon emissions by 2020 and then making emissions decline very sharply in the short to near-medium term - exactly how fast depends on the target level and target probability for rise in average global temperature, for example, a 67% chance of 2° C or a 67% chance of 1.5° C. The trajectory of decarbonization may determine how many critical tipping points we pass before we establish a ceiling on climate change. Whatever the precise numbers, on any account a great deal must be done in the next 25/35 years or the risk is high that climate change will be far more damaging than it would have needed to have been. It may be now or never for irreversible

melting of additional ice sheets. A single generation appears to bear an enormous burden, somewhat as one generation had to fight World War II. Is this an unfair burden for the current generation, or an historic opportunity for an exceptional contribution to all future humanity (Climate Equity Reference Project 2016)?

## References

- Alley, Richard G., Sridhar Anandakrishnan, Knut Christianson, *et al.* (2015) 'Oceanic Forcing of Ice-Sheet Retreat: West Antarctica and More', *Annual Review of Earth and Planetary Sciences*, 43: 207-231. doi:10.1146/annurev-earth-060614-105344.
- Climate Equity Reference Project [EcoEquity and Stockholm Environment Institute] (2016) *Setting the Path towards 1.5° C: A Civil Society Equity Review of Pre-2020 Ambition*. Available online: <http://civilsocietyreview.org/wp-content/uploads/2016/11/Setting-the-Path-Toward-1.5C.pdf>
- Joughin, Ian, Benjamin E. Smith, and Brooke Medley (2014) 'Marine Ice Sheet Collapse Potentially Under Way for the Thwaites Glacier Basin, West Antarctica', *Science* 344: 735-738, doi:10.1126/science.1249055.
- Rignot, E., J. Mouginot, M. Morlighem, H. Seroussi, and B. Scheuchl (2014) 'Widespread, rapid grounding line retreat of Pine Island, Thwaites, Smith, and Kohler glaciers, West Antarctica, from 1992 to 2011', *Geophys. Res. Lett.*, 41, 3502–3509, doi:10.1002/2014GL060140.
- Rogelj, Joeri, Michel den Elzen, Niklas Höhne, *et al.* (2016) 'Paris Agreement climate proposals need a boost to keep warming well below 2° C', *Nature*, 534, 631-639. doi:10.1038/nature18307.
- Shue, Henry (2016) 'Uncertainty as the Reason for Action: Last Opportunity and Future Climate Disaster', *Global Justice: Theory Practice Rhetoric*, Special Issue on Global Justice and Climate Change, 9, 86-103. Available online: <http://theglobaljusticenetwork.org/global/index.php/gjn/article/view/89/65>

# 4. Climate change and volatility

Professor Aled Jones and Dr Craig Rye

## Climate change and volatility: intergenerational risk

The combination of climate change and the declining quality of energy resources represents a number of threats for future generations. The majority of studies of climate change futures explore these issues along the mean line of projection, ignoring the risks associated with extreme events. To ensure intergenerational fairness we have to have a better understanding of volatility, otherwise we risk any gains we might make in tackling climate change being wiped out in one event.

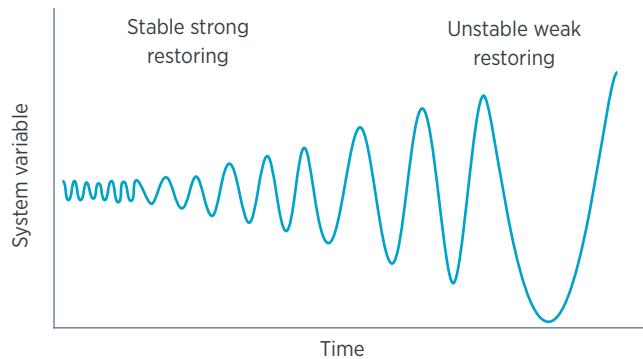
Current long-term environmental trends that are associated with rising temperatures, including increasingly volatile weather, offer a potentially bleak assessment of risks to critical infrastructure, all around the world. The rising costs of adapting current infrastructure to these increased risks presents a very real economic danger. If we are to mitigate the likely future impact of climate change, both public and private purses will be further stressed by the need to invest in flood protection, retrofitting existing homes, sea defences and new heat tolerant construction.

Moreover, these increases in the need for infrastructure investment will be matched by increased costs associated with a variety of societal impacts from health care to disaster risk management.

## Economics: why volatility matters

There is a growing body of literature (e.g. Rye and Jackson 2016, Turchin and Nefedov 2009) suggesting that economic systems undergo periods of stability and periods of instability. During periods of instability, economies are potentially more sensitive to extreme events such as those associated with climate change.

Rye and Jackson (2016) examine the 'stability' of the world's economies over the last century. They highlight prolonged periods of stability and instability and the post-industrial nations are currently trending towards instability.



**Idealised behaviour of a system, such as an economy, as it moves from a stable state, to an unstable state.**

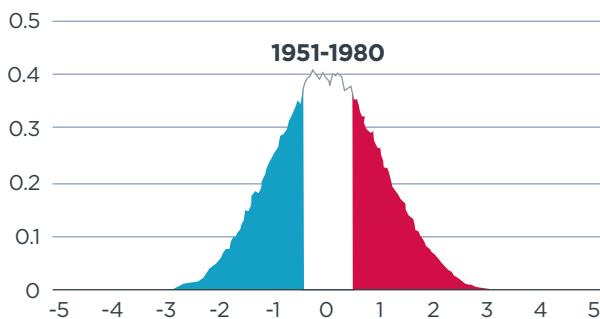
The plausible drivers of instability are similar to those associated with the current conditions of growth-stagnation. These include:

- decreasing quality of physical resources, particularly energy resources;
- increasing inequality;
- increasing public and private debt; and
- demographic trends (Gorden 2012).

It is notable that some of these drivers, particularly the decreasing quality of energy reserves, are linked to fossil fuel use and are highly likely to deteriorate in coming decades (Murphy 2014), and therefore more sensitive to extreme events.

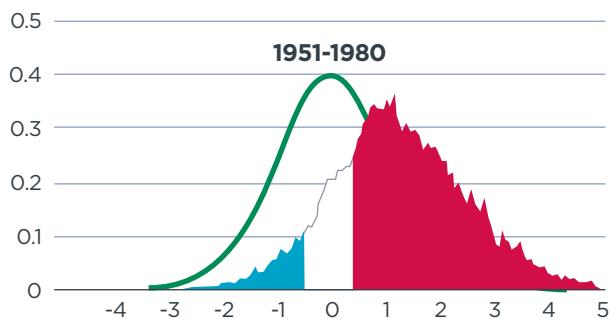
## Why do we need to understand climate volatility?

Those concerned with risk management have much more interest in modelling extreme events than the 'average' weather. However, climate modelling to date has concentrated on modelling the average and not the extremes. Actuaries are well versed in modelling and accounting for extremes in behaviour and there are many opportunities to engage in climate research to explore how best to account for and measure these extremes. Indeed gathering data on past extreme events and quantifying them is only in its infancy.



**Normalised frequency distribution of northern hemisphere temperature (Hansen, Sato and Ruedy 2012).**

**Left panel: 1951-1980, right panel 2001-2011. The green line shows the 1951-1980 distribution.**



It is clear that the variability about the mean has increased. Events that were previously rare have become more common. The range of events has widened and shifted with the generally warmer temperatures.

Being able to explore the current and future implications for business interruption, health (mental and physical) and infrastructure from flooding, droughts, extreme rainfall or strong winds is key for good governance, enterprise risk management and financial risk management.

### Case study: Impact of climate volatility on food security

In 2015 two reports (Bailey *et al.*, 2015 and Lloyds of London, 2015) were published that explored the potential implications of extreme weather events on the global food system. These outlined possible impacts of extreme weather (droughts and flooding) in the near term. Climate change is already having a major impact on our weather system and the impacts on food offer a unique case study to explore how rising volatility in our weather system contributes to global cascading direct and indirect risks.

These two studies explored the plausible impacts from a 10% loss in global food production in one given year. The indirect impacts from these types of scenarios are significant and far-reaching. In the past, losses of a similar scale have had major geo-political impacts including suggestions that they contributed to the Arab Spring (Natalini *et al.*, 2015). The Lloyds of London report found the potential for impacts from such an event on a range of different insurance classes including terrorism and political violence, political risk, business interruption, marine and aviation, agriculture, environmental liability, and product liability and recall. The scenarios explored include significant impact on investments from government debt to equity valuations as well as the collapse of governments within certain countries.

### Thoughts for fairness

Climate change increases the volatility of our weather system. Over a much shorter period of time than we will see the ‘average’ impact from climate change we will see more extreme weather having larger impacts on society.

The impacts of climate volatility are significant and far-reaching from vulnerability of infrastructure to wars resulting from food shortages. Whilst long-term trends are obviously essential to intergenerational fairness, we must better understand the impacts of climate volatility if we are going to protect current and future generations from climate change. Without improving our understanding of the extremes we risk any gains we might make in tackling climate change being wiped out in one event.

### References

- Bailey, R., Benton, T.G., Challinor, A., Elliot, J., Gustafson, D., Hiller, B., Jones, A., Kent, C., Lewis, K., Meacham, T., Rivington, M., Tiffin, R. & Wuebbles, D. (2015) *‘Extreme weather and resilience of the global food system’*, UK-US Taskforce on Extreme Weather and Global Food System Resilience
- Gordon, R. J. (2012) *Is US economic growth over? Faltering innovation confronts the six headwinds* (No. w18315), National Bureau of Economic Research
- Hansen, J., Sato, M., & Ruedy, R. (2012) *‘Perception of climate change’* Proceedings of the National Academy of Sciences, 109(37), E2415-E2423
- Lloyds of London (2015) Food system shock: the insurance impacts of acute disruption to global food supply. Available online: [www.lloyds.com/news-and-insight/risk-insight/library/society-and-security/food-system-shock](http://www.lloyds.com/news-and-insight/risk-insight/library/society-and-security/food-system-shock)
- Murphy, D. J. (2014) *‘The implications of the declining energy return on investment of oil production’* Philosophical Transactions of the Royal Society of London A: Mathematical, Physical and Engineering Sciences, 372(2006), 20130126
- Natalini, D., Jones, A. & Bravo, G. (2015) *‘Quantitative assessment of approaches to measuring likelihood of food riots in countries’*, Sustainability, 7 (4), 4360
- Rye, C. and Jackson, T. (2016) *‘On the use of instability indicators in exploring inter-decadal variability in GDP’*, CUSP Working Paper WP4, Centre for the understanding of Sustainable Prosperity [Available online: CUSP.ac.uk/pub/WP4]
- Turchin, P., & Nefedov, S. A. (2009) *‘Secular cycles’*, Princeton University Press

# 5. The tragedy of the horizon

James Orr and Matt Scott, Prudential Regulation Authority<sup>1</sup>

Mark Carney, Governor of the Bank of England, gave a seminal speech at Lloyd's of London in September 2015, highlighting the threat climate change posed to financial stability and the need to '*break the tragedy of the horizon*'. In his speech, Governor Carney noted '*...the catastrophic impacts of climate change will be felt beyond the traditional horizons of most actors – imposing a cost on future generations that the current generation has no direct incentive to fix*'.

This article briefly explores the relevance of climate-related factors to the PRA's approach to supervision, the wider work of the Bank of England, and the important role for the actuarial profession.

## The PRA Approach

The Prudential Regulation Authority (PRA), part of the Bank of England, is the United Kingdom's prudential regulator of deposit-takers, insurers and major investment firms. In supervising firms, the PRA seeks to take a risk-based and proportionate approach, adopting a forward looking and judgement-based perspective, assessing firms not just against current risks but also against those that could plausibly arise in the future. In doing this, the PRA relies heavily on the work of actuaries to assess the safety and soundness of regulated insurance firms.

The UK insurance industry is the largest in Europe and the fourth largest in the world (Association of British Insurers 2016). General insurers, and reinsurers, are at the forefront of evaluating and managing the day-to-day impact of extreme weather around the globe. Since the 1980s the number of registered weather-related loss events has tripled. Inflation-adjusted insurance losses from these events have increased fivefold since the 1980s to around \$50bn over the past decade (Carney 2015). Insurers are therefore amongst those with the

greatest commercial incentives to understand and mitigate the financial risks associated with climate change in the short term.

Informed by its forward-looking approach, the PRA published a report, alongside Governor Carney's speech in September 2015, on the impact of climate change on the UK insurance sector. The report identified three channels through which climate-related factors could present financial risks to insurance firms: physical; transition; and liability. Each of these channels has relevance to intergenerational fairness. For example, the potentially catastrophic long-term impacts of the physical risks from climate change, the need for early action to support an orderly market transition to a lower carbon future and the potential liability risks which could result from future generations seeking to recover losses from those who they believe may have been responsible.

This work also informed the PRA's involvement in the Sustainable Insurance Forum, an international network of insurance regulators formed to address climate and sustainability-related issues, as well as the Bank's ongoing work on the financial impact of systemic environmental risks (Bank of England 2016).

## Climate Change as a Multiple Equilibrium Problem

Observable trends, whether in markets, insured losses or in the weather, often do not follow simple linear paths, or even smooth exponential growth patterns, but rather dynamic shifts between equilibria. Indeed, the Bank's research considered aspects of climate change as a multiple equilibrium problem, potentially shifting between a high and a low carbon future, illustrating how decisions today can be influenced by expectations of the future.

There are three channels through which climate-related factors could present financial risks to insurance firms: physical; transition; and liability.

1. Any views expressed are solely those of the authors and so cannot be taken to represent those of the Bank of England or to state Bank of England policy. This paper should therefore not be reported as representing the views of the Bank of England or members of the Monetary Policy Committee, Financial Policy Committee or Prudential Regulation Authority Board.

It is not the role of central banks to drive the transition to a low carbon future, or to advocate for one policy response over another: that is for governments to decide. At the same time, financial policymakers do have a clear interest in ensuring the financial system is resilient to any transition, or shift in equilibria, and supporting an efficient allocation of capital. Alongside assessing the risks from climate-related factors, such as those referred to above, the Bank has been actively participating in initiatives to support an orderly market transition to a lower carbon future. This has included co-chairing the G20's Green Finance Study Group with the People's Bank of China, and closely following the work of the Financial Stability Board's private sector Taskforce on Climate-related Financial Disclosures (TCFD).

### The Role of Actuaries

Actuaries can provide valuations and assessments of risk where markets are incomplete or entirely absent. This is often in the context of long-term liabilities, such as retirement pensions or industrial disease liabilities, which cannot be directly traded or fully hedged.

In considering long-term value and risks, actuaries have played a key role in the Bank's work, not least in leading the PRA's report on climate change and insurance, and in informing the Bank's research agenda. This work has involved close collaboration with environmental and catastrophe risk specialists, fostering the dialogue and debate necessary to address these complex and uncertain risks, as well as working with economists to explore the unpredictable responses of markets and different sectors of the economy.

Securing an orderly market transition to a lower carbon future will necessarily involve many different actors. It is clear that actuaries have already played a valuable role. The profession has a rich history of solving complex problems and developing forward-looking insights, often in the public interest. As an institution, the IFoA brings together a range of different specialisms across sectors and industries to form a common view of the future. Actuaries will no doubt continue to make an important contribution, helping to break the tragedy of the horizon through analysis and insight. Whether this contribution, and that of other actors, is sufficient will ultimately be for future generations to decide.

### References

Association of British Insurers (2016) UK Insurance & Long-Term Savings, Key Facts

Bank of England (2016) Climate change, green finance and financial stability. Available online: <http://www.bankofengland.co.uk/pages/climatechange.aspx>

Carney (2015) Breaking the tragedy of horizon – climate change and financial stability. Available online: <http://www.bankofengland.co.uk/publications/Pages/speeches/2015/844.aspx>

# 6. The role of actuarial science

Nico Aspinall, Chair of IFoA Resource and Environment Board

Climate change and related resource and environment issues are the predominant challenge of the 21st century and look set to damage capital and hamper growth (IFoA 2013). Capital inheritance and the prospect of growth are the axioms of intergenerational transfers of risk, so how can society face up to this challenge and modify its processes? Actuarial science is well placed to assist as actuaries routinely deal with the transfer of wealth and risk into the future in the form of life insurance and pensions, but we will have to modify our techniques for the new environment.

Up until the 21st century, most generations could have assumed that the generations to come would have greater wealth, and could pay for the residual debts of their parents in the reasonable hope that their children would be able to afford theirs. In return, each generation worked to improve the capital they left behind. Of course, this is a transfer of risk as well, as the capital left to a future generation may be weaker than assumed and produce less income than required, or the debts greater due to a recent spending need, but this risk has always evened out before. Even if one generation is saddled with greater debt from its parents and a weaker ability to pay back that debt, this was a temporary setback. The steady march of technical progress endowed the following generation with greater wealth than before, and enabled it to pay down the residual debt of proceeding, economically weaker generations.

However, in the 21st century, humans will face up to the true costs of technological progress for the first time. Climate change will push large parts of the world backwards economically, and the assets passed to us by our parents must be written down in value if they will only imperil the future of the planet further. Unreformed, our wealth and risk transfer mechanism is likely to pass on less wealth than we planned, and greater realisation of risk in the form of the cost of climate damage and adaption to a net zero carbon dioxide economy. This would not be a fair deal.

The central tool actuaries use to explore the transfer of wealth and risk into the future is the discount rate (or the discounting function) which enables us to equate values in the future to values in the present. Discount rates, though, are a blunt tool reliant on assumptions which to date have not incorporated the fact and consequences of climate change. While returns on assets are positive, costs and values in the future are lower than at present, but if growth is to decline due to climate change, returns will be negative and costs and values in the future

should be assumed to be higher than at present. Use of positive discount rates is dominant at present, because it has always been true before, making the future essentially worthless and incentivising policymakers to kick the can of climate change mitigation down the road into the future, where it is assumed to be more affordable. A change to negative discount rates will be shocking to many in the financial community, but would send out a signal in terms of the timeframe in which changes to our economy must be made. Even on a business as usual basis, many would believe returns would be negative in future as an unfortunate consequence of our current inability to fully recognise and deal with climate change.

The second tool actuaries use is an understanding of the range of outcomes, and a discussion of which outcomes institutions should plan to avoid. In insurance companies, this becomes the assessment of the scenarios that will render the company unable to pay insurance claims, and regulation requires that reserves be held, so that these scenarios are reasonably unlikely - around 0.5% of probability (akin to flipping eight heads in a row). Understanding the range of potential outcomes from climate change is a vital step, which does not appear to have been taken by governments. Even under the 2°C of warming plan agreed in Paris there are reasonably high probabilities of warming greater than 4°C, which may proceed the extinction of human life on this planet. Government increasingly appears to focus on only its preferred or assessed most likely outcome, ignoring the others - the UK Brexit vote being a case in point. The inability for governments to plan for the worst outcomes of climate change is a pure dereliction of duty and one that future generations may determine to be a betrayal. Work needs to be done now to understand the full range of potential consequences of climate change, and to pre-empt the worst outcomes.

## References

IFoA (2013) Resource constraints: sharing a finite world.  
Available online: <https://www.actuaries.org.uk/documents/resource-constraints-sharing-finite-world-evidence-and-scenarios-future>

# 7. Responsible investment: a quiet revolution

Nathan Fabian, Director of Policy and Research, Principles for Responsible Investment (PRI)

## Sustainability issues are critical for institutional investors

Pension funds allow working people to save for their retirement. They are long-term investors: those joining the workforce in their 20s are unlikely to draw on their retirement income for 40 or 50 years. However, investment decision-making is often short-term and investors are not adequately considering financial risks such as climate change and natural resource depletion.

Failing to take account of these risks is critical to both the current generation and future generation of savers because it could undermine future returns - and even the stability of the financial system - in pursuit of short-term profits.

In this article, we set out some of the key considerations for investors and policymakers to address short-termism in capital markets.

## Investor scale, practices and policies are key

Investors need to implement a responsible investment approach. Responsible investment is an approach to investing that explicitly considers environmental, social and governance (ESG) risks in investment decision-making. ESG risks can be short-term, but often their relevance increases as investors consider long-term investment horizons.

Over the last decade, many investors have made a commitment to responsible investment. In 2006, the UN brought together a number of investors at the New York Stock Exchange to launch six principles of responsible investment. In 10 years, the PRI has since grown to 1600 signatories, from over 50 countries, representing US\$60 trillion actively integrating ESG into their investment decision.

Institutional investors, such as pension funds, sovereign wealth funds and insurance funds, have a key role to play in mainstreaming responsible investment and tackling climate change. Implementing responsible investment at scale and depth, asset owners can create a multiplier effect through the investment chain. Weak implementation of responsible investment by asset owners sends signals to the investment market that issues such as climate change are not a priority, limiting investment consultant and manager willingness to take account of these factors in their strategies and advice.

## Coherency in government policy

Responsible investment needs to be supported by a coherent set of government policies, but there are a number of barriers that need to be addressed. These include embedding ESG issues within wider capital markets policy, clarification of fiduciary duty and good quality corporate disclosure, which are explained further below.<sup>1</sup>

Institutional investors, such as pension funds, sovereign wealth funds and insurance funds, have a key role to play in mainstreaming responsible investment and tackling climate change.

1. Fiduciary duties exist to ensure that those who manage other people's money, act in the interest of the principal. In its simplest form, this requires prudent investment.

## **Responsible Investment Policy and Regulation**

Of the largest 50 economies in the world (by GDP), only Iran does not have any regulation relevant to ESG issues and investment. The PRI's Global Guide to Responsible Investment Regulation has identified almost 300 policy instruments, which support investors to consider long-term value drivers, including climate change.

Our research is the first global study to analyse the impact of responsible investment-related public policy initiatives. We have found that investors are sceptical of the effectiveness of policy because of weaknesses in policy design and monitoring, and inconsistency between different government departments and regulators. Added together these send a signal to investors that sustainability issues, including climate change, are separate from the core purpose of financial markets. Policy makers and regulators worldwide can send stronger signals to the financial sector about the importance of ESG issues.

## **Fiduciary Duty**

Fiduciaries are tasked with the decision to buy, sell, or hold assets. There is no passive behaviour as a fiduciary; there is no "do nothing" task. Outdated perceptions of fiduciary duty and a lack of clarity on what ESG integration means in practice, often lead to ESG factors treated as non-financial factors. However, ESG factors are important to the long-term success of a business and as with any other issue related to the prudent management of capital, considering sustainability is not only important to upholding fiduciary duty, it is obligatory. Action is needed to modernise definitions and interpretations of fiduciary duty in a way that ensures these duties are relevant to 21st century investors.

### **Analysing and assessing ESG risks: the case of climate change**

Fiduciaries need to be able to show that they have identified and assessed the risks (to companies and to their portfolios). In the case of climate change, for example, this would require them to:

- Show that they have recognised relevant risks (even if they are sceptics on the issue of climate change).
- Analyse how climate change might affect investment returns over the short, medium and long-term.
- Explicitly manage the risks, and not assume that the risks are automatically managed by other risk management strategies.
- Interrogate and challenge the individuals or organisations (e.g. investment managers, companies) to ensure that these risks are being effectively managed.
- Establish processes that enable them to demonstrate the actions they have taken.

## **Good corporate disclosure for financial markets**

Corporate reporting is a necessary condition for supporting responsible investment and future climate reporting should aim for international consistency and reference the principles, recommendations and guidance of the Financial Stability Board's (FSB) Task Force on Climate-related Financial Disclosures (TCFD).

The ongoing work of the FSB-TCFD is likely to galvanise environmental disclosure in future years. Though voluntary, the task force recommendations can be seen as an opportunity for governments and accounting standard setters to develop disclosure policy referring to an internationally consistent set of reporting guidelines.

## **Signs of policy change?**

PRI is continuing its work to support responsible investment through the FSB-TCFD, our support for G20 green finance study group, our fiduciary duty programme and the launch of our Responsible Investment Blueprint in spring 2017.

There are also signs that policy is beginning to change with China launching its Guidelines on Establishing the Green Financial System, France's Energy Transition Law and the European Union's announcement of a sustainable financial strategy for European capital markets. However, it is still too early to measure progress and governments need to follow their lead.

## **References**

Fiduciary Duty Project (2016) Fiduciary Duty in the 21st Century. Available online: <http://www.fiduciaryduty21.org/>

PRI (2016) Press release: PRI calls on investors to improve their climate reporting and encourage companies to do the same. Available online: <https://www.unpri.org/press-releases/pri-calls-on-investors-to-improve-their-climate-reporting-and-encourage-companies-to-do-the-same>

PRI (2016) Global Guide to responsible Investment Regulation. Available online: <https://www.unpri.org/about/pri-teams/policy/responsible-investment-regulation>

# 8. Climate, pensions and fairness

Therese Kieve FIA, Senior Research and Engagement Officer, ShareAction

## Introduction

The speed and extent at which climate change is progressing means that it is emerging as a question of both intergenerational and intra-generational fairness. Climate change is affecting the rights and obligations of the generation already alive today and is likely to affect future generations. Globally, those most at risk often have the least influence on the factors affecting climate change. This is true across current populations and future populations.

Bangladesh for example, though its per capita greenhouse gas emissions are amongst the lowest in the world, is already suffering disproportionately from climate change as sea level rise causes an increase in the salinity of its freshwater and is likely to render large areas of this low lying country uninhabitable within decades (The World Bank 2013, The World Bank 2015, Harris, 2014).

Influential leaders, including those within the US military as well as the UN High Commissioner for Refugees (UNHCR), have warned that climate change is set to cause a refugee crisis of “unimaginable scale”, and that mass migration will become the “new normal” unless urgent action is taken to address this issue (Carrington 2016).

A global problem on this scale requires collaborative international solutions, which the UN's 21st Conference of the Parties (COP21) sought to provide. 195 nations signed an agreement, since ratified, aiming to keep temperature increases below 2 degrees (and if possible within 1.5 degrees) to avoid the worst impacts of climate change. However, action is needed across many sectors of society including the investment sector for this aim to be achieved.

## Pensions

In addition to the multiple risks posed to health, safety, and security, climate change presents a significant financial risk to people with pension savings. We are already seeing the physical impacts of the changing climate, including severe heatwaves, drought and flooding, and we can expect to see the financial impact within the lifetime of existing pension schemes. Both the financial and wider macroeconomic risks of climate change will hit younger savers particularly hard.

Good governance is a vital step to effective risk management, and climate risk is no exception. Equity portfolios are particularly exposed to climate risks, as the FTSE100 and other global indices have relatively high proportions of their market capitalisation in carbon intensive stocks. As prudent fiduciary investors, pension funds should ensure that their fund managers assess and reduce their exposure to high carbon, high risk investment holdings. In addition, as long term investors, pension funds should support the creation of a low carbon, resource efficient economy, by actively investing in new technologies, infrastructure projects and other positive investments.

Yet, despite much discussion around the impact of environmental, social and governance (ESG) factors on investments, many pension schemes still fail to take these factors into account. Research published by Professional Pensions magazine in August 2016, found that 39% of respondents do not take ESG factors into account when making, or advising on investment decisions (Klimes 2016).

Additionally, more than half (53%) of participants said they did not see climate risk as a financially material risk to portfolios. This is despite the increasing body of evidence that demonstrates the opposite, including research conducted by Mercer that demonstrated the impact on institutional investment portfolios (Mercer 2011).

There is a growing demand by savers for these types of risks to be taken seriously. For example, the Schroders Global Investor Study (2016) found that ESG factors are more important to savers than to the advisers who actually recommend investments.<sup>11</sup> In particular, the investment decisions of those aged 18-35 were far more influenced by ESG factors than those of investors aged 36 and over. Where decisions on investments are made by the older generation on behalf of younger plan participants, there appears to be a risk that older decision-makers will neglect climate risks to the detriment of younger savers.



## The way forward

One way to address this risk is to open channels of communication. At ShareAction, we believe that pension schemes and their governing boards should be accountable to their members, and members should have opportunities to have a say in where their money goes. We believe that implementing an annual member meeting where pension savers can ask and learn about how their funds invest their money is part of the answer. It is encouraging that some large pension schemes have recently started to introduce these types of meetings. With an estimated 10 million new pension savers set to join the 16 million who already have a non-state pension in the UK, it is timely to address this important issue of communication and accountability.

In the policy space, there are encouraging signs of change. MEPs voted to revise the IORPs Directive, requiring responsible investment in Europe's private pension system (Williams 2016). This is the first major piece of European financial legislation to embed social and environmental factors so comprehensively, but there is still a lot more work to be done. Any real change will include businesses supporting action on climate change, as well as input from other stakeholders including scientists, investors, local governments, parliamentarians, NGOs and many others. Without civil society playing its part, we are unlikely to unlock the potential of our capital markets to address social and environmental problems. It is only by working together and sharing skills and expertise, that we will be able to rebuild the financial system so it reflects concerns for the security and wellbeing of present and future generations.

## References

The World Bank (2013). CO2 emissions (metric tons per capita). Available at: <http://data.worldbank.org/indicator/EN.ATM.CO2E.PC>

The World Bank (2015). Salinity Intrusion in a Changing Climate Scenario will Hit Coastal Bangladesh Hard. World Bank. Available at: [www.worldbank.org/en/news/feature/2015/02/17/salinity-intrusion-in-changing-climate-scenario-will-hit-coastal-bangladesh-hard](http://www.worldbank.org/en/news/feature/2015/02/17/salinity-intrusion-in-changing-climate-scenario-will-hit-coastal-bangladesh-hard)

Harris, G., 2014. Facing Rising Seas, Bangladesh Confronts the Consequences of Climate Change. The New York Times. Available at: [https://www.nytimes.com/2014/03/29/world/asia/facing-rising-seas-bangladesh-confronts-the-consequences-of-climate-change.html?\\_r=0](https://www.nytimes.com/2014/03/29/world/asia/facing-rising-seas-bangladesh-confronts-the-consequences-of-climate-change.html?_r=0)

Carrington, D., 2016. Climate change will stir "unimaginable" refugee crisis, says military. The Guardian. Available at: <https://www.theguardian.com/environment/2016/dec/01/climate-change-trigger-unimaginable-refugee-crisis-senior-military>

Klimes, M., 2016. Climate change is "overblown nonsense" and not a material risk, says industry. Professional Pensions. Available at: [www.professionalpensions.com/professional-pensions/news/2468851/climate-change-is-overblown-nonsense-and-not-a-material-risk-says-industry](http://www.professionalpensions.com/professional-pensions/news/2468851/climate-change-is-overblown-nonsense-and-not-a-material-risk-says-industry)

Mercer (2011) Climate Change Scenarios -Implications for Strategic Asset Allocation. Available at: [https://www.mmc.com/content/dam/mmc-web/Files/Climate\\_Change\\_Scenarios\\_Implications\\_for\\_Strategic\\_Asset\\_Allocation.pdf](https://www.mmc.com/content/dam/mmc-web/Files/Climate_Change_Scenarios_Implications_for_Strategic_Asset_Allocation.pdf)

Schroders (2016). Schroders Global Investor Study 2016: ESG. Millennials put greater importance on ESG factors. Available at: [http://www.schroders.com/en/media-relations-newsroom/all\\_news\\_releases/schroders-global-investor-study-2016-millennials-put-greater-importance-on-esg-factors/](http://www.schroders.com/en/media-relations-newsroom/all_news_releases/schroders-global-investor-study-2016-millennials-put-greater-importance-on-esg-factors/)

Williams, J., 2016. ShareAction welcomes IORP II focus on ESG risks, stranded assets. Investments & Pensions Europe. Available at: <https://www.ipe.com/news/esg/shareaction-welcomes-iorp-ii-focus-on-esg-risks-stranded-assets/10014012.fullarticle>

# 9. Climate change is a key issue for pension funds and they can take action

Faith Ward, Chief Responsible Investment and Risk Officer, Environment Agency Pension Fund

From health to housing, water levels to wealth levels there are many intergenerational issues that pension funds, as long-term stewards of assets, must take into consideration in the way they invest. Of all these issues however, it is climate change that is perhaps the most powerful symbol of the concept of intergenerational equality. For example, a global survey by the World Economic Forum found that climate change is the issue that millennials (18-35 year olds) believe to be the number one most serious issue affecting the world today (Loudenback 2016).

## Why it's important to EAPF and what we do about it

As a long-term investor, the Environment Agency Pension Fund (EAPF) recognises that climate change presents both material financial risks and opportunities. As such, it plays an important role in the creation of our funding strategy, which then informs all our actions from our asset allocation, to mandate tendering, risk management processes and beyond.

In October 2015, EAPF published its **Policy to Address the Impacts of Climate Change**, which made EAPF one of the first pension schemes in the world to run its assets in accordance with the UN-agreed principles of preventing global temperatures from rising by more than 2°C. We also partnered with Mercer in their 'Investing in a Time of Climate Change study', which analysed our whole fund against four different climate change outcomes.

In practical terms, this has led us to set three climate-related targets to invest, decarbonise and engage. Our first goals are:

- to invest 15% of the fund in low carbon, energy efficient and other climate mitigation opportunities by 2020; and
- to decarbonise our equity portfolio, reducing our exposure to future emissions by 2020 to 90% for coal and by 50% for oil and gas, relative to the benchmark level in 2015.

This has led to investments in projects such as the Beatrice Offshore Wind Farm off the north east coast of Scotland. This is a major project to install 84 wind turbines expected to power roughly 450,000 homes once it is completed.

### Our climate change investment beliefs

We believe that:

- Climate change presents a **systemic risk** to the ecological, societal and financial stability of every economy and country on the planet, with the potential to impact our members, employers and all our holdings in the portfolio.
- Climate change is a **long term material financial risk** for the Fund, and therefore will impact our members, employers and all our holdings in the portfolio.
- Considering the impacts of climate change is both our **legal duty** and is entirely consistent with **securing the long term returns** of the Fund and is therefore acting in the best long term interests of our members.
- **Selective risk-based disinvestment** is appropriate but **engagement for change** is an essential component in

On a more day-to-day basis, we also:

- Ask all our fund managers, across all asset classes, to consider climate change in their investment process. In our more illiquid asset classes this is reinforced with investment guidelines, for example, in our real estate, infrastructure, forestry and agriculture portfolios. This is consistent with the analysis from Mercer's research, which showed that these asset classes were the most climate sensitive in terms of both opportunity and risk.
- Use a low carbon approach to our approach to indexation. The Index is constructed by first setting a target for how much it should vary in value, against the standard index (of 0.3% p.a.), and yet provide a substantial reduction in climate risk. A reduction of around 75-80% has been achieved in terms of exposure to greenhouse gas emissions, and 85-90% in exposure to fossil fuel reserves compared to the standard benchmark.
- Complete carbon footprinting on 70% of total assets, including all our equities and our active bonds. To maximise the value of footprinting and other climate risk tools, we also demand high disclosure standards and increased transparency on environmental issues - not just by companies, but also by fund managers, asset owners and other financial intermediaries.

### The vital part that actuaries have to play

Actuaries specialise in the analysis of potential long-term policy consequences and market developments and thus they are ideally placed to influence the mind-set of a pension fund. EAPF consults its actuaries on critical issues around the strategy and operation of its fund. This starts with our funding strategy - which is the cornerstone of our investment cycle and where it is vital that we harness actuarial skills to best understand the impact that climate change is likely to have on our liabilities, to what degree and what actions we can best take today to manage those risks.

As Mark Carney, the Governor of the Bank of England recently said, there is still time to act on climate change, but the window of opportunity is both finite and shrinking.

### Assumptions

We would like our actuaries to take climate change into account when making their assumptions as we believe climate change has the potential to materially impact on all the assumptions that underpin actuarial science.

*"Your assumptions are your windows on the world. Scrub them off every once in a while, or the light won't come in."*

Isaac Asimov

As the world's climate changes and we expect more heatwaves, floods and extreme weather, longevity assumptions are going to be impacted and we are working with our actuaries on this.

We recognise that to tackle assumptions on long term asset performance and how this impacts discount rates would require a more industry wide response, but do believe that those pension funds that are factoring climate risk into their investment decisions have a higher probability of delivering the financial outcomes required to meet their liabilities. If we can find a sensible way in which this could incentivise pension funds to act now, it could have a real impact on managing a risk, which if unabated will be felt most acutely by future generations.

### Working with Hymans Robertson and Club Vita

The funding of pensions schemes has been encouraged by the presumption that investing now will help power economic growth ahead of drawing the benefits and hence make pensions affordable across the generations.

Climate change brings a new overarching set of uncertainties that can feed through to the savings industry in multiple ways: it may directly affect the future health of savers, or the economic prospects of some investments, or may do so indirectly via policy-makers and societal decisions. This raises a number of questions:

- Will members perceive incomes in the far future to be valuable enough to save for?
- Will economic growth be strong enough that pensions remain an affordable part of that at a macro level?

While pension provision and climate change are long-term activities, the way in which schemes are funded, or the extent to which members save out of income are short-term decisions that are difficult to make if the shape of the risks are not understood, or cannot be mitigated.

The work done by Club Vita and the Pensions and Lifetime Savings Association sheds a light on the possible impact of climate change on longevity (PLSA 2014). Hymans Robertson, in conjunction with the EAPF and other interested pension schemes, are now examining the likely financial effect of climate change in order to help schemes (and their actuaries) understand the impact this may have on funding outcomes. This work will then allow schemes to consider their strategy for mitigating the effects of this on future funding outcomes.

## **Long way to go**

We know as a fund we do not have all the answers on the best way to ‘future proof’ our fund for something as large and complex as climate change. All stakeholders have a role to play and actuaries have, perhaps, a bigger role than most.

Thinking long term makes you more aware of issues relating to our natural capital – resources that companies, economies and society rely on, but markets have thus far failed to attribute their true value. This under valuation can lead to exploitation and environmental degradation.

We all need to act now to ensure we avoid the financial, social and environmental crises that unchecked climate change would produce.

## **References**

Loudenback, T. (2016) ‘The 10 most critical problems in the world, according to millennials’, Available online: <http://uk.businessinsider.com/world-economic-forum-world-biggest-problems-concerning-millennials-2016-8/#9-food-and-water-security-151-2>

PLSA (2014) The NAPF Longevity Model – November 2014. Available online: [http://www.plsa.co.uk/PolicyandResearch/DocumentLibrary/0414\\_longevity\\_model\\_nov14.aspx](http://www.plsa.co.uk/PolicyandResearch/DocumentLibrary/0414_longevity_model_nov14.aspx)

As Mark Carney, the Governor of the Bank of England recently said, there is still time to act on climate change, but the window of opportunity is both finite and shrinking.

# Contributors

**Matthew Bell** is the Chief Executive of the Committee on Climate Change. The Committee is an independent, statutory body established under the Climate Change Act 2008. Its purpose is to advise the UK Government and Devolved Administrations on emissions targets and report to Parliament on progress made in reducing greenhouse gas emissions and preparing for climate change.

**Professor Henry Shue** is a Senior Research Fellow, Centre for International Studies, Department of Politics and International Relations, University of Oxford; and Senior Research Fellow Emeritus, Merton College, Oxford.

**Professor Aled Jones** is the inaugural Director of the Global Sustainability Institute (GSI) at Anglia Ruskin University. His work in climate finance has been recognised by the State of California and he has received a key to the city of North Little Rock, USA. He is a Co-Investigator for the ESRC Centre for the Understanding of Sustainable Prosperity. He sits on the Resource & Environment Research Sub-committee for the Institute & Faculty of Actuaries.

**James Orr** and **Matthew Scott** work for the Prudential Regulation Authority at the Bank of England. James is Chief Actuary, General Insurance and provided oversight of the PRA's report on climate change and insurance. Matthew was principal author of the PRA's insurance report and leads on environmental risk and green finance, including supporting the Bank's work co-chairing the G20's Green Finance Study Group with People's Bank of China.

**Dr Craig Rye** is an economist working at the Centre for the Understanding of Sustainable Prosperity at the University of Surrey. He is currently working on novel empirical analyses of economic instability and in explorative energy-transition models. He has a PhD in Ocean Physics and BSc in Environmental Sciences.

**Nico Aspinall FIA** works as an independent consultant in the investment management and pensions industry, focussing on DC benefits. He is Chair of the Institute and Faculty of Actuaries' Resource and Environment Board. The Resource and Environment Board is dedicated to making sustainability issues mainstream in actuarial work and works collaboratively with actuaries, financial institutions and regulators to ensure their analyses and advice include sustainability issues.

The **Principles for Responsible Investment (PRI)** is the world's leading proponent of responsible investment. It works to understand the investment implications of ESG factors and to support its international network of investor signatories in incorporating these factors into their investment and ownership decisions. The PRI acts in the long-term interests of its signatories, of the financial markets and economies in which they operate and ultimately of the environment and society as a whole.

**ShareAction's** vision is of an investment system that truly serves savers and communities, and protects our environment for the long term. It is working towards a system in which long-term thinking is recognised as the best way to guarantee healthy returns. It believes that anyone can play a part in changing the investment system for good.

**Faith Ward's** career has been dedicated to integrating and reporting on ESG risks in finance and investment. Faith leads engagement with the fund management industry and is involved in industry wide initiatives to improve standards in responsible investment, corporate engagement and fund governance and reporting. The EAPF, part of the Local Government Pension Scheme (LGPS), is the pension fund of one of the world's leading environmental organisations. It is responsible for administering the current and future pension benefits of just under 41,000 members. The EAPF remains one of the best funded in the LGPS.

# Additional reading

For those of our readers who would like to learn more about this topic, we have asked our contributors to identify key resources:

Committee on Climate Change, 2015, “*The scientific and international context for the fifth carbon budget*”. Available at: <https://www.theccc.org.uk/publication/the-scientific-and-international-context-for-the-fifth-carbon-budget/>

Committee on Climate Change, 2015, “*UK climate action following the Paris Agreement*”. Available at: <https://www.theccc.org.uk/publication/uk-action-following-paris/>

Committee on Climate Change, 2016, “*UK Climate Change Risk Assessment 2017*”. Available at: <https://www.theccc.org.uk/uk-climate-change-risk-assessment-2017/>

FSB (2016) Recommendations of the Task Force on Climate-related Financial Disclosures. Available online: <https://www.fsb-tcfd.org/publications/recommendations-report/>

IFoA (2015) Climate change: managing risk and uncertainty Available online: <https://www.actuaries.org.uk/documents/climate-change-managing-risk-and-uncertainty-policy-briefing>

Shue, Henry, “*Uncertainty as the Reason for Action: Last Opportunity and Future Climate Disaster*,” Global Justice: Theory Practice Rhetoric, Special Issue on Global Justice and Climate Change, 9 (2016), 86-103. Available at: <http://theglobaljusticenetwork.org/global/index.php/gjn/article/view/89/65>

Stern, N, 2013, “*Ethics, Equity and the Economics of Climate Change; Paper 2: Economics and Politics*”; Centre for Climate change Economics and Policy Working Paper 97b and Grantham Research Institute on Climate Change and Environment Working Paper 84b. Available at: <http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2012/06/WP84b-Ethics-equity-and-the-economics-of-climate-change--Paper-2.pdf>



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