



Institute
and Faculty
of Actuaries

Wider horizons

Climate change reading list

Curated by Mike Clark on behalf of the Sustainability Board

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Foreword by Nick Spencer

As a result of human activity, the climate is changing globally at an unprecedented rate. This change presents ecological, social, economic, and financial risks. The potential impacts of climate change are global and systemic. As well as highly disruptive physical changes there are significant implications for the entire financial system. Yet with so much climate-related information out there, it can be hard to know where to start reading and thinking about the challenges.

This climate change reading list is brought to you by the Sustainability Board. It gives suggestions for reading, with some brief commentary to help contextualise the items suggested. This is part of the IFoA's commitment to support actuaries in their understanding of climate risks and opportunities, and to encourage the incorporation of these risks and opportunities into actuarial advice. I hope you find it useful.

Nick Spencer, Chair of the Sustainability Board

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Introduction

This guide aims to support actuaries in their self-directed learning in an area in which they may have modest prior knowledge and insights. We assume that actuaries have some awareness of the risks that climate change presents and that they need little incentive to explore the relevance of the issue to their professional work. Further, on occasion they may need to persuade their employer/client of its importance.

This guide is part of a wider project to produce such guides in a number of topic areas. The Steering Group for the project has chosen climate change as the first topic to be addressed. Topics under consideration for future guides include systems thinking and new economics.

We welcome and encourage feedback on what you find helpful and not so helpful about this guide, as well as suggestions for material to include in future versions. We intend that this guide will be reviewed and updated regularly.

Objective

This guide curates links to a range of material each with a brief description to help the reader decide whether the linked material is relevant to their current stage of research and learning.

Climate change is an extensive subject and many of the items referenced in this guide will have further references that can be explored as the reader decides. An immense amount of work is taking place in this area. This means that the references included in this guide will soon be followed by yet-to-be published work. It is hoped that by using this guide, the reader will then be able to follow more recent developments in their areas of interest.

In some sections we have included a suggestion for a link you might like to start with, labelled **Editor's choice**.

Structure

This guide is set out as follows:

- The Paris Agreement and the Task Force on Climate-related Financial Disclosures
- IFoA (and other actuarial) climate-related publications
- Science and risk
- Law, policy and regulation
- Investment
- Insurance and banking
- Climate change mitigation measures such as carbon pricing
- Climate change adaptation measures such as insurance
- Other initiatives, guidelines and frameworks focusing on climate change reporting and disclosure
- Other organisations focused on climate change

The Paris Agreement and the Task Force on Climate-related Financial Disclosures

Not sure where to start? Try the **Editor's choice**

The [TCFD Recommendations](#) were published in June 2017.

Although some climate scientists might disagree, it can be said that work on climate change came of age in 2015 at COP21. Held in Paris that year, the United Nations Framework Convention on Climate Change (UNFCCC) annual event, which progresses the UN's work on climate change, led to the [Paris Agreement](#). This Agreement came into force during 2016 when the required hurdle of formal country commitments was reached.

The Paris Agreement is a comprehensive global commitment to tackle climate change. The Conference of the Parties (COP) process is part of the UNFCCC governance process. [COP26](#), due to have been held in Glasgow in late 2020, was postponed because of the Covid-19 crisis and will now be held from 1–12 November 2021.

The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping the global temperature rise this century to well below 2 degrees celsius above pre-industrial levels, and to pursue efforts to limit the temperature increase even further to 1.5 degrees celsius. Additionally, the agreement aims to strengthen the ability of countries to deal with the impacts of climate change. The temperature rise is already above 1 degree.

These goals are covered in Article 2.1 (a) and (b) of the Agreement while Article 2.1 (c) states the supportive: *Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.*

Limiting temperature rise to achieve the Paris Agreement's central aim is referred to as one possible future 'scenario'. Other scenarios with higher temperatures are also possible if global efforts are not successful. The different ways that these end-century scenarios might evolve are referred to as 'pathways'. Different pathways might be driven by transition from carbon-based to carbon-free energy at different pace (or no transition), linked to government policy actions at different times and resulting in different impacts on financial markets.

At the Paris COP21, the Financial Stability Board (FSB) launched the Task Force on Climate-related Financial Disclosures ([TCFD](#)). TCFD's goal was to develop voluntary, consistent climate-related financial risk disclosures. The [TCFD Recommendations](#) were published in June 2017.

Since that time, the recommendations have been embraced globally by companies and other financial institutions. There is a general move to make them mandatory in some countries and in some sectors, for example [in the UK](#).

In November 2020 the UK government announced that the UK is heading towards mandatory disclosure within five years: [TCFD taskforce interim report and roadmap](#). The [TCFD Knowledge Hub](#) offers an extensive selection of resources.

2015 was also the year that [Transforming our world: the 2030 Agenda for Sustainable Development](#) with its 17 [Sustainable Development Goals](#) (SDGs) was adopted by all UN member states. The agenda is a universal call to action to end poverty, protect the planet and improve the lives and prospects of everyone, everywhere. While SDG13 is specifically about climate action, the SDGs are deliberately interdependent and many of the other goals are also relevant to climate change, for example SDG7 Affordable and Clean Energy. The SDGs are a mechanism with which to hold governments to account for progress on the agenda.

IFoA (and other actuarial) climate-related publications

Not sure where to start? Try the **Editor's choice**

[Climate Change for Actuaries](#) is an introduction to the topic.

The IFoA formed a Resources and Environment Board some years ago. Much of its work relates to climate issues. Recently, the board has been renamed the Sustainability Board. The weekly Sustainable Finance Community updates are a useful resource. Please contact sustainablefinancecommunity@gmail.com to join the distribution list.

In May 2017 the IFoA issued a [Risk Alert](#) on climate, drawing actuaries' attention to a risk that is central, and would become increasingly so, to many actuaries' work. Climate change is covered in the [JFAR Risk Perspective 2019/20](#) published by the Joint Forum on Actuarial Regulation.

[Climate Change for Actuaries](#) is an introduction to the topic, first published in March 2019 and revised in July 2020. Several practical guides have been issued for [Life actuaries](#), [GI practitioners](#) and [Actuaries working in DC Pensions](#).

Climate change was the topic for the first issue of the [Intergenerational Fairness Bulletin](#).

Climate scenario analysis for pension schemes is covered in [A UK case study](#) and the accompanying [An illustration of potential long-term economic & financial market impacts](#).

Three papers cover [Sponsor Covenant Assessments](#), [Mortality](#), and [Financial Assumptions](#).

[Reporting Practices](#) analyses climate risk reporting by UK insurers and pension schemes.

[The risk of climate ruin](#) addresses the issue: How large a risk is society prepared to run with the climate system?

[A user guide to climate-related financial disclosures](#) was produced by the IFoA working with the Institute of Environmental Management & Assessment (IEMA). The guide seeks to assist users of financial disclosures to make the best use of them. The Q&A format is intended to stimulate challenge and discussion. The guide looks to support the TCFD recommendations as their adoption delivers major change.

The IFoA has a formal link with the [Oxford Smith School of Enterprise and the Environment](#). An IFoA representative sits on the Global Advisory Council of the Sustainable Finance Programme. Initially, this programme was narrowly titled Stranded Assets but after some years was renamed to reflect the broader scope of work that developed. The Sustainable Finance Programme publishes a wide range of research and is a lead institution in a number of networks.

A recent development is spatial finance, the integration of geospatial data and analysis into financial theory and practice. Here, the Smith School founded and works through the [Spatial Finance Initiative](#), which aims to mainstream geospatial capabilities.

The IFoA has a formal link to the [Centre for the Understanding of Sustainable Prosperity](#) (CUSP). As the name suggests, their work includes, but goes well beyond, climate change issues.

The IAA has published [Importance of Climate-Related Risks for Actuaries](#) and another earlier paper on [A Decarbonization Briefing for Actuaries](#).

Written from an Australian perspective, [Net-zero Emissions: What are Governments and Companies Doing?](#) discusses what actions are being taken around the world.

In North America, several actuarial bodies have come together to produce the [Actuaries Climate Index](#). Australia has followed suit with the [Australian Actuaries Climate Index](#).

You can see a note on climate change for Australian Appointed Actuaries [here](#).

Science and risk

Not sure where to start? Try the **Editor's choice**

The 2019 IPCC [Special Report on Global warming of 1.5 Degrees](#).

Science has been addressing climate change for many decades.

The place to start is the work of the Intergovernmental Panel for Climate Change (IPCC). This is the UN body that assesses the science related to climate change. Through its assessments, the IPCC determines the state of knowledge on climate change. It identifies where there is agreement in the scientific community on topics related to climate change, and where further research is needed. The IPCC does not conduct its own research. IPCC reports are neutral, policy-relevant but not policy-prescriptive. Created in 1988, the IPCC has 195 member countries.

Although the Paris Agreement wording is “*keeping the global temperature rise this century to well below 2 degrees celsius above pre-industrial levels, and to pursue efforts to limit the temperature increase even further to 1.5 degrees celsius*”, growing concern about the damage inflicted by a 2 degree rise led to the IPCC publishing a [Special Report on Global warming of 1.5 Degrees](#) in 2019.

Physical risks from climate change arise from a number of factors and relate to specific weather events (such as heatwaves, floods, wildfires and storms) and longer-term shifts in the climate (such as changes in precipitation, extreme weather variability, sea level rise and rising mean temperatures).

Transition risks arise from the process of adjustment towards the low carbon economy, such as climate-related developments in policy/regulation, the emergence of disruptive technology and business models, shifting societal preferences and evolving evidence and legal interpretations.

Liability risks arise from parties who have suffered loss or damage from the crystallisation of physical or transition risks seeking to recover those losses from those they hold responsible.

IPCC reports are also one place to learn more about important climate change terminology from the [Paris Agreement](#). ‘Mitigation’ is (human) intervention to reduce emissions or enhance the sinks of greenhouse gases, eg renewable energy or afforestation. ‘Adaptation’ is the process of adjustment (including human intervention) to actual or expected climate and its effects, eg flood defences. These activities, whatever their motivation, impact future climate change risks. ‘Loss and damage’ is the term given to the residual unavoidable harm caused by climate change, linked to liability risk.

Energy lies at the heart of many climate issues. The International Energy Agency (IEA) was created in 1974 to help co-ordinate a collective response to major disruptions in the supply of oil. While oil security remains a key aspect of its work, the IEA has evolved since its foundation. Founded in 2009, the International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy.

While this guide focuses on finance and risk, and does not seek to cover developments across the non-financial economy, [Deep decarbonization](#) examines green hydrogen in the context of net zero greenhouse gas emissions and the future of the EU Emissions Trading Scheme.

Law, policy and regulation

Not sure where to start? Try the **Editor's choice**

The UK's [Committee on Climate Change](#) is an independent statutory body established under the Climate Change Act 2008.

Law, policy and regulation is evolving to manage climate change risk. This typically takes place in a national framework, although international networks promote knowledge-sharing and best practice.

The UK's [Climate Change Act 2008](#) became law over ten years ago. In June 2019 the UK passed [net zero](#) legislation committing the UK to a legally binding target of net zero emissions by 2050.

The UK's [Committee on Climate Change](#) is an independent statutory body established under the Climate Change Act 2008. Its purpose is to advise the UK on emissions targets and to report to parliament on progress made in reducing greenhouse gas emissions and preparing for, and adapting to, the impacts of climate change.

France also has significant climate legislation, which extends into the financial sector. The French Sustainable Investment Forum (FIR,) has produced an [Article173 Handbook](#). In New Zealand the [Climate Change Response \(Zero Carbon\) Amendment Act 2019](#) sets out how a country highly dependent on agriculture is tackling climate change. National legislation reflects local circumstances. Whereas a lot of the focus in the UK has been on decarbonising energy, the agricultural sector is a prime focus for New Zealand.

Government support extends to education. The [Green Finance Education Charter](#) is a commitment from chartered and professional bodies (including the IFoA) to integrate green finance and sustainability into their core curricula, new qualifications, and the continued professional development of their members.

The Network of Central Banks and Supervisors for Greening the Financial System ([NGFS](#)) brings together a growing number of national central banks and financial regulators. At the time of writing, the US is notable for its absence. NGFS has published a number of reports, and climate scenario modelling is an early focus of its work. For example, you can find the NFGS paper on environmental risk analysis [here](#).

There is a growing trend in climate change litigation. The [Grantham Research Institute on Climate Change and the Environment](#) and the Centre for Climate Change Economics and Policy have published [Global trends in climate change litigation 2020 snapshot](#). Thomson Reuters *Practical Law* covers climate law. It is a commercial subscription service and actuaries could reasonably expect their legal departments to have access to it.

The environmental charity [ClientEarth](#) is active in using the law to reach climate goals. There is currently a case before the Australian courts (NSD1333/2018) in which a member of a pension fund is seeking confirmation from the trustees that they have taken specific actions to support their public statements on the risks of climate change. In the UK a pension fund member took a complaint to [The Pensions Ombudsman](#) that the fund would not provide all the information he had requested relating to how the fund was taking into consideration the potential risks of climate change.

In the UK the four principal financial regulators are developing their approach to the management of climate risk. This commenced publicly with the then-Governor of the Bank of England Mark Carney's speech [Breaking the tragedy of the horizon - climate change and financial stability](#) in September 2015. The [Bank of England Climate change](#) page is a gateway to a number of resources including the 2015 insurance report and:

- [Transition in thinking: The impact of climate change on the UK banking sector](#), an early (2018) examination of the financial risks from climate change that impact the PRA's role

- This was followed in April 2019 by Supervisory Statement SS 3/19 [Enhancing banks' and insurers' approaches to managing the financial risks from climate change](#)
- The December 2019 Discussion Paper [The 2021 biennial exploratory scenario on the financial risks from climate change](#) moved the UK regulatory position forward (although the timeline has slipped on account of the Covid-19 situation). More recently, the PRA's CEO letter [Managing climate-related financial risk - thematic feedback from PRA's review of firms' SS3/19 plans](#) moved things along and clarified the regulator's expectations and timeline.

The UK government published its [Green finance strategy](#) in 2019.

The Prudential Regulatory Authority (PRA), part of the Bank of England, published its [Consultation on its proposals for stress testing the financial stability implications of climate change](#) in December 2019. This involves a Biennial Exploratory Scenario (BES) exercise. Although not formally a stress test, the objective of BES is to test the resilience of the largest banks and insurers to the physical and transition risks associated with different possible climate scenarios, and the financial system's exposure more broadly to climate-related risk

In March 2020 the FCA issued consultation paper CP20/3 [Proposals to enhance climate-related disclosures by listed issuers and clarification of existing disclosure obligations](#). In October a [Letter from the FCA to the Minister for Pensions and Financial Inclusion](#) set out the FCA's plans to implement consistent climate-related disclosure requirements for asset managers and FCA-regulated pension schemes, and also references the cross-Whitehall/cross-regulator climate taskforce.

The PRA and FCA co-convened the [Climate Financial Risk Forum](#) (CFRF), an industry forum that seeks to build capacity and share best practice across financial regulators and industry to advance the sector's responses to the financial risks from climate change. In June 2020 CFRF published an extensive guide together with a summary [Climate Financial Risk Forum Guide 2020](#).

In February 2020 the Financial Reporting Council (FRC) announced a review to [assess company and auditor responses to climate change](#). More recently, the FRC published [A Matter of Principles: The Future of Corporate Reporting](#).

The [Pensions Regulator](#) in the UK will be responsible for enforcing regulations yet to be issued for consultation, which will flow from the Pensions Bill currently before Parliament when enacted. Parts of the Bill deal with climate matters. The Bill should complete its passage through parliament in the autumn of 2020. In August 2020 the DWP published a consultation [Taking action on climate risk: improving governance and reporting by occupational pension schemes](#). This consultation proposes TCFD making reporting mandatory for large pension schemes. It is also the government's intention that scenario analysis will increasingly be seen as best practice in the strategic risk management of climate change. The consultation proposes that trustees will use two scenarios on a best efforts basis.

UK parliamentary Select Committees are considering climate issues. In 2018 the House of Commons [Environmental Audit Committee](#) held a [Green Finance inquiry](#). This resulted in two reports, and the Committee also sent a letter to the UK's 25 largest pension funds seeking information on how they were tackling climate change. The Committee published their [response](#) to this information. The Treasury Select Committee held a [Decarbonisation and Green Finance](#) inquiry over 2020.

In preparing for COP26, the UK has appointed Nigel Topping as [UK Climate Champion](#), working alongside the [Chile High-Level Champion](#) from COP25.

The EU has been developing the overlapping areas of climate and sustainability policy and regulation for some years. The EU Taxonomy is a classification tool aimed at investors, companies and financial institutions to define environmental performance of economic activities across a wide range of industries, and sets requirements that corporate activities must meet to be considered sustainable.

The Principles for Responsible Investment's (PRI) [EU Sustainable Finance Taxonomy](#) is one place to start. This Finextra briefing [EU adopts green taxonomy](#) gives a June 2020 update on the adoption by the EU parliament of the Taxonomy Regulation. An internet search will deliver many commercial providers offering analysis, advice and services around the taxonomy.

In Ireland the government published the [Climate Action Plan](#) in 2019. An LSE Grantham report [Governance of climate change policy: A case study of South Africa](#) states "*South Africa has put in place one of the most elaborate and consultative climate governance systems observable among developing and emerging economies.*" Columbia University's School of International and Public Affairs has published an extensive [Guide to Chinese Climate Policy_2019](#). The IEA has published [China's Emissions Trading Scheme](#), as China introduces a national ETS in 2020.

Investment

Not sure where to start? Try the **Editor's choice**

[All Swans are Black in the Dark](#) is a piece of research that helpfully illustrates how the short-term focus of financial analysis does not shed light on long term risks.

In 2006 a leading group of investors established the UN-backed Principles for Responsible Investment ([PRI](#)). At the time of writing, the PRI has nearly 1,200 signatories representing over \$70trn. The PRI works:

- To understand the investment implications of environmental, social and governance (ESG) factors
- To support its international network of investor signatories in incorporating these factors into their investment and ownership decisions.

Leading organisations are starting to take a strategic response to ESG and sustainability, and are considering changes needed to products and market positioning, as well as to processes, operations and supply chains. [Read more about ESG investing.](#)

From 2020, PRI signatories must report how they have considered specific climate-change risks in their portfolios.

The financial risk of climate change has emerged as one of the primary issues that the PRI seeks to address. The [Inevitable Policy Response](#) (IPR) work involves PRI, Vivid Economics and Energy Transition Advisors. They are building a Forecast Policy Scenario (FPS) which lays out the policies that are likely to be implemented in the 2020s and quantifies the impact of this response on the real economy and financial markets. Much climate scenario work seeks to avoid specific forecasts so the FPS is particularly helpful in this regard.

In Europe the Institutional Investors Group on Climate Change ([IIGCC](#)) is a membership organisation of investors focusing on climate change. The [Net Zero Investment Framework for Consultation](#) is the first publication of the IIGCC's Paris Aligned Investment Initiative. Equivalent organisations to IIGCC are [Ceres in North America](#), and [C](#) and [AIGCC](#) in Asia.

Leading asset owners are seeking to manage the strategic financial risks of climate change. This can lead to designing investment mandates (as a client) or products (as an investment manager) to meet that goal. Early pension fund movers include HSBC Bank (UK) Pension Scheme ([TCFD Statement](#)), NEST ([Note to members and climate change policy](#)), and the Environment Agency Pension Fund ([EAPF](#)).

Outside the UK examples include

- France: ERAPF ([SRI including climate](#)), FRR ([The FRR and Climate Change](#))
- Sweden: AP4 ([Climate and the environment](#)), AP1
- United States: CalPERS ([Climate Change](#)), New York State Common Retirement Fund ([Climate Action Plan](#)), CalSTRS ([Transition to a Low-Carbon Economy](#))
- Australia: HESTA ([Climate change](#))
- Canada: OPTrust ([Climate Change Action Plan](#))

As well as strategic risk, strategic asset allocation and portfolio construction, investors are increasingly using their voting power to influence companies. [Climate Action 100+](#) is a global investor initiative that seeks to ensure the world's largest corporate greenhouse gas emitters take necessary action on climate change.

The [Net-Zero Asset Owner Alliance](#) is a growing group of international institutional investors delivering on a commitment to transition their investment portfolios to net-zero greenhouse gas

emissions by 2050. Launched in September 2019 with no UK asset owners as members, Aviva and the Church Commissioners have since joined the Alliance.

The [Investment Integration Project](#) (TIIP) addresses system issues for investors. They continue to publish helpful reports. For example, [Assessing System Level Investments](#) is a guide to help asset owners assess their managers' effectiveness in addressing systemic social and environmental risks and rewards.

The [Transition Pathway Initiative](#) (TPI) is a global, asset-owner led initiative that assesses companies' preparedness for the transition to a low carbon economy.

[All Swans are Black in the Dark](#) is a piece of research that helpfully illustrates how the short-term focus of financial analysis does not shed light on long-term risks.

The 2° Investing Initiative ([2DII](#)) is an international, non-profit think tank working to align financial markets and regulations with the Paris Agreement goals.

[Understanding Physical Climate Risks and Opportunities](#), published by the IIGCC and lead-authored by Acclimatise, seeks to help investors understand physical climate risks and how they are measured. This guidance provides an overview of the physical climate science and illustrates how physical risks are manifesting and causing financial consequences. It provides investors with practical guidance on how they can begin to analyse, assess and manage the risks and opportunities presented by physical climate hazards, both acute and chronic.

Stranded assets are assets that have suffered a premature write-down in value and this may be caused by environment-related risks. You can see a paper that explores stranded assets [here](#).

Health

There is a growing understanding of how climate change impacts human health. These health arguments are an increasingly powerful perspective on the importance of climate risk mitigation and adaptation.

For actuaries whose work entails projections of human health, morbidity, and mortality, the list of relevant climate change impacts is long and complex. Uncertainties in projections considering health are also magnified by future responses to climate change, at both an individual behaviour level and societal level. These may mitigate or exacerbate primary climate change drivers. While not an exhaustive list, some important issues impacting human health are:

1. Air quality changes
 - a. Associated with fossil fuel burning
 - b. Wildfire smoke
2. Temperature extremes
 - a. Heatwave and cold spells
 - b. Increases in intensity and frequency
 - c. Changing geographical patterns
 - d. Changing patterns in endemic infectious disease
3. New epidemics/pandemics
 - a. New pathogens, zoonoses, and disease vectors associated with changing land use and precipitation patterns
 - b. Increases in frequency and severity
 - c. Health system stability and continuity during crises
4. Deterioration in mental health
 - a. Eco-anxiety
 - b. PTSD after disaster events
5. Water and food security
 - a. Drought
 - b. Flooding and water-borne diseases
 - c. Changing agricultural production patterns and capacity
 - d. Political instability and conflict risk
6. The response to climate change risk
 - a. The extent and pace of greenhouse gas emission reduction
 - b. Health system adaptation and disaster readiness
 - c. Public efforts to mitigate preventable health impacts
 - d. Climate change-induced migration and demographic shifts
 - e. Adoption of low-carbon lifestyles with secondary health impacts
 - f. Changing consumer buying behaviour towards private health protection

Since 2016, the [Lancet Countdown: Tracking Progress on Health and Climate Change](#) has been monitoring how climate change threatens public health, and how the response to it potentially brings immense benefits for human health. It is a collaboration of over 120 leading and diverse experts, who publish an annual report ahead of the UN climate change negotiations.

In 2021, prior to COP26 in Glasgow, the WHO published a [COP26 Special Report on Climate Change and Health](#). It proposes 10 recommendations from the global health community to governments and policymakers, calling on them to act with urgency on the current climate and health crises.

In 2021, the journal [Nature Climate Change published a study](#) spanning nearly three decades of heat deaths across 732 cities. It concludes that 37% of warm-season heat-related deaths can be attributed to human-caused climate change. Exposure to excessive heat is known to exacerbate cardiovascular conditions, while dehydration and alterations in renal system functioning lead to chronic kidney disease. The brain, liver and gut are also affected by excessive heat.

In 2021, the Global Climate and Health Alliance published [The Limits of Livability – The emerging threat of smoke impacts on health from forest fires and climate change](#).

In 2014, 2017 and 2021, the American Psychological Association and ecoAmerica have published updated reports: [Mental Health and Our Changing Climate: Impacts, Implications, and Guidance](#) to increase awareness about these challenges and address them.

Insurance and banking

Not sure where to start? Try the **Editor's choice**

Supervisory Statement SS 3/19 [Enhancing banks' and insurers' approaches to managing the financial risks from climate change](#) April 2019.

The [Bank of England Climate change](#) page is a gateway to a number of (often PRA) regulatory resources including the 2015 insurance report and:

- [Transition in thinking: The impact of climate change on the UK banking sector](#), an early (2018) examination of the financial risks from climate change that impact the PRA's role
- This was followed in April 2019 by Supervisory Statement SS 3/19 [Enhancing banks' and insurers' approaches to managing the financial risks from climate change](#)
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[EIOPA has issued views on the integration of sustainability](#), in particular climate-related developments, into the Solvency II framework for the valuation of assets and liabilities, investment and underwriting practices, the calibration of market and natural catastrophe risks and the use of internal models.

Some of the NGFS publications address climate risk in bank business models from a regulatory perspective.

The Partnership for Climate Accounting Financials ([PCAF](#)) seeks to develop harmonised and transparent carbon accounting. This requires measuring and disclosing the GHG emissions associated with the lending and investment activities of financial institutions, creating transparency and accountability.

Climate change mitigation measures such as carbon pricing

Not sure where to start? Try the **Editor's choice**

The World Bank's [State and Trends of Carbon Pricing 2020](#).

Earth's climate is a complex adaptive system interconnected to the atmosphere, oceans and land surface. Our emissions of greenhouse gases – primarily CO₂ due to burning fossil fuels and deforestation but also methane, nitrous oxide and some other industrial chemicals – jeopardise the balance within the system. Droughts, fires, storms and floods are hugely disruptive risks to our lives, livelihoods and landscapes. Mitigating these climate change risks means radically [reducing emissions](#) ... but how ... when carbon is so embedded in our current economies?

It is crucial to decouple economic growth from emissions growth. Carbon pricing is an effective instrument to guide production and investment decisions towards [mitigating emissions](#) and can be implemented using a tax, an emissions trading system, or a combination of the two.

Economists have made a strong case for carbon (CO₂) pricing for many years. Carbon (carbon emissions) are an externality. They are often unpriced, even though priced research shows that price levels are below what is needed to support the changes the world needs to transition to a low carbon economy. [Carbon pricing increases the cost of CO₂ emissions and implements the polluter pays principle](#). It does this by increasing costs and, if sufficiently high and rising over time, making carbon-intensive energy carriers unprofitable. Coal is the most carbon-intensive fossil fuel we burn so carbon pricing can effectively counteract the global renaissance of coal.

The World Bank's [State and Trends of Carbon Pricing 2020](#) is the latest in their annual reports which gives a comprehensive update on carbon pricing around the world. The Foreword to the report says: *"A well-designed carbon price embedded in a broader package of climate, energy and development policies and measures remains critical to solving the climate challenge and advancing the achievement of sustainable development aspirations."*

For some years the UK has been a member of the European Union Emissions Trading Scheme (ETS). At the time of writing the Department for Business, Energy and Industrial Strategy (BEIS) has consulted on a UK ETS, operative after the UK leaves the European Union ([UK ETS](#)).

ETS allowances were designed as part of industrial strategy, but investors have started to consider them as investible entities.

Energy policies urgently need to promote energy efficiency while embracing clean energy sources to make things move, heat up and cool down. The [energy transition](#) is a pathway towards transformation of the global energy sector from fossil-based to zero-carbon by the second half of this century. At its heart is the need to reduce energy-related CO₂ emissions to limit climate change. The [Energy Transitions Commission](#) is a global coalition of leaders from across the energy landscape committed to achieving net-zero emissions by mid-century.

Afforestation is another mechanism for climate change mitigation. It is considered a cost-effective and readily available climate change mitigation option.

Appropriate policies for agriculture, forestry and other land use are also needed as these sectors account for about [a quarter of net emissions](#) mainly from deforestation, agricultural emissions from soil, and nutrient management and livestock. The most cost-effective mitigation options in forestry are afforestation, sustainable forest management and reducing deforestation, with large differences in their relative importance across regions. In agriculture, the most cost-effective mitigation options are cropland management, grazing land management, and restoration of organic soils. Demand-side

measures, such as changes in diet and reductions of losses in the food supply chain, have a significant, but uncertain, potential to reduce emissions from food production.

These climate change mitigation measures are closely related to broader concepts of sustainability. The **circular economy** aims to redefine growth, focusing on positive society-wide benefits. It entails gradually decoupling economic activity from the consumption of finite resources and designing waste out of the system. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital. It is based on three principles:

- Design out waste and pollution
- Keep products and materials in use
- Regenerate natural systems

The **Doughnut Economy** has balance as its central theme. The theory postulates that a thriving human existence is only possible by considered use of available resources. Use too much, and we risk catastrophic effects that are harmful to human life. However, using earth's resources unwisely can also lead to a shortfall, with humans existing in danger and hardship. The 'doughnut' is the safe zone between these two extremes. It represents the ability to thrive economically, with 12 social foundations, such as water, food, health and income, being met for all people.

Climate change adaptation measures such as insurance

Not sure where to start? Try the **Editor's choice**

[Insurance for Climate Adaptation – Opportunities and Limitations](#) argues that greater collaboration between the insurance industry and state policy makers, including investment in open-source risk models, could improve society's ability to recover from disasters linked to climate change.

Adaptation involves taking action to prevent or minimise the damage the adverse effects of climate change can cause, or taking advantage of opportunities that may arise. It has been shown that well-planned, [early adaptation action](#) saves money and lives later, for example using scarce water resources more efficiently, adapting building codes to future climate conditions and extreme weather events, building flood defences and raising the levels of dykes.

Climate change adaptation has increasingly [focused on building resilience](#) so that people can cope better with climate change impacts. This agenda converges with disaster risk management, an area with its own separate set of international institutions and agreements such as the [Sendai Framework](#).

Some stakeholders view insurance as a form of adaptation as it enables people to bounce back faster from the adverse effects of climate change. This portends insurance playing a larger role globally in driving greater resilience, both in closing current protection gaps and introducing innovative new climate coverages. There is also the hypothesis that insurance incentivises other adaptation activities that reduce loss and damage, akin to risk management practices in more traditional insurance policies. Adapting to climate change, by increasing our ability to recover from specific disasters, reducing vulnerability around the globe, and promoting both financial and physical resilience to its effects, is essential to society.

Other initiatives, guidelines and frameworks focusing on climate change reporting and disclosure

There are multiple initiatives seeking to tackle the challenges of climate change.

The **CDP** (formerly the Carbon Disclosure Project) runs a global disclosure system for investors, companies, cities, states and regions to manage their environmental impacts.

The **Climate Disclosure Standards Board** (CDSB) is an international consortium of business and environmental NGOs. CDSB looks to advance and align the global mainstream corporate reporting model to equate natural capital with financial capital. Their reporting framework is a voluntary one designed to elicit climate change-related information of value to investors in mainstream financial reports.

The **Global Reporting Initiative** (GRI) helps businesses and governments worldwide understand and communicate their impact on critical sustainability issues, such as climate change, human rights, governance and social wellbeing. This enables real action to create social, environmental and economic benefits for everyone.

The UNEP FI **Principles for Sustainable Insurance** (PSI) serve as a global framework for the insurance industry to address environmental, social and governance risks and opportunities. The purpose of the PSI Initiative is to better understand, prevent and reduce environmental, social and governance risks, and better manage opportunities to provide quality and reliable risk protection.

Other organisations focused on climate change

Carbon Tracker is a financial think tank that carries out analysis on the impact of the energy transition on capital markets and the potential investment in high-cost carbon intensive fossil fuels. They are credited with coining the term *stranded assets*.

Chapter Zero is a forum focused on non-executive directors, helping them bring climate change to the board. In the UK, Chapter Zero is hosted by the Hughes Hall Centre for Climate Change Engagement. There are a growing number of Chapter Zero communities around the world.

ShareAction is a long-established NGO (formerly Fair Pensions) which seeks to make investment a force for good. They are working towards a system in which long-term thinking is recognised as the best way to guarantee healthy returns.

Launched in 2020, **OS-C** (Open Source Climate) is an open source collaboration community seeking to boost global capital flows into climate change mitigation and resilience. It plans to aggregate data, modelling, computing and data science worldwide into an AI-enhanced physical-economic model that functions like an operating system.

The Coalition for an International Platform for Climate Finance (IPCF) is a developing initiative. The goal is to do for climate finance what the IPCC does for climate science. It has been described as the global CFO for Article 2.1.c of the Paris Agreement'. In this media link **IPCF** has Aviva's Chief Responsible Investment Officer explaining the plan. If this comes to fruition, we can reasonably expect it to be a significant formal announcement at COP26.

There is a growing focus on communicating climate change in a way that encourages acceleration of activity. One organisation with this focus is **Climate Outreach**.

This guide would not be complete without a reference to civil activity. Greta Thunberg has significantly raised the profile of the urgency, especially among younger people, of responding to climate change. The Climate Assembly UK brought together 100+ people from all walks of life and shades of opinion to discuss how the UK should meet its 2050 net zero commitment. Meeting over six weekends in the spring of 2020 they heard evidence on the choices the UK faces, discussed them and made recommendations. Their report **The path to net zero** was published in September 2020.

Launched in 2020, **Make My Money Matter** is a movement calling for the money invested in UK pensions to build a better world.

Extinction Rebellion is an international movement that seeks to use non-violent civil disobedience to draw attention to climate change and some of its effects. It elicits strong feelings in both its supporters and its detractors.



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