



BANK OF ENGLAND
PRUDENTIAL REGULATION
AUTHORITY

Transition in thinking: The impact of climate change on the UK banking sector

September 2018



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Foreword



There are two paradoxes in managing the financial risks from climate change.

The first is that the future will be past. Climate change is a tragedy of the horizon which will impose major costs on future generations that the current one has no direct incentive to fix. The catastrophic impacts of climate change will be felt beyond the horizons of most actors.

Once climate change becomes a clear and present danger to financial stability it may already be too late to stabilise the atmosphere.

The second paradox is that success is failure. Too rapid a move towards a low-carbon economy could materially damage financial stability. A wholesale reassessment of prospects could destabilise markets, spark a pro-cyclical crystallisation of losses and lead to a persistent tightening of financial conditions: a climate Minsky moment.

The PRA recognises these paradoxes could have implications for the financial system. The first implies a need to adjust time horizons for the long-term, and to consider actions today in light of how the financial risks from climate change may evolve in the future. The second implies the need to find the right balance; it is foreseeable financial risks will be realised in some form, the challenge is minimising their impact while firms and society maximise the opportunities.

The good news is that with foresight these risks can be managed in an orderly, effective and productive manner. And the main actors in the quest for sustainability – governments, markets, financial firms and regulators – are already transitioning their thinking and actions.

First, governments. In reaching agreement in Paris, global leaders took *political action* to mitigate the impact of climate change. They committed to curbing greenhouse gas emissions to limit the rise in global temperatures relative to the pre-industrial world to well below 2°C. In the UK, this has led to the Clean Growth Strategy, which includes policies to make homes, businesses and transport more energy efficient, and to lower the carbon intensity of the UK's energy supply.

Second, markets. At the One Planet Summit in 2018, financial institutions responsible for managing almost \$100 trillion of assets – more than equivalent to annual global GDP – publicly supported the principle of disclosing material, decision-useful climate-related financial risks by signing up to the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD). The supporters included 23 global systemic banks, 8 of the top 10 global asset managers, the world's leading pension funds and insurers, and the two dominant shareholder advisory service companies.

Third, financial institutions led by insurers and now banks, the focus of this report.

Insurers have long been on the front line of the physical risks posed by climate change. Since the 1980s, the number of registered weather-related loss events has tripled. Inflation-adjusted insurance losses have increased from an annual average of around \$10 billion in the 1980s, to

around \$55 billion over the past decade. Insurers have responded to these risks through developing their modelling and forecasting capabilities, developing better exposure management and adapting coverage and pricing accordingly. So while events such as Hurricane Andrew in the early 1990s led to significant challenges, the industry has generally remained robust to more recent severe weather events.

For banks, the financial risks from climate change have tended to be beyond their planning horizons. The PRA's survey of 90% of the UK banking sector found that these horizons averaged four years – before risks would be expected to be fully realised and prior to stringent climate policies taking effect.

The report finds that the majority of banks are beginning to treat the risks from climate change like other financial risks – rather than viewing them simply as a corporate social responsibility issue. As such, oversight of the financial risks from climate change and overall responsibility for setting the strategy, targets and risk appetite relating to these risks is beginning to be considered at board level.

The report finds that banks have begun considering the most immediate physical risks to their business models – from the exposure of mortgage books to flood risk, or the impact of extreme weather events on sovereign risk. And they have started to assess exposures to transition risks where government policy is already pulling forward the adjustment. This includes exposures to carbon-intensive sectors, consumer loans secured on diesel vehicles, and buy-to-let lending given new energy efficiency requirements.

But many banks have some way to go to identify and measure the financial risks from climate change comprehensively. This requires strategic board oversight and more dynamic scenario analysis so actions today can be considered in light of future impacts.

Finally, the regulators.

Awareness of the risks and opportunities that arise from climate change has been growing among financial authorities internationally. Central banks and supervisors have established a Network for Greening the Financial System to share best practice. The Network has expanded from eight founding institutions since its launch in late 2017 to over 20 members and observers from countries that account for more than 40% of global output and carbon emissions.

The Bank of England's domestic focus is two-fold: first, enhancing the PRA's approach to supervising the financial risks from climate change to promote the safety and soundness of banks and insurers; and second, enhancing the resilience of the UK financial system by supporting an orderly market transition to a low-carbon economy.

This approach underpinned the PRA's report in 2015 on how climate change affects the insurance sector. It again motivates the report on banking and the PRA's next steps on microprudential regulation of climate-related financial risks in banks.

- The PRA expects banks to consider this report at board level, and to reflect on their current approach in light of the report's findings. The PRA will publish a consultation on its supervisory expectations for how banks and insurers should manage the financial risks from climate change. It will centre on how firms' governance, strategy and risk management frameworks need to

incorporate the financial risks from climate change, including the expectation that firms take a long-term view of the risks and a strategic, board-level approach.

- We will also establish a Climate Financial Risk Forum to share best practice and provide intellectual leadership.

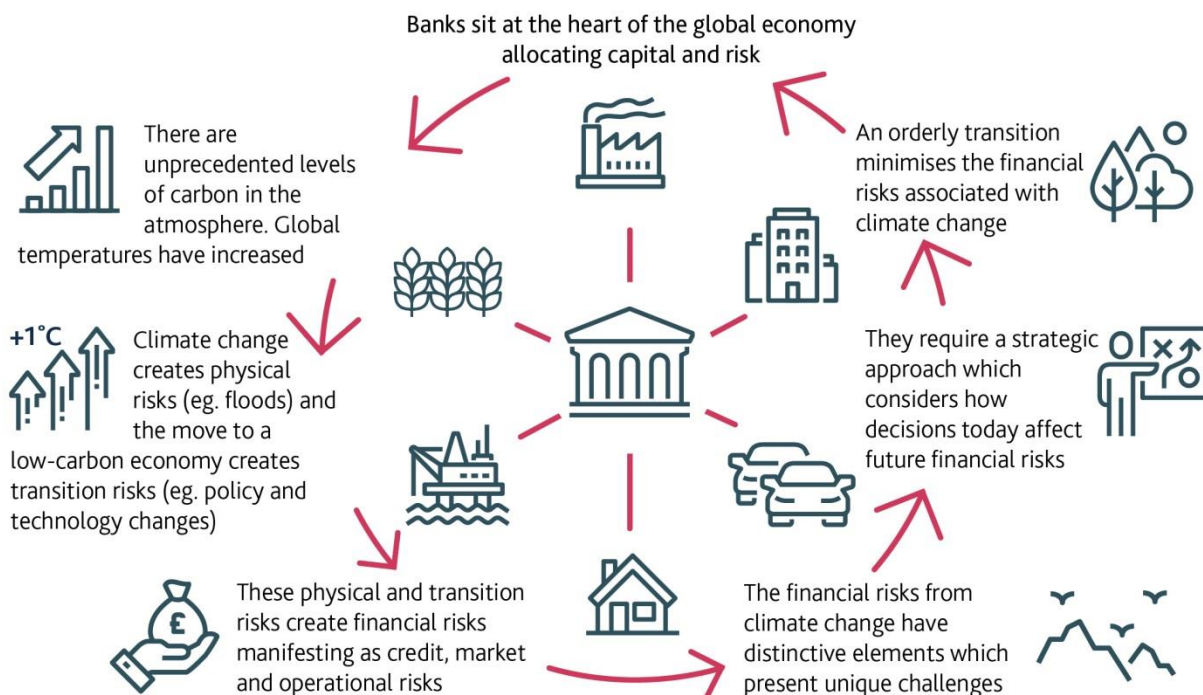
The Financial Policy Committee will consider the macroprudential implications of the financial risks from climate change.

We, as financial policymakers, will not drive the transition to a low-carbon economy, but we will expect our regulated firms to anticipate and manage the risks associated with that transition. To overcome the financial risks that climate change creates, bank boards must consider seriously the findings and implications set out in this report. And we invite you to engage with the PRA's next steps so that we may work together to fight the paradoxes we all face as we transition to a low-carbon world.

A handwritten signature in black ink, appearing to read 'M. Carney', with a stylized flourish at the end.

Mark Carney
Governor

Climate change presents financial risks to the UK banking sector



A transition in thinking is taking place as firms enhance their approach



30%
Responsible

Viewing climate change primarily through the lens of Corporate Social Responsibility (CSR)



60%
Responsive

Assessing climate change as a financial risk focusing within a three to five year time horizon



10%
Strategic

Taking a forward-looking view, grounded in long-term financial interests

Firms developing a strategic approach are:



Deepening understanding by leveraging enhanced disclosure and scenario analysis



Agreeing a board level, firm-wide strategic response



Integrating climate-related factors into present day risk management to reduce future risks

We will be enhancing our own response



Setting expectations for banks and insurers through a Supervisory Statement



Building intellectual capacity through a Climate Financial Risk Forum



Considering the system-wide financial risks from climate change

Executive summary

The purpose of this report¹ is to:

- examine the financial risks from climate change that impact Prudential Regulation Authority (PRA) regulated banks, building societies and designated investment firms (hereinafter ‘banks’);
- assess how banks are responding to and managing the financial risks from climate change; and
- help banks understand the PRA’s supervisory approach to the financial risks from climate change.

The PRA has a statutory objective to promote the safety and soundness of regulated firms. The PRA’s approach to supervision is forward-looking, assessing firms not just against current risks, but also against those that could plausibly arise in the future. The PRA has identified climate change as a future financial risk that is also relevant today, and has sought to understand how it impacts on the banking sector and what banks are doing in response. To inform the report, the PRA has:

- conducted a survey covering 90% of the UK banking sector representing over £11 trillion in assets;
- completed many bilateral meetings with firms and stakeholders; and
- incorporated the findings from the Bank of England’s broader climate-related work.

Climate change presents financial risks to the UK banking sector

Financial risks from climate change arise from two primary channels or ‘risk factors’: physical and transition.²

Physical risks can arise from climate and weather-related events, such as heatwaves, droughts, floods, storms and sea level rise. They can potentially result in large financial losses, impairing asset values and the creditworthiness of borrowers.

Transition risks can arise from the process of adjustment towards a low-carbon economy. Changes in policy, technology and sentiment could prompt a reassessment of the value of a large range of assets and create credit exposures for banks and other lenders as costs and opportunities become apparent.

For banks, these climate-related risk factors manifest as increasing credit, market and operational risks.

Credit risks

If damages from physical risks are not insured, the financial burden can fall onto other market participants, increasing credit exposures for banks. Extreme weather events can cause significant

1 This review was led by Ryan Barrett, Emma Dalhuijsen, Tanveer Hussain, Sarah Kemmitt, Matthew Scott, Julia van Huizen and sponsored by Sarah Breeden, Executive Director with oversight of the Bank’s climate-related work. The review was supported by many colleagues across the Bank of England and the review team would like to thank external stakeholders who provided valuable comments and advice.

2 The PRA’s insurance report also highlighted the importance of liability risks which continue to be considered within the PRA’s climate-related financial risk framework and are described in chapter 3. See PRA (2015).

losses for homeowners, reducing their ability to repay their loan and damaging the value of the property. For banks this increases the credit risk on their loan books as both the probability of default and loss given default increases.

Banks may also have credit exposures to companies with business models that are not aligned with the transition to a low-carbon economy, which therefore face a higher risk of reduced corporate earnings and business disruption. This may leave them unable to repay loans or meet their obligations on other financial transactions at the same time as reducing the value of the business. Survey respondents identified companies in the energy, transport, property and agriculture sectors to be most at risk, particularly if the transition to a low-carbon economy occurred late and was not orderly.

Market risks

The impact of the transition on carbon-intensive sectors could affect energy and commodity prices, corporate bonds, equities and certain derivatives contracts. While the risk of a sudden and significant system-wide adjustment may not be immediate, the financial risk from an abrupt transition to a low-carbon economy can increase if, over the coming years, portfolios are not aligned with expected climate pathways.

The increasing frequency of severe weather events could also impact macroeconomic conditions through sustained damage to national infrastructure and weaken fundamental factors such as economic growth, employment, and inflation. This could have implications for the market price of sovereign debt for those countries most susceptible to the physical impacts of climate change.

Operational risks

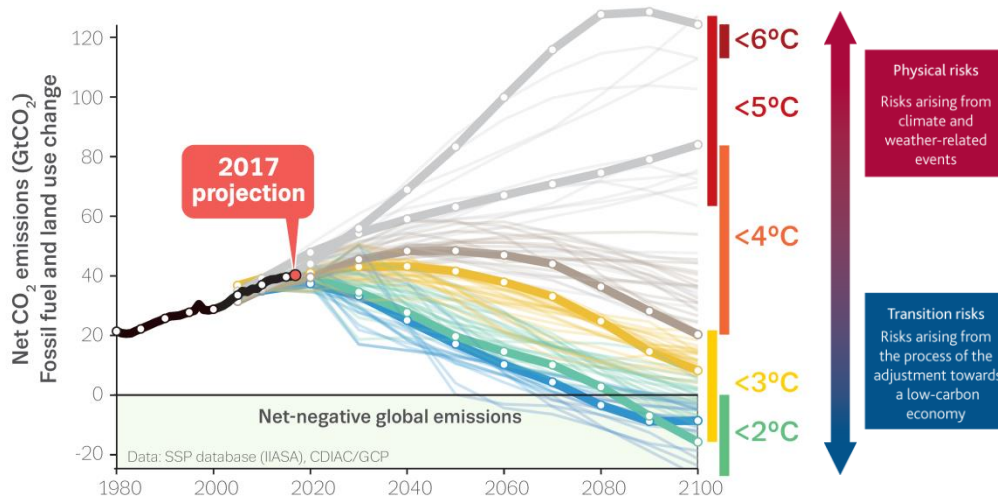
Severe weather events could impact business continuity, including branch networks, offices, infrastructure, processes, and staff. The pricing of inputs such as energy, water and insurance could increase. In terms of transition risks, reputational risk could also arise from shifting sentiment among customers and increasing attention and scrutiny from other stakeholders on the banking sector's response to climate change.

Financial risks are already becoming apparent

The four case studies (pages 27 to 36) demonstrate how the financial risks from climate change are already relevant to banks. In line with risks to the banking sector more generally, the case studies focus on increasing credit risk. Three of these, tightening energy efficiency standards in rented property, coal financing and lending to the automobile sector, arise from the transition to a low-carbon economy. The fourth, flood risk to residential mortgages, relates to physical risk. These examples underline that the financial risks arising from climate change need to be managed now.

Financial risks have distinctive elements

Continued greenhouse gas emissions are expected to lead to rising temperatures, increasing the financial risks from the physical impacts of climate change. As illustrated in Chart 1 below, limiting these impacts would require substantial reductions in carbon emissions, increasing the financial risks associated with the transition. The later these reductions begin, the more accelerated they will need to be for global temperatures to remain within the well below 2°C goal agreed in Paris.

Chart 1: Possible carbon emission pathways and climate-related risk factors

Source: Global Carbon Project (2017) with Bank graphic.

This dynamic, and other aspects of the physical and transition risk factors, give rise to the financial risks from climate change having a number of distinctive elements which, when considered together, present unique challenges. These are explained in Table A below.

Table A: Distinctive elements

Element	Description
Far-reaching in breadth and magnitude	The financial risks from physical and transition risk factors are relevant to multiple lines of business, sectors and geographies. Their full impact on the financial system may therefore be larger than for other types of risks, and is potentially non-linear, correlated and irreversible.
Uncertain and extended time horizons	The time horizons over which financial risks may be realised are uncertain, and their full impact may crystallise outside of many current business planning horizons (tragedy of the horizon). Using past data may not be a good predictor of future risks.
Foreseeable nature	While the exact outcome is uncertain, there is a high degree of certainty that financial risks from some combination of physical and transition factors will occur.
Dependency on short-term actions	The magnitude of future impact will, at least in part, be determined by the actions taken today. This includes actions by governments, financial market participants and a range of other actors.

The magnitude of the financial risks from climate-related factors will depend on future scenarios that will, at least in part, be determined by actions taken today.

A 'too little, too late' scenario, where significant action is taken, but too late to achieve climate goals, could result in the most severe financial risks crystallising in the banking sector. Financial risks from climate change will be minimised if there is an orderly market transition to a low-carbon world, but the window for an orderly transition is finite and closing.

In consequence, managing the financial risks from climate change requires a strategic approach, one which is forward looking and grounded in the long-term financial interests of the firm.

A transition in thinking is taking place as firms enhance their approach

The PRA identified three broad categories that define how banks are responding:

- 30% are being 'responsible' – an approach primarily driven by a Corporate Social Responsibility (CSR) perspective, focusing on reputational risks;
- 60 % are being 'responsive' – an approach where climate change is viewed as a financial risk, albeit from a relatively narrow, short-term perspective; and
- 10% are being 'strategic' – a more comprehensive approach taking a long-term view of the financial risks. This includes engaging at board level, considering both current and future risks, and taking action in the long-term financial interests of the firm, minimising the financial risks and so supporting an orderly transition.

As this transition in thinking is taking place, firms are enhancing their approaches to governance and risk management of the financial risks from climate change. Firms that are becoming more strategic in their approach are beginning to respond to the distinctive elements, as set out in Table B.

Table B: Examples of actions being taken by firms with a strategic approach

Distinctive elements	Example actions
Far-reaching in breadth and magnitude	<p>Deepening understanding of the financial risks from climate change</p> <ul style="list-style-type: none"> • Engaging with clients to understand the risks clients face over the longer-term • Publically supporting enhanced climate-related financial disclosures • Considering how to classify and identify assets to enable climate-related risk analysis across portfolios • Using scenario analysis and forward-looking data to assess the longer term financial risks <p>Agreeing a board level firm-wide strategic response</p> <ul style="list-style-type: none"> • Reviewing board-level responsibilities to respond to, and manage, the financial risks from climate change • Considering whether the current and future financial impacts from climate change have been factored into the firm's risk appetite <p>Considering how decisions today affect future financial risks</p> <ul style="list-style-type: none"> • Beginning to integrate climate-related risk factors into forward-looking assessments • Developing a comprehensive, firm-wide framework for climate-related risk management
Uncertain and extended time horizons	
Foreseeable nature	
Dependency on short-term actions	

The PRA's next steps

This report finds that financial risks arising from climate change are sufficiently material to be considered at board level and that the current approach to risk management varies widely between banks. Given these findings and the finite timescale for ensuring an orderly market transition to a low-carbon economy, and so to minimise financial risks, the PRA will be enhancing its own response:

(i) Setting supervisory expectations for banks and insurers

The PRA expects firms to consider the risks identified in this report and reflect on their current approach. The PRA will be setting out its supervisory expectations for consultation shortly after the publication of this report. Building on the PRA's earlier work, expectations will be set for both banks and insurers. They will centre on firms' governance, strategy and risk management in responding to the financial risks from climate change, including the extent to which boards are strategically considering the distinctive elements of the financial risks.

(ii) Establishing a Climate Financial Risk Forum to share best practice and provide intellectual leadership in this emerging field

The PRA recognises there are shared challenges to be addressed to build capacity to consider climate-related financial risks: for example, around improving data and the development of climate-related scenarios. The Bank is already actively collaborating with other stakeholders to tackle these issues. To accelerate progress, the PRA and the Financial Conduct Authority (FCA) will be establishing a Climate Financial Risk Forum, involving private sector participants, technical experts and other relevant stakeholders.

Considering the system-wide financial risks from climate change

This report will inform the Bank's wider work. This includes the considerations of the Financial Policy Committee (FPC) in its role of identifying, monitoring and taking action to remove or reduce systemic risks with a view to protecting and enhancing the resilience of the UK financial system. The Bank will assess the system-wide financial risks from climate change and explore whether climate-related factors should be included in a future Biennial Exploratory Scenario (BES).

Climate-related opportunities

The PRA survey and discussions also highlighted a range of opportunities that banks are already considering, particularly those relating to green finance. These include financing of low-carbon energy and transportation, such as electric vehicles. And the role of banks in facilitating access to capital markets through securitisation of green projects and assets, which can support climate mitigation and adaptation. We outline some of the opportunities that were highlighted as part of the review in Appendix A of the report.

1 Introduction

This chapter provides an introduction to the report, setting out its purpose in the context of the Bank's wider strategy for responding to climate change. It outlines the report's structure and methodological approach taken.

Purpose

1.1 The PRA has two primary objectives: a general objective to promote the safety and soundness of firms; and an objective specific to insurance firms, to contribute to ensuring that policyholders are appropriately protected.³

1.2 The PRA's approach to supervision is forward looking, assessing firms not just against current risks, but also against those that could plausibly arise in the future. Where the PRA judges it necessary to intervene, it aims to do so at an early stage.

1.3 The purpose of this report is to examine the financial risks from climate change that impact on the UK banking sector and assess how banks are responding to and managing these risks. The report is also intended to help banks understand the PRA's supervisory approach to the financial risks from climate change.

1.4 The report is an important element of the Bank's broader strategy in this area, as discussed in Box 1. It builds upon a similar review undertaken for the insurance sector, published in 2015.⁴

Structure

1.5 The report is structured as follows:

- Chapter 2 sets out the background and context on the two primary climate-related risk factors, physical and transition. This includes findings from the climate science community and background on the low-carbon transition;
- Chapter 3 examines the financial risks from climate change that impact on the UK banking sector. The chapter includes four specific case studies demonstrating how these risks are already becoming relevant to PRA-regulated banks. It also discusses how the financial risks have distinctive elements and how they may evolve;
- Chapter 4 assesses how banks are responding to and managing the financial risks from climate change through their governance and risk management frameworks. It does this through the lens of the PRA's supervisory framework. The chapter discusses the transition in thinking observed within the banking sector in its approach to these issues; and
- Chapter 5 concludes the report and outlines next steps.

3 The PRA also has a secondary objective to facilitate effective competition in relevant markets, in so far as is reasonably possible, when pursuing its primary objectives.

4 PRA (2015).

Methodology

1.6 The PRA commenced this review of the impact of climate change on the UK banking sector in summer 2017. The PRA sent a letter to the CEOs of 39 PRA-regulated UK and international banks requesting the completion of a survey which is attached as Appendix B to the report.

1.7 The survey responses covered around 90% of the UK banking sector, representing over £11 trillion in assets.⁵ The review leverages analysis and insights gained from many meetings with firms and other stakeholders and is informed by the Bank's wider climate-related work.

Box 1: The Bank of England's response to climate change

The Bank's initial work on climate-related issues focused on insurance, as discussed in the PRA's report on the impact of climate change on the insurance sector, published in 2015.⁶ The Bank's activities have since broadened, as summarised in a Quarterly Bulletin article in June 2017.⁷

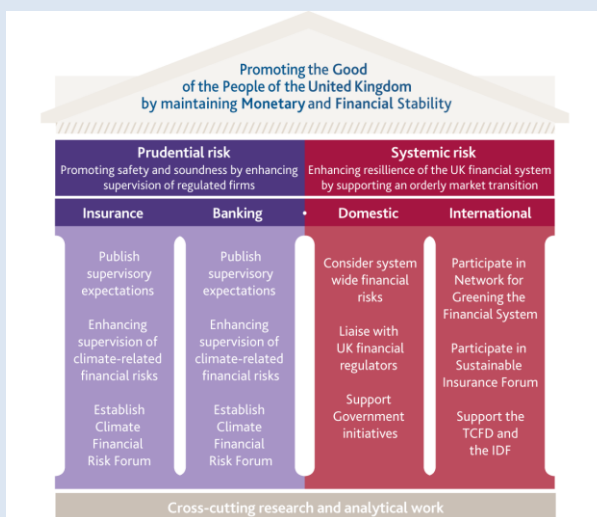
The Bank's response (Figure A) has two core elements motivated by its statutory objectives. The first involves promoting safety and soundness by enhancing the PRA's approach to supervising the financial risks from climate change. This includes setting out its supervisory expectations on these issues for banks and insurers and establishing a Climate Financial Risk Forum, as discussed in this report.

The second involves enhancing the resilience of the UK financial system by supporting an orderly market transition to a low-carbon economy. This includes considering the system-wide financial risks from climate change, liaising with UK financial regulators and supporting Government initiatives, such as participating as an observer in the UK's Green Finance Taskforce and co-chairing, with China, the G20's Sustainable Finance Study Group.

The Bank is also engaging internationally with other central banks and financial regulators. This includes being a founding member of the Sustainable Insurance Forum (SIF) and the Central Banks and Supervisors Network for Greening the Financial System (NGFS), where the Bank chairs one of the Network's three workstreams.⁸ The Bank also supports the Task Force on Climate-Related Financial Disclosures (TCFD) and the Insurance Development Forum (IDF).

Finally, the Bank undertakes cross-cutting research and analytical work to support its work in this area, and engages with a range of other initiatives relevant to its objectives.

Figure A: The Bank's response to climate change



5 Bank analysis on consolidated UK group or branch level balance sheet data as at July 2016.

6 PRA (2015).

7 Bank of England (2017b).

8 See NGFS website available at www.banque-france.fr/en/financial-stability/international-role/network-greening-financial-system. The Bank chairs workstream 2 of the Network, focused on macrofinancial risks from climate and environmental-related factors.

2 Climate-related risk factors

The purpose of this chapter is to provide background and context to the report, including introducing the two primary climate-related risk factors, physical and transition. In doing so, the chapter includes findings from climate science and context on the low-carbon transition.⁹

Findings from the climate science community

2.1 The increase in global GDP and energy use since the 1850s has been accompanied by a rise in average global surface temperature of around 1°C, and increases in global sea level of over 20cm, compared to the pre-industrial era. These trends are shown in Chart 2.1. Atmospheric concentrations of carbon dioxide (CO₂), the largest greenhouse gas by source, are unprecedented in at least the last 800,000 years. Box 2 below sets out the findings from the Intergovernmental Panel on Climate Change (IPCC).

Box 2: Findings from the IPCC

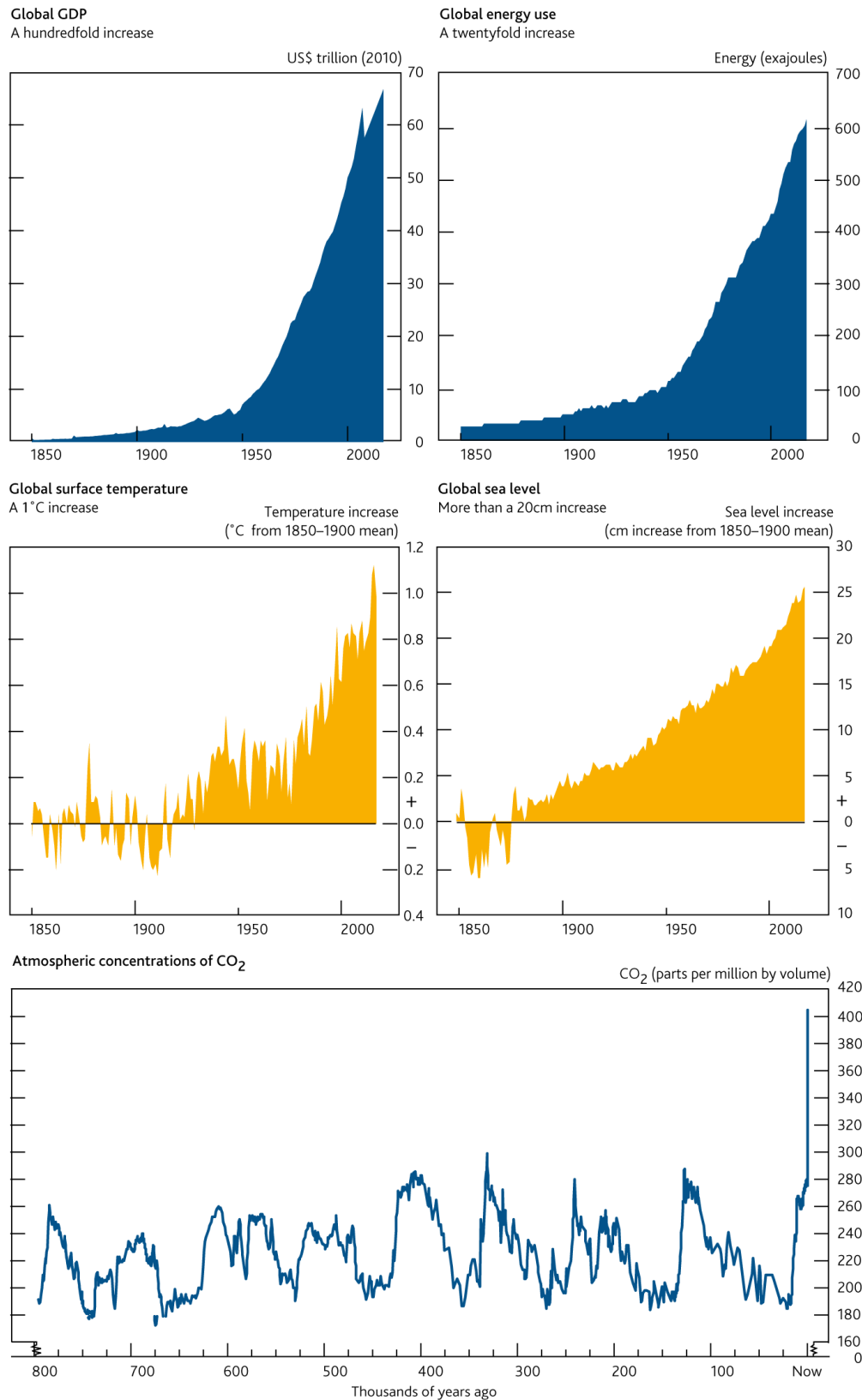
The IPCC's Fifth Assessment Report (AR5) provides a view of the state of scientific knowledge relevant to climate change in 2014.¹⁰ A number of the conclusions from the Synthesis Report of AR5, relevant to the PRA's review are below:

- (i) 'Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, and sea level has risen.'
- (ii) 'Anthropogenic greenhouse gas emissions have increased since the pre-industrial era, driven largely by economic and population growth, and are now higher than ever. This has led to atmospheric concentrations of carbon dioxide, methane and nitrous oxide that are unprecedented in at least the last 800,000 years. Their effects, together with those of other anthropogenic drivers, have been detected throughout the climate system and are extremely likely to have been the dominant cause of the observed warming since the mid-20th century.'
- (iii) 'Continued emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems. Limiting climate change would require substantial and sustained reductions in greenhouse gas emissions.'

9 The PRA has not developed an independent view on the science behind climate change or undertaken a detailed assessment of the low-carbon transition. The report seeks to reflect evidence provided by respected authorities, such as the IPCC and IEA.

10 IPCC (2014). A special IPCC report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways is expected to be published in October 2018.

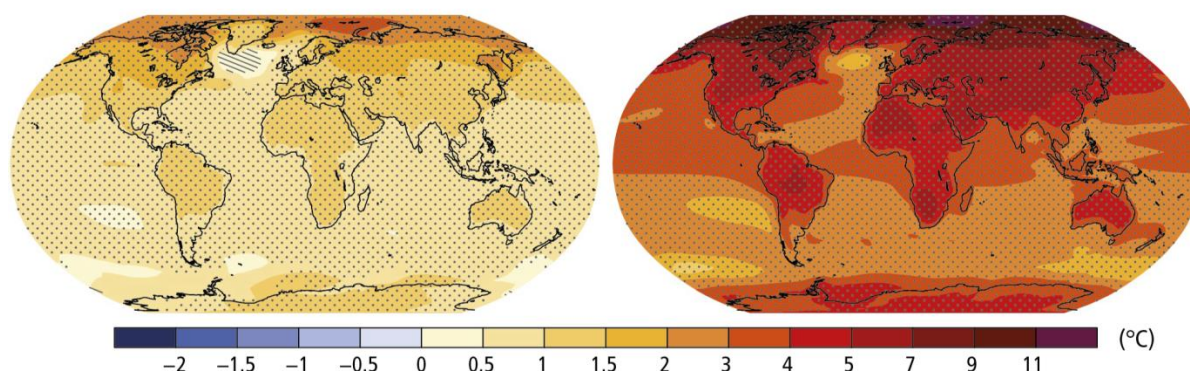
Chart 2.1: Global GDP, energy use, surface temperature and sea level since 1850 and CO₂ concentrations over the last 800,000 years



Source: British Antarctic Survey. Data compiled from a wide range of sources. See HRH The Prince of Wales et al. (2018).

2.2 The images in Chart 2.2 show the predicted change in annual average surface temperature in the period 2081-2100, relative to a near present day period, in a low and high greenhouse gas emission scenario.¹¹ Under the high scenario (shown on the right-hand side), temperatures are predicted to increase by around 10°C or more in certain areas compared to recent decades, with global average temperatures about as likely as not to exceed 4°C relative to pre-industrial times.

Chart 2.2: Change in annual average surface temperature (1986-2005 to 2081-2100)



Source: IPCC (2014).

2.3 To put this in context, global temperature increases currently being experienced are around 1°C above pre-industrial levels (see Chart 2.1). There is also evidence to suggest that warming of 2°C could lead to non-linear, and potentially irreversible, effects on certain aspects of the climate system.¹² During the 10,000 years prior to the industrial era, global temperatures were relatively stable, with an extended period of modest warmth until about 5,000 years ago followed by a gradual, long-term cooling of about 0.7°C.¹³

2.4 The relationship between cumulative greenhouse gas emissions and expected increases in global temperatures gives rise to the notion of global emissions budgets. A carbon budget, for example, is the total quantity of carbon that can be emitted over a specified time, and is typically stated at different probabilities of remaining within a stated increase in temperature, such as 2°C.

2.5 Recent studies give a range of values for the remaining carbon budget but broadly speaking if the current level of global carbon emissions continues, the entire budget for 2°C could expire within about 30 years.¹⁴ This implies there is a need to begin meaningful emissions reductions in the short term, and reach net zero carbon emissions by early in the second half of the century.¹⁵

2.6 In December 2015 in Paris, the international community committed to reduce greenhouse gas emissions and limit the rise in global average temperatures to well below 2°C above pre-industrial levels, and to pursue efforts to limit the temperature increase to 1.5°C. To achieve this, signatories agreed to reach a global peak of greenhouse gas emissions as soon as possible and to undertake rapid reductions thereafter so as to achieve net zero greenhouse gas emissions in the second half of this century. This would require historically unprecedented reductions in emissions.

11 These low and high scenarios are referred to as Representative Concentration Pathways (RCPs) 2.6 and 8.5 in IPCC (2014). They are explained further in the PRA's insurance report; RCP 2.6 is consistent with keeping temperature increases within 2°C, RCP 8.5 is a scenario with increasing greenhouse gas emissions, rising above the present level.

12 Steffen et al. (2018).

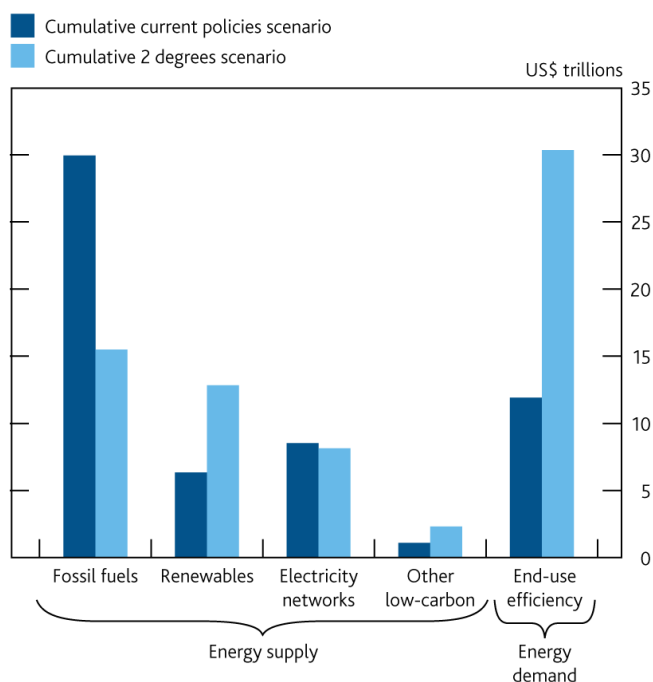
13 Marcott et al. (2013).

14 Probabilities used for calculating carbon budgets (generally 50%, 66% or 80% chance of keeping within a specific temperature goal) differ considerably from risk tolerances applied in the financial sector (for example, assessing capital requirements for insurers at a 1 in 200 level).

15 Matthews et al. (2018).

2.7 Signatories of the Paris agreement also committed to making finance flows consistent with a pathway of low greenhouse gas emissions and climate-resilient development.¹⁶ The financial implications of a low-carbon transition are significant, implying the reallocation of tens of trillions of dollars of investment. Chart 2.3 shows one estimate of the capital reallocation required relating to the energy sector for a transition pathway consistent with keeping the increase in global temperature to well below 2°C.¹⁷

Chart 2.3: Capital re-allocation in the energy sector consistent with a 2°C pathway



Source: International Energy Agency World Energy Outlook (2017) and Bank calculations.

2.8 While continued investment in fossil fuels would still be needed in such a scenario, the amount is substantially less than the fossil fuel demand trajectories implied by policies currently enacted. At the same time, investment in end-use energy efficiency and renewable energy would need to increase substantially.

Physical and transition risk factors

2.9 Climate change, and societal responses to address it, gives rise to two primary climate-related risk factors: physical and transition. Physical risks from climate change arise from a number of factors, and can be related to specific weather events (such as heatwaves, floods, wildfires and storms) and longer term shifts in climate (such as changes in precipitation and extreme weather variability, sea level rise and rising mean temperatures). The final recommendations of the TCFD refer to these categories as ‘acute’ and ‘chronic’ risks.

2.10 The Committee on Climate Change (CCC), an independent statutory body responsible for advising the UK government on climate change, noted climate change has already at least doubled the chance of a severe heatwave in Europe.¹⁸ While the natural variability in the climate makes it difficult to attribute any single extreme weather event to climate change, this is becoming increasingly possible, and work is underway to assess whether recent heatwaves experienced by

¹⁶ Article 2.1(c) of the Paris Agreement. Available at http://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf.

¹⁷ Figures are based on the International Energy Agency’s Sustainable Development Scenario, World Energy Outlook (2017).

¹⁸ Committee on Climate Change (2016).

Europe in the summer of 2018 were made more likely due to elevated levels of greenhouse gases in the atmosphere.¹⁹

2.11 The CCC has also noted that physical risks from flooding and coastal change in the UK are already significant and expected to increase as a result of climate change. Specifically, flood events as occurred in autumn 2000, and extremely wet winters as took place in the winter of 2013/14, have become more likely. There is also evidence that heavy moisture-laden air currents, linked with flooding in England in November 2009 and December 2015, are more likely to form and can hold more moisture with climate change.²⁰

2.12 Storms and floods also lead to physical damage of infrastructure assets, such as those in the telecommunications, transportation, or electricity sectors. For example, economic assets in China's Guangzhou region are highly prone to floods which can place manufacturing, transportation, and supply chains, both in China and internationally, at risk. In particular, floods along the Yangtze River are frequent and threaten energy assets such as petrol stations and petroleum refineries in the area. These are long-lived, high value capital assets that cannot easily be moved in response to the physical risks.²¹

2.13 The impacts from storms and floods can be made worse over time by chronic factors such as gradual sea level rise, particularly as development in coastal areas is still increasing in many locations across the world.²² Since 1900, sea levels have already risen by around 20cm on average and further increases could have far-reaching impacts. Continuing on an emission pathway that would result in a 4°C temperature increase will increase the rate of sea level rise significantly and could result in around 1 metre of rise by 2100. This would increase the frequency and severity of flooding events in coastal cities around the world. In some cities this would require significant investment in sea defences, and would otherwise make others effectively uninhabitable.

2.14 Sustained increases in temperature can also cause other structural shifts in climate which, for example, could lead to water scarcity and declining crop yields causing stress to the agricultural sector. In this and other ways, climate change may be linked to wider macroeconomic impacts such as declining productivity, food insecurity, increased morbidity and even large-scale migration and political instability.²³

2.15 To stabilise at any specific increase in temperature – be it 2°C, 4°C or 6°C – there is a need to reach net zero greenhouse gas emissions.²⁴ The process of adjustment to a low-carbon economy is influenced by a range of factors including:

- **Developments in climate-related policy and regulation:** As discussed in the TCFD's final report, policy actions may seek to either constrain actions which contribute to the adverse effects of climate change or promote adaptation. Examples include the implementation of carbon pricing or the tightening of energy efficiency standards. Regulatory developments could include new disclosure or reporting requirements introduced within the financial sector to address climate-related issues.
- **New technology and disruptive business models:** The emergence of new technologies, for example related to battery storage, renewable energy or carbon capture and storage, could accelerate the low-carbon transition. As technology evolves, and unit costs decrease, new

19 World Weather Attribution (2018).

20 Committee on Climate Change (2016).

21 Deutsche Asset Management, Global Research Institute (2017).

22 Neumann et al. (2015).

23 IPCC (2014).

24 Matthews et al. (2018).

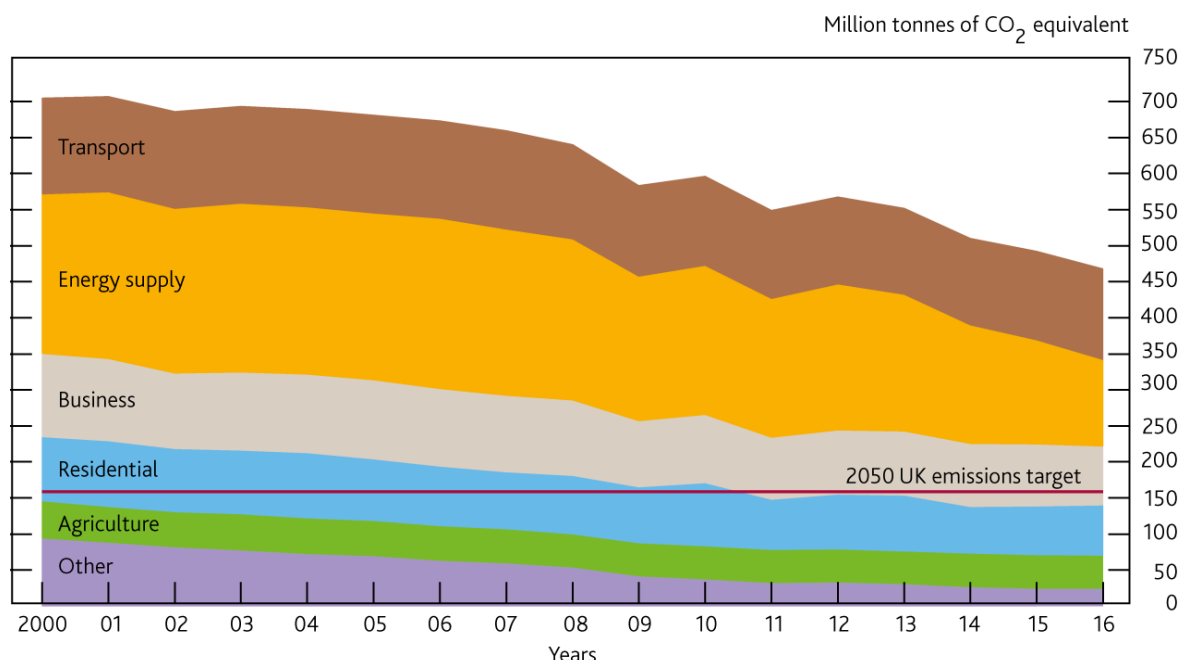
disruptive business models may also emerge. These developments are likely to create ‘winners’ and ‘losers’ as the transition evolves.

- **Shifting sentiment, demand and expectations:** As climate-related risks and opportunities become more evident, there may be shifts in investor sentiment, consumer demand and/or societal expectations.
- **Evolving evidence, frameworks and interpretation:** The continued evolution of scientific evidence, for example relating to the attribution of specific weather events to climate change, or new legal interpretations of existing frameworks, could also lead to financial risks; for example, through increasing climate-related litigation relating to the failure to disclose, adapt to, or mitigate the impacts of climate change.²⁵

2.16 The UK government has committed to reducing emissions by 80% by 2050 compared to 1990 and has set five-yearly carbon budgets which currently run until 2032.²⁶ The European Commission has set out targets for the European Union as a whole, including a binding commitment to reduce emissions by at least 40% by 2030.

2.17 Chart 2.4 shows UK greenhouse gas emissions by source category between 1990 and 2016. Today, the transportation sector accounts for the largest single source of greenhouse gas emissions, primarily from vehicles with internal combustion engines. This is closely followed by emissions from the supply of energy. This gives an indication of the economic sectors which could be most disrupted from the transition to a low-carbon economy. Transformative changes will also be needed in business, residential homes and agriculture to reduce the use of fossil fuels and increase energy efficiency.

Chart 2.4: UK greenhouse gas emissions by source category



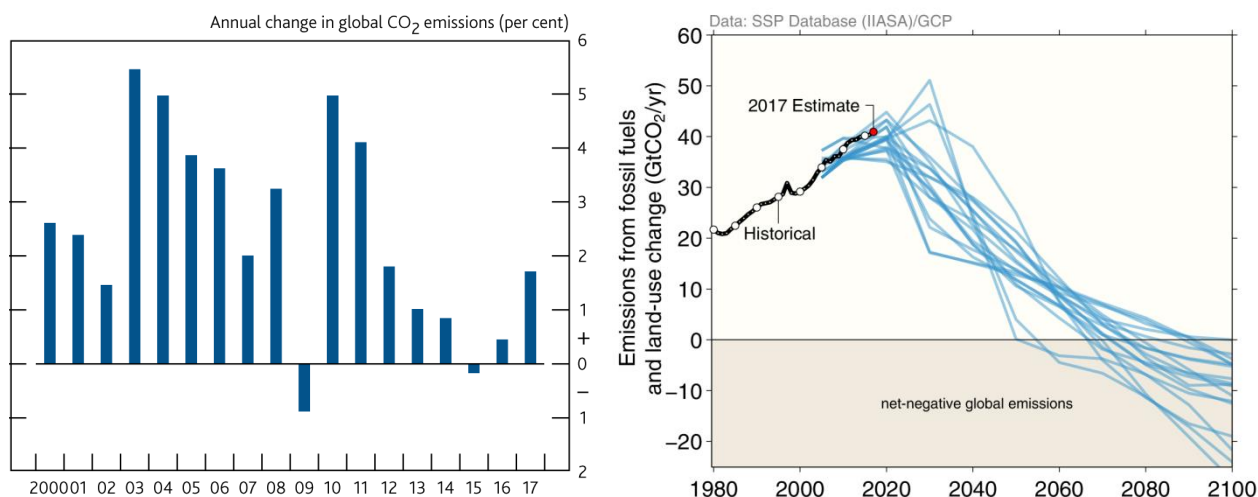
Source: UK Government Final UK greenhouse gas emissions national statistics: 1990-2016 and Bank analysis.

25 The PRA's insurance report highlighted liability risks resulting from climate-related litigation given its particular relevance to the insurance sector.

26 Proposals for how this will be achieved were set out in the Clean Growth Strategy. See UK Government Department for Business, Energy and Industrial Strategy (2018).

2.18 Transformative changes would also be needed on a global level. As shown on the left-hand side of Chart 2.5 global carbon emissions have generally continued to increase since the year 2000. The right-hand side shows possible carbon emission pathways consistent with limiting the increase in global average temperature to 2°C. As can be seen, pathways with continued increases in emissions will require more significant reductions in emissions in later years. This can have important implications for the financial risks to the UK banking sector, explored further in chapter 3.

Chart 2.5: Change in global carbon emissions and possible 2°C carbon emission pathways



Source: Global carbon project (2017) and Bank analysis (left-hand side). Global carbon project (2017) (right-hand side). See Riahi et al. (2016) for an overview of SSP scenarios and explanation of emissions pathways.

3 Financial risks from climate change facing the UK banking sector

The purpose of this chapter is to examine the financial risks from climate change that impact the UK banking sector. It provides an overview of how physical and transition risk factors can manifest as increased credit, market and operational risks to banks and discusses how these risks are becoming apparent today, focusing on four specific case studies. It concludes by discussing how the financial risks have distinctive elements and how they may evolve.






How climate-related risk factors impact the UK banking sector

3.1 If losses related to physical risk factors are insured they can directly affect insurance firms through higher claims. Since the 1980s, the number of registered weather-related loss events has tripled. Inflation-adjusted insurance losses have increased from an annual average of around \$10 billion in the 1980s, to around \$55 billion over the past decade.²⁷ If losses are uninsured the burden can fall on households and companies, impairing asset values and reducing the value of investments held by financial institutions, including banks.

3.2 In terms of transition risk factors, changes in policy, technology and sentiment could prompt a reassessment of the value of a large range of assets and create credit exposures for banks and other lenders as costs and opportunities become apparent. As part of a highly globalised financial centre, UK financial institutions are exposed to a wide range of sectors across the world, many of which will be affected by climate change and the financial transformation related to the transition.

3.3 While the PRA's insurance report primarily focused on insurers' liabilities, discussions with banks have largely focused on the potential for these climate-related risk factors to impair the value of bank assets: 90% identified examples relating to credit risk, 70% to operational risk and 20% to market risk. Figure 3.1 provides examples of how climate-related risk factors could manifest as credit, market and operational risks.

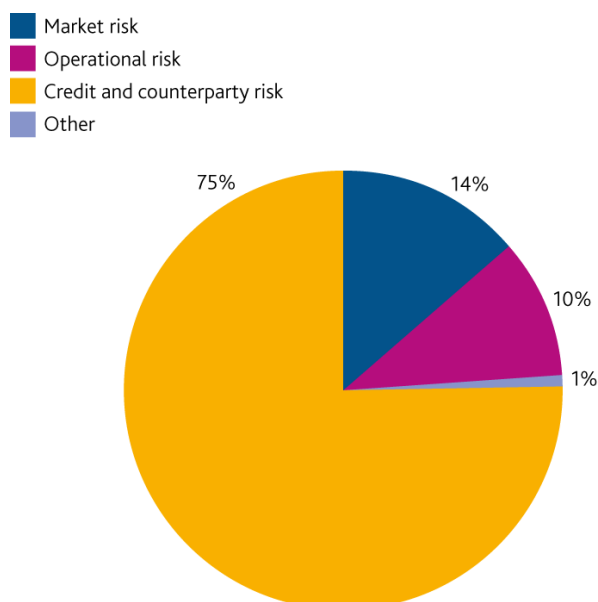
Figure 3.1: Examples of climate-related financial risks to bank's assets

	 Credit	 Market	 Operational
 Physical	Increasing flood risk to mortgage portfolios Declining agricultural output increases default rates	Severe weather events lead to re-pricing of sovereign debt	Severe weather events impact business continuity
 Transition	Tightening energy efficiency standards impact property exposures Stranded assets impair loan portfolios Disruptive technology leads to auto finance losses	Tightening climate-related policy leads to re-pricing of securities and derivatives	Changing sentiment on climate issues leads to reputational risks

²⁷ Munich Re NatCatSERVICE statistics as at end 2017.

3.4 Increasing credit risks from climate-related factors being the primary concern is broadly consistent with the profile of solvency risks to the banking sector more generally. As shown in Chart 3.1, around three quarters of aggregate risk weighted assets in the UK banking sector relate to credit and counterparty risk.

Chart 3.1: Risk weighted assets of the UK banking sector by exposure



Source: Banking sector regulatory capital, Bank of England Q1 2018.

3.5 A high-level overview of the credit, market and operational risks from climate-related risk factors is provided below.

Credit risk

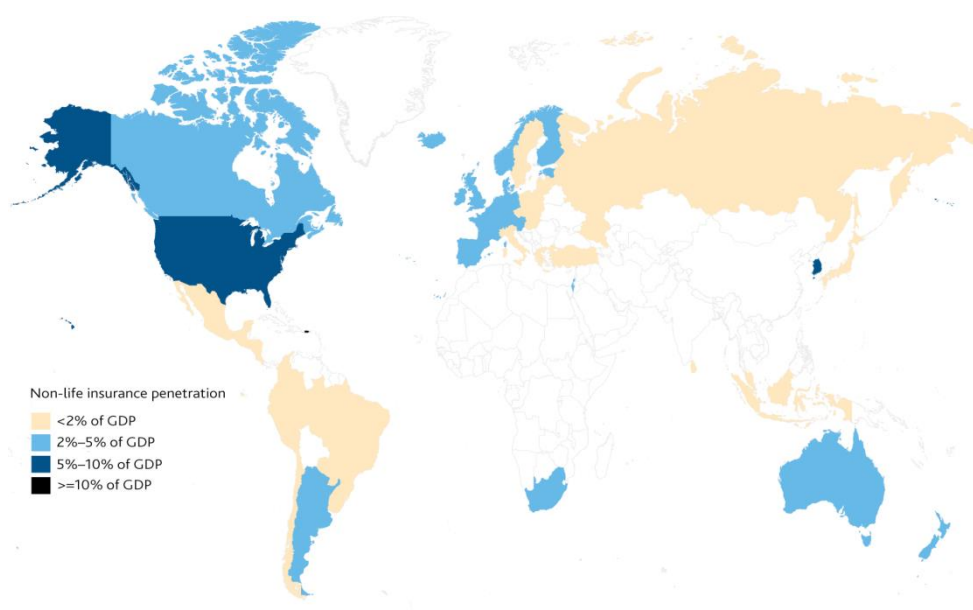
3.6 Banks face credit risk because they have exposures to households, companies and financial counterparties that may default on their obligations. Although the underlying channel is the same for climate-related credit exposures, a distinguishing feature is ‘wrong way risk’ for collateralised exposures: the loss event impairs both the credit of the borrower, increasing the probability of default, as well as the value of the collateral underpinning the loan. Managing such ‘wrong way risk’ exposures is inherently difficult and requires a more sophisticated approach.

Physical risk factors

3.7 The credit risks from non-insured losses could be relevant to a wide range of UK banks, and particularly those with international exposures. Non-life insurance penetration is less than 10% of GDP even in developed markets, and much less in many regions which may be most exposed to climate change (Chart 3.2). Insurance contracts, primarily written on a one year basis, are frequently re-priced and there are already examples of private insurance cover being withdrawn, negatively impacting property values.²⁸ Representatives from the insurance sector have warned that a +4°C world would not be insurable.²⁹

²⁸ PRA (2015).

²⁹ de Castries (2015).

Chart 3.2: Non-life insurance penetration

Source: OECD (2016).

3.8 Many of the retail banks surveyed identified the increasing incidence of flood risk as one of the most significant climate-related financial risks. Flood events can cause significant losses for home owners, reducing their ability to repay loans, at the same time as damaging the value of the property. For a bank this increases the credit risk on loan books through a greater probability of default and loss given default. A more detailed case study on the impact of flood risk on residential mortgages in the UK is discussed in Box 6.

3.9 In addition to acute weather events, structural changes in the climate could also cause losses and business disruption for companies. For example, if a client's agricultural business is impacted by shifting seasons and lower agricultural yields, the business could face a drop in revenue, rising insurance costs or disruption to its supply chain. This increases the credit risk of the company to its commercial lenders.

Transition risk factors

3.10 Commercial banks and investment banks identified potential credit exposures to companies with business models that are not aligned with a 2°C scenario. These clients face a higher risk of reduced corporate earnings and business disruption from a low-carbon transition. This may leave the client unable to repay loans or meet their obligations on other financial transactions at the same time as reducing the value of the company as a going concern. Although a bank will often have a secured claim on the collateral of the company, only a limited portion of losses may be recoverable through corporate insolvency procedures.

3.11 Survey respondents identified companies in the energy, transport, and agriculture sectors to be most at risk, particularly if the transition to a low-carbon economy occurred late and was not orderly. A number of banks specifically identified the potential for significant disruption in the automotive sector, as well as the potential financial risks related to the coal industry. These risks are explored in more detail in Box 4 and Box 5.

3.12 While many banks identified the potential impacts from physical risk factors on property and real estate, few identified the potential impacts from the transition. Buildings, which make up 19% of UK greenhouse gas emissions, use a significant amount of energy for power, heating and

cooling.³⁰ The UK Government has announced a range of initiatives focussed on improving the energy efficiency of buildings. Box 3 explores how tightening standards on the energy efficiency of residential properties could increase credit risks for banks.

Market risk

3.13 Market risk is the risk of losses arising from adverse movements in market prices. This is relevant for many different aspects of a bank's activities, depending on its business model. Banks will be subject to market risk on securities in their own treasury holdings, and they often also play a critical role in assisting customers to manage market risk in their capacity as an executing broker, asset manager or investment advisor. Approximately 20% of survey respondents identified market risk related to climate change as an important issue to consider.

Physical risk factors

3.14 The increasing frequency of severe weather events can impact macroeconomic conditions such as economic growth, employment and inflation, for example through sustained damage to national infrastructure. Some banks noted that increased sovereign risk could result in a downgrade to a national or local government's credit rating, thereby impacting the value of securities held on banks' balance sheets.

3.15 There is increasing focus from credit rating agencies (CRAs) on developing methodologies to assess the physical impacts from climate change on sovereign issuers. Moody's, for example, looks at sovereign susceptibility as a function of a country's exposure, focusing on economic diversification and geographic location, and resilience, focussing on development level, fiscal flexibility and government policies.³¹

Transition risk factors

3.16 A number of banks identified that the transition to a low-carbon economy will be relevant for a wide variety of asset classes. For example, at a macroeconomic level, the impact of the adjustment on macroeconomic factors such as growth, productivity and investment could have implications for sovereign risk. The impact of the transition on carbon-intensive sectors could also have implications for a broad range of prices related to energy and commodities, such as corporate bonds, equities and certain derivatives contracts. For example, following changes to the EU emissions trading scheme in 2018, prices of European CO₂ Emission Allowances have risen to a high of €25 a tonne, an increase of over 300% in the past 12 months.³²

3.17 Some banks highlighted the breadth and magnitude of the potential transition risk factors and the risk of a more abrupt and widespread correction in financial markets as the financial risks from climate change are re-evaluated. Such a wholesale reassessment of prospects could destabilise markets, spark a pro-cyclical crystallisation of losses and lead to a persistent tightening of financial conditions: a climate Minsky moment.³³ In such a scenario it could be difficult for banks to manage their exposures to carbon-intensive investments simultaneously, increasing losses and potentially also causing liquidity issues.

Operational risk

3.18 Operational risk is the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events. 60% of survey respondents identified climate change as a factor which could increase their operational risk profile, especially if key aspects of a firm's operations, or wider supply chain, are located in areas particularly vulnerable to a changing climate.

30 UK Government Final UK greenhouse gas emissions national statistics: 1990-2016.

31 Moody's Investors Service (2016).

32 Thomson Reuters EIKON data and Bank analysis.

33 Carney (2016).

Physical risk factors

3.19 Firms indicated that extreme weather events could potentially impact business continuity, including branch networks, offices, infrastructure, processes and staff. Further disruption could be caused by greater price volatility of inputs such as energy, water and insurance. These operational risks are not limited to the impact on operations in the UK. A number of the large banks have a global geographic footprint that includes satellite offices and intra-group service providers in other regions of the world. The physical risk profile in these regions may be different to the UK in terms of susceptibility to different types of severe weather events and the ability of governments to respond.

Transition risk factors

3.20 Survey respondents noted shifting sentiment among customers, and increasing attention and scrutiny from other stakeholders on the banking sector's response to climate change. For example, some banks referred to the reputational risks that could be associated with dealing with companies which continue to generate high carbon emissions. Others noted increasing pressure to divert capital flows towards sectors that contribute to the transition to a low-carbon economy.

How the financial risks are becoming apparent today

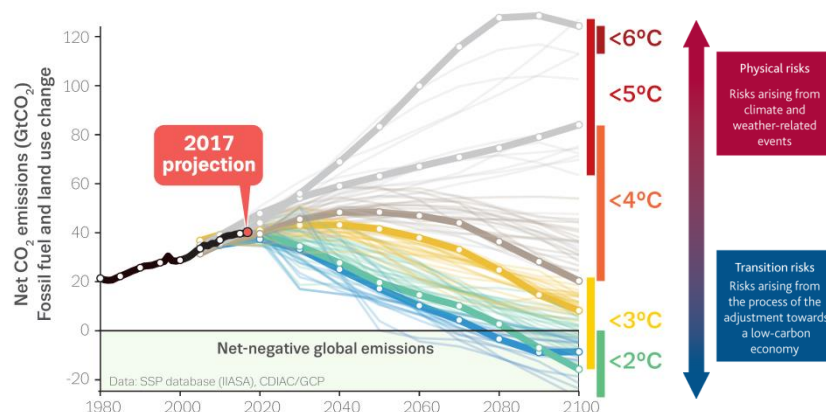
3.21 The end of this chapter presents four case studies with more specific and detailed analysis. These case studies illustrate the relevance of climate-related risk factors to banks today. They all relate to increasing credit risks to the UK banking sector, the first three relating to the transition to a low-carbon economy and the fourth to increasing physical risk.

- Box 3: Case Study 1 – Tightening energy efficiency standards and the UK buy-to-let market.
- Box 4: Case Study 2 – The low-carbon transition and the automotive industry.
- Box 5: Case Study 3 – The energy transition and the coal industry.
- Box 6: Case Study 4 – The impact of flood risk on residential mortgage portfolios.

How the financial risks have distinctive elements

3.22 Continued greenhouse gas emissions are expected to lead to rising temperatures, increasing the financial risks from the physical impacts of climate change. As illustrated in Chart 3.3 below, limiting these impacts would require substantial reductions in carbon emissions, increasing the financial risks associated with the transition. The later these reductions begin, the more accelerated they will need to be for global temperatures to remain within the well below 2°C Paris goal.

Chart 3.3: Possible carbon emissions pathways and climate-related risk factors



Source: Global Carbon Project (2017) with Bank of England graphic.

3.23 This dynamic, and other aspects of the physical and transition risk factors, give rise to the financial risks from climate change having a number of distinctive elements which, when considered together, present unique challenges. These are explained in Table 3.A below.

Table 3.A: Distinctive elements

Element	Description
Far-reaching in breadth and magnitude	The financial risks from physical and transition risk factors are relevant to multiple lines of business, sectors and geographies. Their full impact on the financial system may therefore be larger than for other types of risks, and is potentially non-linear, correlated and irreversible.
Uncertain and extended time horizons	The time horizons over which financial risks may be realised are uncertain, and their full impact may crystallise outside of many current business planning horizons (tragedy of the horizon). Using past data may not be a good predictor of future risks.
Foreseeable nature	While the exact outcome is uncertain, there is a high degree of certainty that financial risks from some combination of physical and transition factors will occur.
Dependency on short-term actions	The magnitude of future impact will, at least in part, be determined by the actions taken today. This includes actions by governments, financial market participants and a range of other actors.

3.24 The magnitude of future financial risks from physical and transition risk factors will depend on future climate-related scenarios that will, at least in part, be determined by actions taken today. Future states of the world include scenarios where global temperature increases remain within the Paris goal of well below 2°C and those that exceed this target. They also include scenarios where a transition to a low-carbon economy is orderly or disorderly.

3.25 For instance, a ‘too little, too late’ scenario (where action is taken, but insufficient and too late to achieve Paris climate goals) could result in the most severe financial risks crystallising in the UK banking sector. Physical risks from increases in global temperatures well in excess of 2°C could not only lead to more extensive physical damage to collateral and other financial assets held by banks, but also to insurance being significantly re-priced, or withdrawn, therefore increasing banking sector exposures. Late, abrupt and significant policy action aimed at reducing greenhouse gas emissions would also significantly increase credit and market risks, particularly in carbon-intensive sectors.

3.26 Financial risks will be minimised in an orderly market transition to a low-carbon economy. While the level of physical risk exposure will continue to increase as global temperatures rise, the risk of non-linear and irreversible physical changes will be reduced if the Paris goals are achieved. The pace of decarbonisation will still be significant, relative to past trends, but less severe than a late and sudden transition, reducing the size of potential credit and market risk exposures in high-carbon sectors. An orderly approach will also reduce the risk that any potential shortfall in investment in energy infrastructure constrains the global economy.

Liability risks

3.27 Although not discussed in depth in this chapter or in survey responses, the distinctive elements outlined above also give rise to a particular area of risk, liability risks. These risks can arise if parties who have suffered losses from physical and transition risk factors seek to recover these losses from those they view as responsible. Specific mechanisms include a failure to disclose financial risks, a failure to adapt to their foreseeable nature, and a failure to take the short-term action required to mitigate future financial risks.

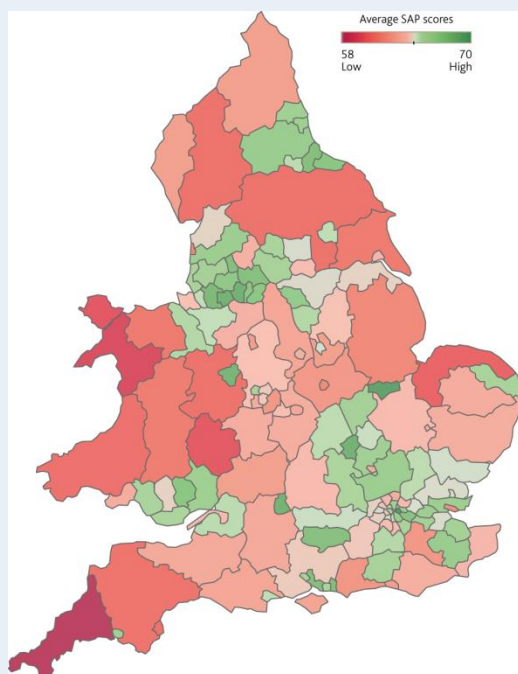
Box 3: Case Study 1 – Tightening energy efficiency standards and the UK buy-to-let market

Context

Residential housing accounts for around 14% of total UK Greenhouse Gas (GHG) emissions.³⁴ To address this, the UK Government has released a plan to accelerate the rate of improvements to housing energy efficiency. One important pillar of this plan is the Minimum Energy Efficient Standard (MEES) for both domestic and commercial buildings. Currently, buildings have an Energy Performance Certificate (EPC) rating from A to G, based on a Standard Assessment Procedure (SAP) score of 0-100; ratings F and G are the least efficient.³⁵ Chart A below shows the average SAP score for rental property in each local authority, highlighting regions better and worse than the average SAP score of 64.

The MEES for rented property is now an E rating in England and Wales. Since 1 April 2018 properties rated F and G may not be rented as new leases or renewals, and this will be extended to existing leases from 1 April 2023, with significant penalties for non-compliance.

Chart A: Average SAP scores of rental housing in Local Authorities in England & Wales



Source: EPC data (September 2016), covering 4.6 million properties intended for renting.

Financial risks to banks

This energy efficiency policy could create transition risks for UK banks. If landlords of these properties make the improvements to energy efficiency, the tenants will save on energy bills and be more able to pay their rent, with the landlord then posing a lower credit risk to the bank. However, if they do not make the necessary adjustments before the end of a current contract, or before 2023, this may impact banks in two ways:

- landlords' credit positions may deteriorate due to lost rental income from no longer being able to let out their property, resulting in an increased probability of default; and/or

³⁴ UK Government Final UK greenhouse gas emissions national statistics: 1990-2016.

³⁵ Using the government's Standard Assessment Procedure (SAP) a property is given a numerical score from 1-100 SAP points. These scores are divided into bands as follows: EPC rating A = 92-100 SAP points (most efficient), EPC rating B = 81-91 SAP points, EPC rating C = 69-80 SAP points, EPC rating D = 55-68 SAP points, EPC rating E = 39-54 SAP points, EPC rating F = 21-38 SAP points, and EPC rating G = 1-20 SAP points (least efficient).

- the market value of F and G rated buildings may drop due to landlords being unable to let them out and buyers being unable to obtain a Buy-to-Let (BTL) mortgage, impacting the loan to value (LTV) of the assets on banks' balance sheets.

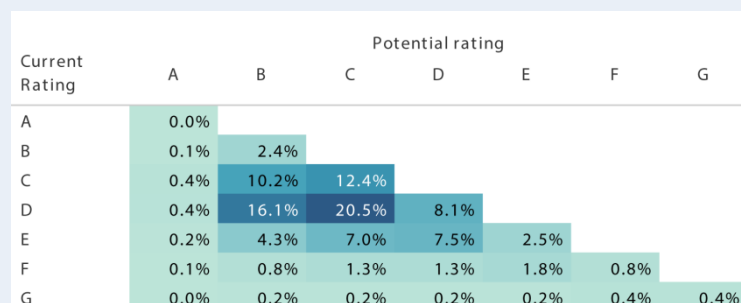
Bank of England analysis of data on residential mortgages suggests that the energy efficiency of a property is a predictor of credit risk. Mortgages on energy-efficient properties (with EPC ratings of A, B or C) are 18.4% less likely to be in arrears than mortgages on energy-inefficient properties (with EPC ratings E, F or G). This difference is statistically significant at the one percent level. It remains similar when controlling for differences in household income and other property and household characteristics.

At this stage, only a limited number of rental properties are affected (around 5%, Chart B.2), so the adjustment cost to homeowners, and the financial risks to bank mortgage portfolios are likely to be relatively low, subject to potential concentration risk for individual lenders. However, the risk may be more pronounced for non-domestic properties, 16% of which have an EPC rating of F or G.³⁶ If not managed, the financial risks could become more significant as energy efficiency regulation tightens. The UK's Clean Growth Strategy included a commitment to consult on extending regulations on privately rented homes with the aim of upgrading as many homes as possible to a C rating by 2030, and for as many homes as possible across all tenure types to reach a C rating by 2035.³⁷

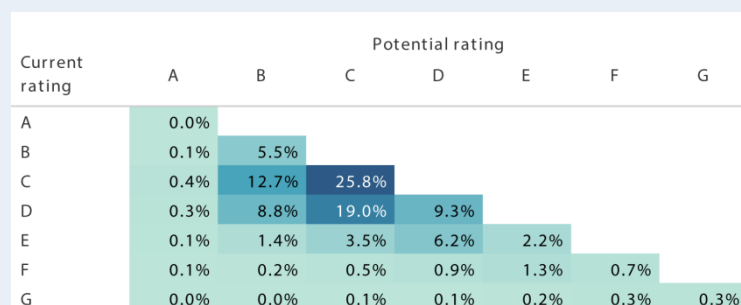
It is also conceivable that energy efficiency standards could be extended to owner occupiers. The Scottish Government has already signalled that it will consider introducing a minimum C standard for owner occupiers and homeowners in the 2030s.³⁸ Currently, around 72% of the UK's homes have an EPC rating below C.

Chart B: Percentages of residential and rental properties by current and potential EPC Ratings

(1) Residential Properties



(2) Rental Properties



Source: Open Data website.³⁹

³⁶ UK Government Live tables on Energy Performance of Buildings Certificates, Table A: non-domestic EPCs and Bank analysis.

³⁷ UK Government Department for Business, Energy and Industrial Strategy (2018).

³⁸ Scottish Government (2018).

³⁹ UK Government Open data: Energy Efficiency and Performance and Bank analysis.

Banks' responses

Survey responses revealed very low awareness of the new MEES regulation and little investment in analysing the energy performance of the properties banks hold as loan collateral. Banks are now able to access good energy performance data on the properties that they are lending against and may benefit from increasing their understanding of this transition risk within their mortgage books. Chart B.1 shows that 50% of residential properties have the potential to be improved to a B or C rating from a D, E or F rating, presenting a real opportunity to offer green loan facilities for customers to make energy efficiency home improvements.

The PRA observed the following examples of good risk management in survey responses:

- undertaking analysis to understand how the MEES regulation will impact the revenue streams of its BTL mortgage and commercial customers;
- as part of a mitigation strategy, only arranging commercial lending on F and G rated properties if there is an acceptable remediation plan to bring the EPC rating up to the required standard; and
- putting in place a panel of third party EPC assessors who can offer support to customers.

Box 4: Case study 2 – The low-carbon transition and the automotive industry*Context*

Transport accounts for 26% of greenhouse gas emissions in the UK, the largest single source of emissions.⁴⁰ In 2011, the UK Government was the first in the world to announce its intention that conventional car and van sales would end by 2040, and for almost every car and van on the road to be a zero emission vehicle by 2050.⁴¹ A number of other countries have made similar policy announcements.

Of the 32.2 million licensed cars in the UK at the end of 2017, only 1.5% were alternative fuel vehicles (AFVs, ie electric, hybrid, gas or fuel-cell) and AFVs were only 4.7% of new car registrations during the year.⁴² As the average age of a car at scrappage is almost 14 years and the average age of cars on the road is almost eight years,⁴³ over the next twenty years there will be a significant transition in the car market from internal combustion engine (ICE) cars to AFVs. Although many car manufacturers have responded to the regulation by announcing targets for the production of EVs, sales forecasts remain highly variable,⁴⁴ making the pace of the transition uncertain.

Financial risks to banks

Banks are exposed to the automotive industry through their lending to manufacturers, firms in the supply chain, dealerships and directly to consumers. Banks are also exposed through their holdings of automotive asset-backed securities. The PRA has previously estimated major UK banks' total exposures to UK car finance to be in the region of £20 billion.⁴⁵ One source of risk is from the uncertainty over the residual value of ICE cars purchased on finance agreements.⁴⁶

The pace of transition will be important in determining whether it is orderly or not. There is significant uncertainty, which poses risks to the sustainability of business models of manufacturers and businesses in the supply chain, up-and-down stream. As electric vehicle technology improves, the associated infrastructure scales up, and policies are implemented, there may be a tipping point where this transition happens much more rapidly. Chart A shows the increase in stock of electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV) over the past five years across the world.

Banks' responses

Several survey respondents identified the automotive and transport industries as one of the sectors most impacted by transition risks due to policy changes aiming to reduce the sector's contribution to global emissions. Respondents expect the transition to have a significant impact within the next five years. Many banks demonstrated awareness of national policies to move from ICE cars to AFVs over the next 10-20 years, and noted the impact on the production chain, the fact that there will be new actors, and that revenues and margins in the value chain will adjust.

Other policies, such as tightening engine emissions policy and traffic restrictions in urban areas were noted as impacting the pace of transition. Other risks highlighted included the second order effect of a reduction in demand for petrol and diesel on the oil sector and the disproportionate impact on countries with concentrated exposures.

40 UK Government Final UK greenhouse gas emissions national statistics: 1990-2016.

41 UK Government Department for Environment Food and Rural Affairs & Department for Transport (2017).

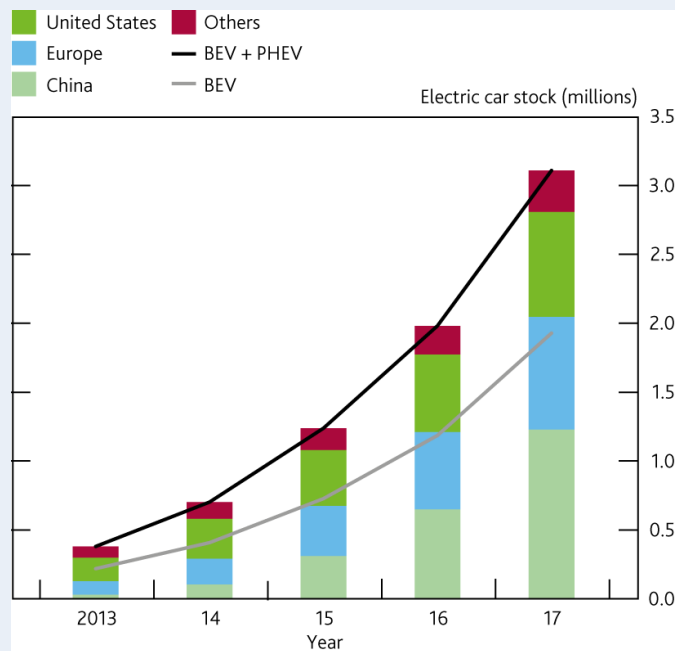
42 UK Government Statistical Data Set Cars: VEH02 and Bank analysis.

43 The Society of Motor Manufacturers and Traders (2017).

44 Business Green (13 July 2017); Reuters Business News (10 July 2017); Bloomberg Business Week (6 July 2017); Carbon Tracker and the Grantham Institute at Imperial College London (1 February 2017).

45 Bank of England (2017a) N.B. This statistic does not include lending by motor finance subsidiaries of banks.

46 For example residual value risk from Personal Contract Purchase agreements, whereby the lender is exposed to loss if the vehicle is not worth the Guaranteed Minimum Future Value (GMFV) when the contract comes to an end, should the customer chose to return the vehicle to the lender, rather than purchase it for the pre-agreed bullet payment.

Chart A: Global stock of electric vehicles

Source: IEA Global EV Outlook (2018).

The PRA observed the following examples of good risk management in survey responses:

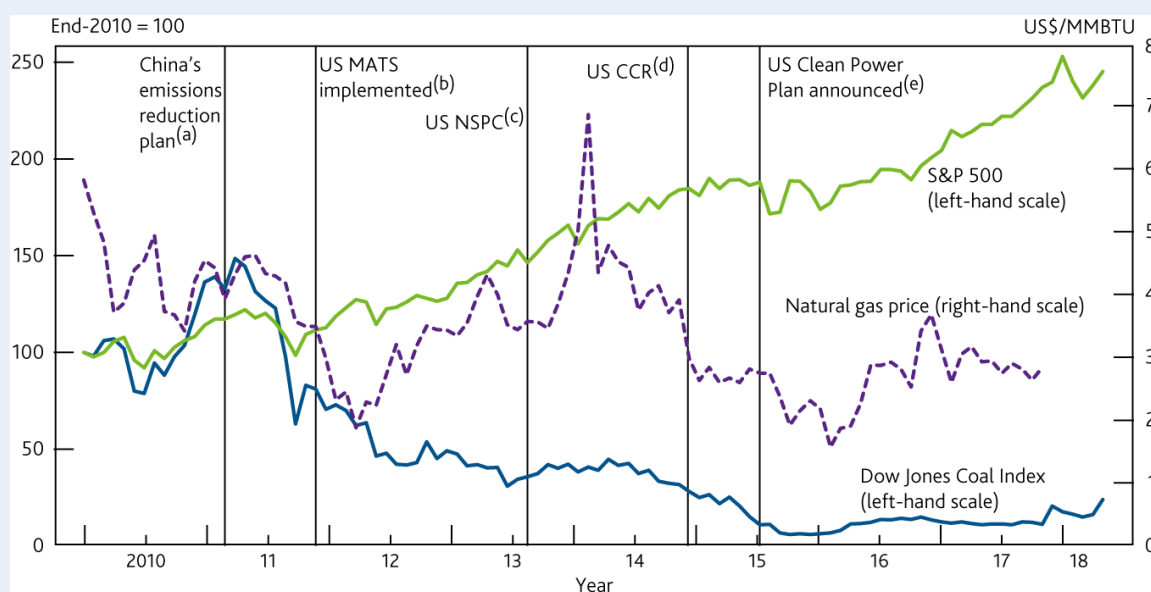
- setting clear risk appetite statements, credit policies, exposure limits and targets for financing defined geographical areas, sectors, vehicle types and counterparties;
- analysis of changing consumption patterns and cost structures in the wider automotive industry;
- reviewing residual value risk exposure from personal contract purchases (PCPs);
- recognising the risk of failing to realise the opportunities from becoming a financial services provider to new market entrants; and
- recognising potential refinancing risks associated with the low carbon transition when analysing commercial customers' ability to repay loans.

Box 5: Case study 3 – The energy transition and the coal industry

Context

Limiting the rise in average global temperatures to below 2°C is expected to require significant reductions in fossil fuel use: over 80% of existing coal reserves may not be usable.⁴⁷ Coal accounts for approximately 28% of the global primary energy mix.⁴⁸ In the EU, 54% of coal power plants are currently loss-making and in certain scenarios this is projected to rise to 97% by 2030.⁴⁹ Since 2011, three of the top five US coal firms have filed for bankruptcy and the Dow Jones US Coal Index has fallen by over 85%.⁵⁰ Chart A shows these changes in relation to various events since 2010.

Chart A: US Coal sector valuation related to regulatory announcements and demand factors



Source: Thomson Reuters DataStream and Bank analysis. (a) Chinese government announced emissions reductions targets in March 2011, which may have contributed to slowing of coal consumption, including a marked slowdown in coal imports from the US. (b) Mercury and Air Toxic Standards required installation control technology which a large share of coal plants did not have. (c) New Source Performance Standards raised efficiency requirements for new coal units. (d) The Coal Combustion Residuals Rule introduced a set of requirements for the safe disposal of coal ash from coal-fired power plants. (e) Proposals to reduce CO₂ emissions by about 30% by 2030.

Financial risks to banks

Banks may be exposed to losses if their risk models do not accurately predict their credit exposure to their customers. The coal industry has a significant credit footprint, with the top 35 global coal-exposed banks providing \$75 billion to the coal power industry and £58 billion to the coal mining industry during 2014-2016.⁵¹

Banks' responses

Nearly three quarters of commercial banks and designated investment firms responding to the PRA's survey stated that they explicitly consider the financial risks facing the coal industry from the low-carbon transition. Most are actively reducing their exposures particularly to greenfield coal mines, thermal coal mining activities and new coal-fired power plants. The most advanced banks with large corporate portfolios are developing frameworks to monitor climate-related credit risk across specific sectors (including coal) and geographies.

47 McGlade and Ekin (2015).

48 BP (2018).

49 Carbon Tracker (2017a). This projection is based on modelling which utilises the International Energy Agency (IEA) B2DS scenario.

50 Dow Jones United States Coal Index, 19 September 2018, and Reuters (2016).

51 Rainforest Action Network (2017).

Many respondents also suggested the short tenure of loans to vulnerable industries indicated that these could be exited relatively quickly if the counterparty's credit risk increases. However, if multiple banks look to exit loans simultaneously this could create feedback effects exacerbating the risks of stranded capital and leading to a disorderly adjustment to carbon-intensive energy supply.

The PRA observed the following examples of good risk management in survey responses:

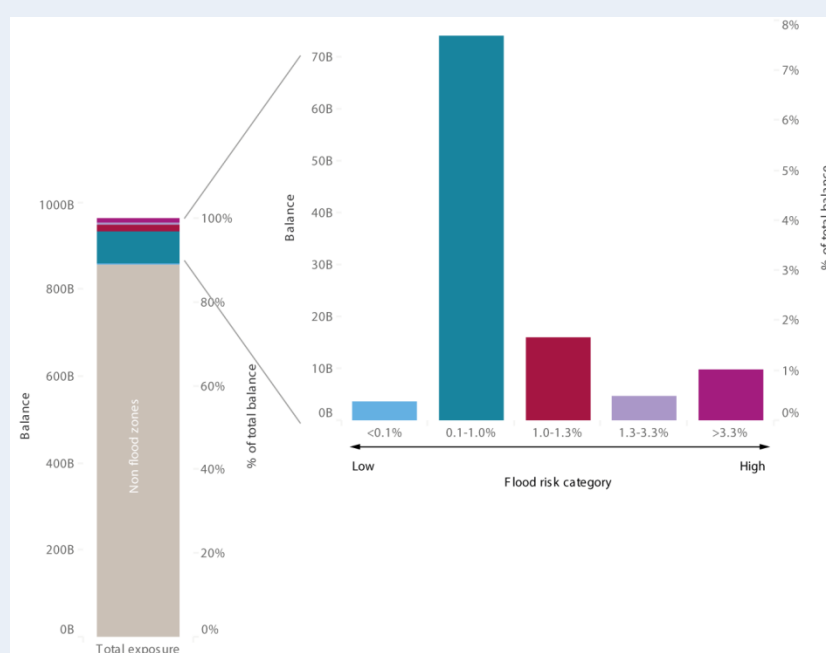
- engaging with customers to understand their exposure to climate-related risks;
- supporting increased, standardised disclosure of climate-related financial risks as set out by the TCFD;
- developing frameworks to monitor specific climate change impacts on the credit risk of banks' portfolios; and
- considering refinancing risks associated with the low carbon transition when analysing borrower's ability to repay loans.

Box 6: Case study 4 – Impact of flood risk on residential mortgage portfolios*Context*

The impacts of flooding and coastal change in the UK are already significant and expected to increase as a result of climate change.⁵² The UK Met Office estimates that under a medium emissions scenario the frequency of heavy rain days (days with over 25 mm rainfall) will increase over most of lowland UK by a factor of 2-3.5 in winter and 1-2 in summer by the 2080s compared to 1990 levels.⁵³ Coastal properties will also be impacted by sea level rise and the subsequent increase in storm surge risk. Under a 2°C scenario, sea level in England and Wales is projected to rise a further 21-28cm by 2080.⁵⁴

In the UK, flood insurance is normally part of an annual home insurance policy, which is a requirement at the point of mortgage origination. However, during the lifetime of a mortgage, homeowners might fail to renew their policy, leaving them, and eventually the bank, exposed to the financial risk of flooding.

The PRA used UK Environment Agency (EA) data on flood risk alongside the Product Sales Database (PSD)⁵⁵ and found that 8.8% of current mortgage exposure in England is located in a flood risk zone (Chart A). Most of these properties fall within the low risk category (probability of flooding of 0.1-1% in any one year). However both the proportion of mortgages located in a flood risk zone and risk category would be expected to increase on the basis of the estimates discussed above.

Chart A: Mortgage exposure to flood risks

Source: Bank of England analysis using EA data (March 2017) and PSD data (end-2016).

Financial risks to banks

Chart B shows that, generally, postcodes in high flood risk areas have a low outstanding mortgage balance, with the greatest outstanding mortgage balances to higher flood risk areas being in the South East. The chart shows that the distribution for London is very different to the rest of the country. This may be due to inadequacies in data; apartment property is classed as having no flood

52 Committee on Climate Change (2016).

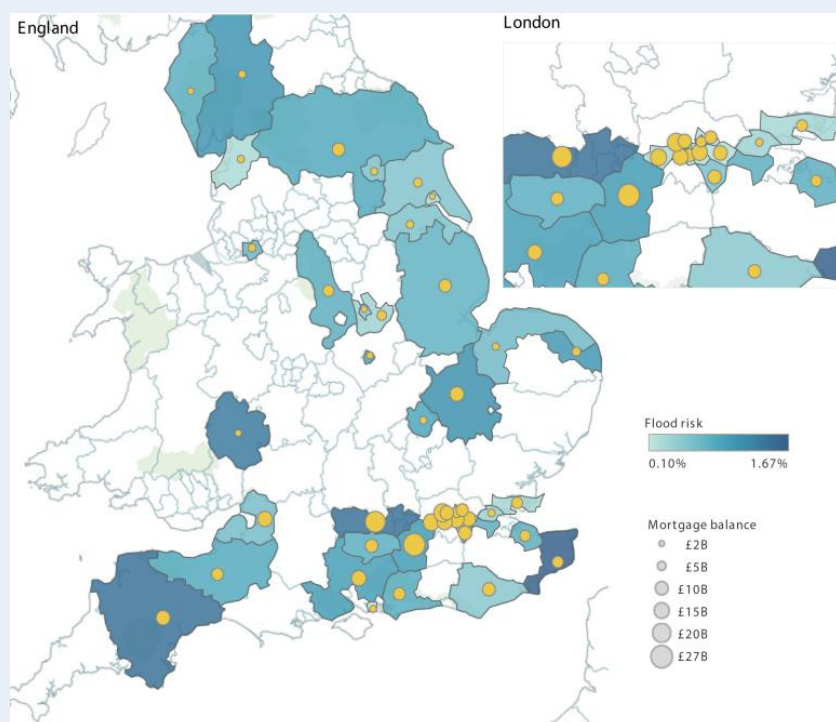
53 Met Office (2018).

54 Sayers et al. (2015).

55 Information available at www.fca.org.uk/data/product-sales-data.

risk if it is above ground level. London has many high value riverside apartment properties in this category. While being above ground level may protect a property from one-off damage, the property is not necessarily immune from value impairment, should flooding become more regular. Floods might also have adverse effects on the local economy, which can be reflected in lower incomes and therefore greater risks that customers will be unable to make loan repayments.

Chart B: Mortgage exposure and average flood risk by Local Administrative Unit



Source: Bank analysis using EA data (end-2016) and PSD007 data (end-2016) which captures the outstanding stock of owner occupied loans.

Banks' responses

Retail banks indicated in the PRA's survey that flood risk will continue to be adequately mitigated by the catastrophe risk element of home insurance policies. However, very few banks have modelled the risk that increased flood incidence and severity alongside expanding flood hazard zones may cause insurance premiums to rise, potentially decreasing the availability and/or affordability of home insurance over the term of a mortgage. Some survey responses did demonstrate a general awareness of the risk that insurance cost and availability may affect the market value of properties, and therefore the LTV of assets on banks' balance sheets. However, no respondents demonstrated active monitoring of flood insurance cover throughout the full term of the mortgage.

A number of banks have developed or are developing approaches to assess the financial risks of flooding on their mortgage books, and some are taking action to mitigate future risks. This, in combination with high penetration of private market insurance and the existence of Flood Re,⁵⁶ makes the net short term financial risk of flooding low to moderate. However, the financial risks may increase if floods in the UK become more frequent and severe due to climate change. These financial risks could crystallise if, for example, insurance firms are unable to pay out claims, Flood Re is discontinued, or insurance becomes unavailable.

⁵⁶ Flood Re is a flood re-insurance scheme to help to support households at high flood risk through a voluntary agreement between the Government and members of the Association of British Insurers. The Flood Re scheme provides information to consumers about how to increase their understanding of their level of flood risk and how they can take action to reduce that risk.

The PRA observed the following examples of good risk management in survey responses:

- formalising requirements in underwriting policies, risk measurement and reporting to assess and manage the current and future financial risks from flooding;
- ensuring valuation policies guard against the effects of adverse climate events, such as by monitoring the presence of flood risk insurance throughout the loan period;
- taking advantage of opportunities to assist customers in mitigating flood risk, for example by offering loans to enhance the flood resilience of the property;
- putting in place policies to provide support to customers impacted by severe flooding. Customers may, for example be granted a payment holiday for a defined period of time, which can help them manage the situation and avoid arrears; and
- nascent attempts to quantify flood risk to balance sheets.

4 The banking sector's response

The purpose of this chapter is to explore how the UK banking sector is responding to the challenges posed by the financial risks from climate change through their governance, strategy and risk management frameworks. The chapter begins by introducing the PRA's risk framework before discussing the survey findings, the 'transition in thinking' that is taking place across the sector and how firms are enhancing their approaches to managing the financial risks.

The PRA's risk management framework

4.1 The PRA's primary objective is to promote the safety and soundness of firms. It does so by assessing the gross risk posed by a firm as well as the mitigating factors in place. These include how well the firm manages the risks (operational mitigants) and the financial resources it has in place to ensure it is resilient to the risks (financial mitigants). Its assessment also reflects the nature of the firm's business, the external environment in which the firm operates and the risks which arise from the firm's business strategy.

Figure 4.1: The PRA's risk management framework

Gross risk			Mitigating factors				
Potential impact	Risk context		Operational mitigation		Financial mitigation		Structural mitigation
Potential impact	External context	Business risk	Management and governance	Risk management and controls	Capital	Liquidity	Resolvability

4.2 In this review the PRA has initially focused its assessment on the maturity of firms' mitigation of the gross financial risks from climate change by reviewing approaches to governance and risk management.

- **Management and governance:** as set out in the PRA's supervisory approach,⁵⁷ it is the responsibility of each firm's board and management to manage the firm prudently, consistent with its safety and soundness, thereby contributing to the continued stability of the financial system. The PRA has reviewed how firms identify and monitor the financial risks from climate change, including the level of engagement from boards and senior executives and the extent to which a firm-wide strategy is in place.
- **Risk management and controls:** the PRA also attaches particular importance to firms managing risk effectively because it is the crystallisation of risk, or concerns about risks crystallising in the future, which may cause problems for firms' safety and soundness. The PRA has reviewed risk management practices including how firms have integrated the financial risks from climate change into their risk identification and risk appetite, the use of climate scenarios to assess longer-term exposures and the maturity of more granular, bottom-up analysis to estimate potential exposures.

57 PRA (2016).

TCFD recommendations

4.3 The PRA's review started shortly after the TCFD, an industry-led body convened by the Financial Stability Board, published its final recommendations. The core elements of their recommendations on climate-related financial disclosures, shown in Box 7, Chart A below, are consistent with the PRA's risk framework.

4.4 More than 280 financial firms have now endorsed the TCFD accounting for almost \$100 trillion of assets and including 23 Global Systemically Important Banks (G-SIBs). During the PRA's review, firms seeking to implement the TCFD recommendations noted that the TCFD framework has been helpful in enhancing their approach on climate-related issues.

Box 7: Task Force on Climate-related Financial Disclosures

In June 2017, the industry-led TCFD published its recommendations for voluntary, consistent, comparable, reliable and clear disclosures on climate-related financial risks for companies to provide information to lenders, insurers, investors and other stakeholders.⁵⁸ These recommendations fall in the four areas outlined in Chart A.

- **Governance.** Disclose the organisation's governance around climate-related risks and opportunities.
- **Strategy.** Disclose the actual and potential impacts of climate-related risks and opportunities on the organisation's businesses, strategy, and financial planning where such information is material
- **Risk management.** Disclose how the organisation identifies, assesses, and manages climate-related risks.
- **Metrics and targets.** Disclose the metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material.

Chart A: Core Elements of Climate-Related Financial Disclosures



Source: TCFD (2017).

The recommendations also include financial sector metrics and examples of non-financial sector metrics, such as those relating to greenhouse gas emissions and energy and water efficiency. TCFD disclosures could significantly help financial sector analysts to better price climate-related risks and opportunities.

Review findings: A transition in thinking

4.5 The rest of this chapter highlights the findings of the review with respect to firms' responses to the financial risks from climate change. It also discusses some of the challenges that emerged from the survey and discussions, and how firms are taking action to address these (Boxes 8 and 9).

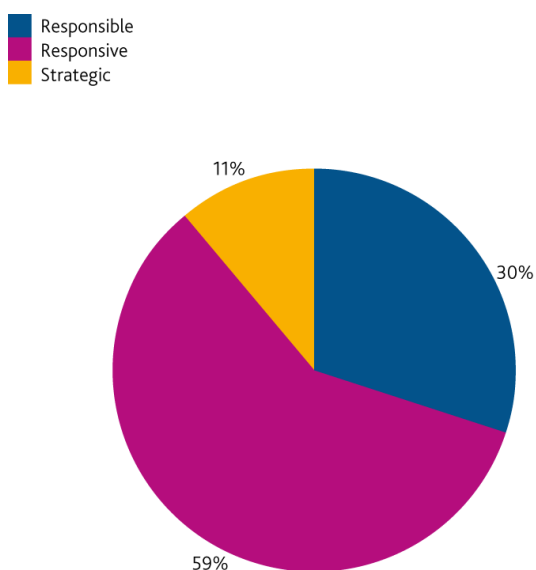
⁵⁸ Task Force on Climate-related Financial Disclosures (2017).

4.6 The review has highlighted that, as the financial risks from climate change become more apparent, a transition in thinking is taking place across the banking sector. Firms' approaches are evolving from a CSR perspective to considering climate change as a core financial and strategic risk. At a high level, the PRA identified three broad categories that define how banks are responding:

- (i) 'responsible' – an approach primarily driven by a CSR perspective, focusing on reputational risks;
- (ii) 'responsive' – an approach where climate change is viewed as a financial risk, albeit from a relatively narrow, short-term perspective; and
- (iii) 'strategic' – a more comprehensive approach taking a long-term view of the financial risks. This includes engaging at board level, considering both current and future risks, and taking action in the long-term financial interests of the firm, minimising financial risks and so supporting an orderly transition.

4.7 While an element of judgment is inevitably involved, based on the survey responses and meetings with firms the PRA considers about 30% to be in the first of these categories, around 60% in the second and about 10% in the third, albeit at different stages of maturity within each. As discussed further below, this transition in thinking is shaping how firms are responding to the financial risks from climate change through their approaches to governance and risk management.

Chart 4.1: Maturity of firms' response to the financial risks from climate change



Source: Results of the PRA survey and Bank analysis.

Being responsible: 30% of banks

4.8 The consideration of sustainability-related factors is not new to many banks. Whether motivated by succeeding in the firm's mission while minimising harm to the environment, or by managing reputational risk, the majority of firms have had CSR policies that cover environmental and sustainability issues in place for some time. Banks that consider climate factors through a CSR lens tend to be more focused on reputational risks than core financial risks and set a strategy that reflects this.

Governance

4.9 Boards that engage with climate change issues through the lens of ‘being responsible’ generally do this via board-level committees focused on the firm’s conduct, values, reputation and public responsibilities. These committees are typically responsible for approving and monitoring the implementation of Environmental, Social and Governance (ESG) policies and targets. In these firms the CEO is ultimately responsible for overseeing and sponsoring the firm’s effort on climate change and sustainability alongside other CSR objectives.

4.10 Several of these firms have yet to consider a specific strategy to respond to the financial risks presented by climate change outside of their ESG policies. For some this is because it is not deemed material to the current business strategy, while others are awaiting further international policy development before they consider the risks in more depth.

Risk management

4.11 Where the impact of climate change has been considered by firms focused on being responsible, it tends to be focused on reducing credit risk exposure to borrowers or counterparties in high risk economic sectors such as the coal industry. However this tends to be driven more by concerns around reputational risk and banks’ CSR policies. Analysis is often carried out on the impact that a specific company or project may have on the environment, and therefore on the bank’s reputation, rather than, for example, the financial risks resulting from the wider structural changes related to the low-carbon transition.

4.12 It is encouraging to see a number of banks starting the process of integrating a more financial risk-based approach. Only a very limited number of banks viewed the financial risks from climate change as too immaterial to warrant any management attention. Many have started to identify at a high level the potential impact of physical and transition factors on specific, existing risks, such as the risk of flooding to business continuity or mortgage portfolios.

4.13 Although the extent of these activities often falls short of a formal, quantitative vulnerability assessment, many banks indicated that they are intending to build out this capability in the future.

Being responsive: 60% of banks

4.14 60% of banks that responded to the survey are focused on responding to climate change as a significant financial risk beyond business continuity or the reputational risks associated with a CSR-led approach. These banks have progressed further in the process of identifying and measuring specific financial risks from climate change, albeit within their current business planning horizons of three to five years.

Governance

4.15 In these banks the PRA observed that the board has oversight via the board risk committee and the Chief Risk Officer (CRO) is often expected to report on climate-related financial risks. These firms are starting to coordinate a range of activities across multiple business units into a more coherent, firm-wide approach to manage the near-term financial risks from climate change.

4.16 The majority of these banks are doing this by integrating analysis of the financial risks from climate change into their existing enterprise-wide risk management frameworks. These risks are generally identified, as with other financial risks, by the first and second line.⁵⁹ However there was some divergence in approach and some banks are beginning to build specialist technical expertise to enhance their approaches to assessing the financial risks that could emerge.

⁵⁹ The first line of defence for risks is usually considered to be the line of business unit; the second line of defence is independent risk management (compliance and risk functions etc.); and the third line of defence is the internal audit function.

4.17 Information on these risks is generally reported up through divisional risk committees to the executive risk committee and onwards to the board. For example one firm closely monitors the financial risks from climate change at a risk management forum which reports to the group risk committee on a periodic basis. Although many firms do not have any risk metrics specifically on climate-related factors, several are in the process of developing them and some have already developed climate-related targets such as those relating to financial exposures to certain carbon-intensive sectors.

Risk management

4.18 In assessing the impact of climate-related factors on credit risk, firms identified that the approach taken to date has been bottom-up, focused on assessing the physical and transition risk factors at a relationship or transaction level. This includes discussing with borrowers how their business may be impacted by changing assumptions about the future productive use of a commercial lender's capital, or the risks to property from different physical events.

4.19 Several firms also provided examples of how they are mapping physical risk factors to their credit risk frameworks in a top-down approach. This is done by considering the potential losses over varying time periods from different types of severe weather events at borrower and loan level, particularly for those loans which are secured by real estate. Some of the survey respondents noted their participation in the United Nations Environmental Programme for Financial Institutions working group to develop a more sophisticated approach to assessing credit risks (see Box 9).

4.20 Although much of the focus has been on credit risk, some banks have started to consider the potential for physical or transition events to trigger a sudden correction to possible mispricing of climate-related risks in financial markets. However, in general, the approach used for assessing market risks on these issues is much less developed than for credit risks. Firms developing their approaches in this area have focused on creating specific indicators related to climate change and mapping these to potential market risks.

Being strategic: 10% of banks

4.21 Around 10% of banks that responded to the survey are beginning to develop a more strategic response to the financial risks from climate change with board level engagement. This more comprehensive approach involves a long-term perspective grounded in the long-term financial interests of the firm. Firms in this category are beginning to enhance their governance and risk management accordingly, to minimise financial risks and so support an orderly transition.

Governance

4.22 In the most advanced firms, the board has been engaged with developing a comprehensive response to the financial risks from climate change. This approach recognises the long-term challenge and the banking sector's role in mitigating the financial risks. It aims to incorporate a forward-looking view of the financial risks outside current business planning horizons. Assessment of climate-related financial risks in this way is being embedded throughout the business, or made central to the bank's mission and strategy. In some banks this included ensuring that climate-related financial risk responsibilities are included in scorecards or remuneration frameworks.

4.23 Firms with a strategic approach also recognised some of the challenges in responding to climate change such as the tendency to focus on near-term issues, limited knowledge of the strategic context and the wide-ranging nature of the potential transmission channels. They are proactively looking for solutions to these issues and are enhancing their organisation's capability. This includes utilising climate financial risk specialists within their risk function or partnering with universities, research institutes or consultants to assist them in this process.

Risk management

4.24 Firms beginning to take a strategic approach are further ahead in embedding financial risk assessments of the future impacts from climate change. For example, some firms are already actively assessing and mitigating these risks at portfolio or individual counterparty level, by scoring the sensitivity of individual clients to the financial risks from the low-carbon transition within their credit risk frameworks. They are doing this by engaging with clients to discuss how the long-term financial risks from climate change would be managed in different scenarios. Others have integrated the impact of climate change as an economic risk factor in internal stress testing frameworks for their Internal Capital Adequacy Assessment Process.

Developing a strategic approach

4.25 The distinctive elements of the financial risks from climate change discussed in chapter 3 present unique challenges. The uncertain and extended time horizons of physical risk factors, together with a lack of detailed regional data, makes it difficult to assess potential losses. For transition risk factors, different assumptions about how policy action, technological change and consumer behaviour will develop lead to different results for the potential impact on sectors.

4.26 Table 4.A provides examples of actions being taken to address the challenges that arise from the distinctive elements of climate-related financial risks.

Table 4.A: Examples of actions being taken by firms with a strategic approach

Distinctive elements	Example actions
Far-reaching in breadth and magnitude	<p>Deepening understanding of the financial risks from climate change</p> <ul style="list-style-type: none"> Engaging with clients to understand the risks clients face over the longer-term Publically supporting enhanced climate-related financial disclosures Considering how to classify and identify assets to enable climate-related risk analysis across portfolios Using scenario analysis and forward-looking data to assess the longer term financial risks <p>Agreeing a board level firm-wide strategic response</p> <ul style="list-style-type: none"> Reviewing board-level responsibilities to respond to, and manage, the financial risks from climate change Considering whether the current and future financial impacts from climate change have been factored into the firm's risk appetite <p>Considering how decisions today affect future financial risks</p> <ul style="list-style-type: none"> Beginning to integrate climate-related risk factors into forward-looking assessments Developing a comprehensive, firm-wide framework for climate-related risk management
Uncertain and extended time horizons	
Foreseeable nature	
Dependency on short-term actions	

4.27 No firm has perfected its approach, and there is still much more work to be done to fully understand the financial risks from climate change in the banking sector. Approaches for responding will develop over time as best practice begins to emerge. The case studies below provide further detail on how banks are responding in two specific areas – enhancing data for risk assessment and developing innovative analytical techniques.

Box 8: Case study 5 – Enhancing data for risk assessment

Many firms identified access to data as a significant challenge in addressing the financial risks from climate change. While TCFD-related disclosures are driving, and will continue to drive, significant progress towards providing consistent, decision-useful information, the review also provided evidence that firms are making use of other available data sources, working with external experts and actively requesting data from clients to overcome this issue.

For example, further to the case study on flood risk discussed in chapter 3, firms are using letter box level data on flood scores, other environmental factors and listed building status from partner organisations to facilitate flood risk assessment in the mortgage lending process. Using asset level data in this way not only helps firms to understand the risks better, but also to support clients' resilience to these risks; for example, by offering green loan facilities to improve flood protection. Additionally, analysing the LTV of properties at risk of persistent flooding can make it clearer which party is carrying the risk, and therefore what mitigating strategies might be most appropriate.

Similar approaches can also be used to address other risks highlighted in this report. For example, the use of EPC data to consider the impact of tightening energy efficiency standards on buy-to-let mortgage portfolios is also relevant to the case study presented earlier. Collaboration between the public and private sector and the contribution of academics and data experts to further progress is welcome, for example, through the Asset Level Data Initiative.⁶⁰

The review has also highlighted that certain firms are beginning to actively request data from clients to inform their assessment of risks and potential client exposures in this area. For example, firms are embedding consideration of climate-related factors as part of due diligence processes for loan origination or renewal, or asking clients to provide information on their carbon intensity when considering a deal. This type of data collection can happen independently and ahead of the implementation of the TCFD recommendations.

Box 9: Case study 6 – Innovative analytical techniques

Firms have described how it can be challenging to assess future financial risks posed by climate change and are beginning to develop a range of analytical techniques to address this.

For example, to support responses to the TCFD recommendations, several preparer forums have been established. An example specific to the banking sector is a pilot project run by the United Nations Environment Programme Finance Initiative (UNEP FI), which brought together 16 global banks to facilitate implementation of the TCFD recommendations. The pilot project has published guidance to support the assessment of both physical and transition risks.⁶¹ As part of the transition risk report, the project developed a scenario methodology to assess the transition-related exposures and credit risk in banks' corporate loan portfolios. The use of such analytical techniques and scenarios can then inform decision-making and alignment of portfolios with 2°C pathways. The use of more qualitative scenarios can also help firms form a view of longer-term exposures and inform a strategic response.

Other examples of analytical techniques include using a shadow carbon price to assess the resilience of clients and projects to the low-carbon transition. Using a carbon price in combination with qualitative factors such as emissions reduction strategies can be used to stress clients' earnings profiles. Such analysis can also be applied to identify which clients generate the most emissions in their industry, inform counterparty ratings and assess best-in-class and worst-in-class within a sector wide portfolio.

60 Available at <https://assetleveldata.org/>.

61 The UNEP FI pilot project has made these two reports publicly available for industry to use for their own risk assessments: www.unepfi.org/banking/tcfd/.

5 Conclusion

5.1 This report has examined the financial risks from climate change impacting the UK banking sector and assessed how banks are responding to and managing these risks. It has done so through the lens of the PRA's statutory objectives.

5.2 The review has highlighted how financial risks from climate change arise through two primary risk factors – physical and transition – and manifest as increasing credit, market and operational risks for banks.

5.3 These financial risks are relevant to the UK banking sector today, primarily through the impact of the low-carbon transition creating credit risk. Examples include the impact of tightening energy efficiency standards on the UK buy-to-let market and disruption in the energy and automotive sector on bank lending.

5.4 The distinctive elements of the financial risks from climate change, when considered together, also present unique challenges. The financial risks are far-reaching in their breadth and magnitude, have uncertain and extended time horizons, are foreseeable and actions taken today will, at least in part, determine the magnitude of how the financial risks will be realised in the future.

5.5 The size of the financial risks will depend on future climate-related scenarios – both whether Paris climate goals are achieved and whether the market transition is orderly or disorderly. The financial risks from both physical and transition risk factors will be minimised if there is an orderly transition to a low-carbon economy, but the window for an orderly transition is finite and closing.

5.6 As financial risks become apparent, a transition in thinking is taking place across the banking sector. The PRA identified three broad categories that define how banks are responding:

- (i) 30% are being 'responsible': an approach primarily driven by a CSR perspective, focusing on reputational risks;
- (ii) 60% are being 'responsive': an approach where climate change is viewed as a financial risk, albeit from a relatively narrow, short-term perspective;
- (iii) 10% are being 'strategic': an approach where firms are taking a forward-looking, long-term view grounded in long-term financial interests.

5.7 As this transition in thinking takes place, firms are enhancing their approaches to governance and risk management. Firms that are becoming more strategic are beginning to respond to the unique challenges presented by climate change. Examples include deepening their understanding of the financial risks by using scenario analysis, forming a board-level strategic response and considering how decisions today affect future financial risk.

5.8 As the UK's prudential regulator, the PRA has a statutory objective to promote the safety and soundness of its regulated firms. It does this by taking a forward-looking approach, assessing firms not just against current risks, but also those that can plausibly arise in the future.

5.9 The PRA has been considering the relevance of climate-related financial risks on its objectives for some time, initially focused on reviewing the impact of climate change on the UK insurance sector, the findings of which were published in 2015.

5.10 Over 90% of firms that responded to the survey viewed there to be an important role for the PRA to play in ensuring that regulated firms consider the financial risks from climate change. The distinctive elements of the financial risks from climate change and current maturity of firms' responses necessitates a proportionate response as discussed further below. This response will be for both the banking and insurance sectors.

Setting supervisory expectations for banks and insurers

5.11 The PRA expects firms to consider this report at board level, and to reflect on their current approach in light of the report's findings. The PRA will be setting out its supervisory expectations for consultation shortly after publication of this report. Building on the PRA's earlier work in insurance, expectations will be set for both banks and insurers. They will centre on how firms' governance, strategy and risk management frameworks need to incorporate the financial risks from climate change, including the expectation that firms take a long-term view of the risks and a strategic, board-level approach.

5.12 Setting supervisory expectations with regard to the financial risks from climate change is a key element of integrating climate-related financial risks into banking supervision, in line with work already underway in insurance. This will include ensuring PRA supervisors are equipped to engage with firms on the financial risks from climate change and assess if firms' responses are in line with the PRA's expectations.

5.13 These activities will form part of the PRA's involvement in the Bank of England's broader strategy for responding to climate change, as outlined in chapter 1. This includes ongoing work in insurance, and engaging with other financial regulators, both domestically and internationally; for example, through the Bank's participation in the NGFS.

Establishing a Climate Financial Risk Forum to share best practice and build intellectual capacity in this emerging field

5.14 As noted in chapter 4, discussions with firms and survey responses indicated a number of challenges faced by banks in fully assessing and responding to the financial risks from climate change; for example those relating to data analysis, development of scenarios, and broader capacity building.

5.15 The PRA welcomes the steps a number of firms are taking to address these challenges, such as filling data gaps by using external sources of information or requesting data from clients, and developing scenarios to explore longer-term exposures. The PRA is also supportive of industry-led collaboration around these, and other important issues; for example, working groups to advance climate-related financial disclosures in response to the TCFD recommendations.

5.16 The Bank is also actively collaborating with industry and other stakeholders. For example, the Bank co-hosted a workshop on climate scenario analysis with the TCFD in 2017 and participated as an observer in the UK's Green Finance Taskforce.

5.17 Recognising the need to build intellectual capacity, and to enable best practice to develop over time, the PRA and Financial Conduct Authority intend to establish a Climate Financial Risk Forum. The forum will involve private sector participants, technical experts and other relevant stakeholders. The objective of the forum will be to advance approaches for assessing, managing and responding to the financial risks from climate change. It will achieve this by supporting, for example, the development of analytical tools and techniques, such as climate-related scenarios, to help more fully integrate climate-related factors into present day financial decision making.

Assessing the system-wide financial risks from climate change

5.18 This report will inform the Bank's wider work. This includes the considerations of the Financial Policy Committee (FPC) in its role of identifying, monitoring and taking action to remove or reduce systemic risks with a view to protecting and enhancing the resilience of the UK financial system. The Bank will assess the system-wide financial risks from climate change and explore whether climate-related factors should be included in a future Biennial Exploratory Scenarios (BES).

Climate-related opportunities

5.19 In line with the PRA's objectives, this report and the PRA's response focus on the financial risks from climate change. The PRA survey and discussions also highlighted a range of opportunities that banks are already considering, particularly those relating to green finance. These include financing of low-carbon energy and transportation, such as electric vehicles, and the role of banks in providing access to capital markets through securitisation of green assets, which can support climate change mitigation and adaptation. We outline some of the opportunities that were highlighted as part of the review in Appendix A to the report.

5.20 The PRA is grateful to all those who have contributed to this report, including the regulated firms who responded to the PRA's survey and provided additional insights through bilateral meetings, as well as wider stakeholders and technical experts who have offered support.

5.21 The PRA looks forward to discussing this report with regulated firms, to the forthcoming consultation on its supervisory expectations and to establishing the Climate Financial Risk Forum to advance progress on the issues discussed.

6 Appendices

Appendix A: Opportunities in Green Finance

Responses to the PRA's survey, and wider discussions, highlighted that climate change and the transition to a low-carbon economy will also provide opportunities for banks. As discussed, the financial implications of a low-carbon transition are significant, implying the reallocation of tens of trillions of dollars of investment.

Being at the heart of capital allocation, the review suggested two main channels through which the banking sector can play a role in the transition. The first is through banks' primary balance sheet activities, the second is by providing the conditions for other actors to tap into capital markets.

Commercial lending and advisory services are key areas where banks can play a role to facilitate the transition. Technological changes lead to many new opportunities, for example, financing of electric vehicle technologies, smart grids, or end-use energy efficiency solutions in buildings. In the PRA survey banks identified that they are well-placed to meet the financing and advisory needs of new and emerging sectors, and are already supporting clients in their low-carbon or energy efficiency investments, in efforts to decarbonise the economy. Other opportunities include the focus on renewable energy generation, from which banks can benefit through project finance advisory or lending transactions.

However, banks alone do not have the balance sheet capacity to either mobilise or absorb the trillions of dollars of required investments. With financing needs growing, the banking sector can also play a central role enabling access to capital markets. For example:

- (i) green securitisation will be essential to free up banks' balance sheets to allow for further investment. By securitising the assets, banks certify borrowers' credit quality and the capital market finances the borrowers – a mechanism that will be pivotal for institutional investors to provide the financing needed for the energy transition and long-term sustainable infrastructure.
- (ii) recent years have seen a rapid acceleration in issuance in the green bond market, providing a number of business opportunities for banks. As underwriters, banks can provide capital market access for green bond issuers, or can invest in the green bond market themselves. Several banks have started issuing green bonds, with the proceeds being used for projects with environmental benefits.

Banks noted in the PRA survey that missing out on these opportunities is a risk in itself, and could impact upon longer term business model viability. They also indicated that those responding early could build a competitive advantage, creating value for themselves and their clients.

Appendix B: The Climate Change Survey

1) Current impacts of climate-related risk

1a) Within your organisation's current business planning horizon, what climate-related risks have you identified in relation to:

- (i) the achievement of your firm's business plan;
- (ii) the continued safety and soundness of your firm; and/or
- (iii) the protection of your shareholders / investors / deposit holders

Please let us know the duration of your current business planning horizon: _____ years

Please list your top 3 to 5 risks arising from climate change.

1b) Has your organisation assessed the likelihood and impact of these climate risks? YES / NO

If yes, please provide further details, including the timescale over which risks have been assessed.

1c) Are there specific business activities, asset classes, and/or geographies, within your organisation that will be more affected by climate change than others (e.g. loan book, trading book)? YES / NO

If yes, please provide further details.

1c) Has your organisation undertaken any granular, quantified analysis on the potential impact of climate-related risks on your assets, both for:

- Assets linked to sectors and projects with high carbon business models to estimate potential losses in the event of a rapid transition to a lower carbon economy (i.e. transition risk)? YES / NO
- Assets linked to sectors, regions and clients particularly vulnerable to climate-related events, such as storms, floods or drought? (YES / NO) If yes, please provide further information.

2) Future impacts of climate-related risk

2a) Beyond your existing business plan horizon (as indicated in 1a), has your organisation evaluated the longer-term impact of climate-related risk on your business model, safety and soundness of your firm and to policyholders? YES / NO

If yes, please provide further information below, including how the risks differ, if at all, from those identified in Question 1 and the future timescale(s) over which these risks have been considered.

2b) If you have not done so as part of question 2a), please consider climate-related risks that may arise by 2030. In doing this, please include how these 2030 risks differ, if at all, from those identified in Question 1.

3) Governance and management of climate-related risks

3a) Please describe your organisation's approach to managing climate-related risks. Within this, the PRA would welcome further information relating to climate-risk governance and strategy, including board oversight, as well as your approach to risk management and the use of targets and metrics.

3b) If not covered in 3a), does your organisation have a specific document outlining its strategic response to climate change? YES / NO

3c) Please provide any further information on approaches you find particularly effective for assessing and managing climate-related risks (e.g. stress testing or scenario analysis).

4) The role of the banking industry and banking regulators

4a) What do you consider to be the role of the banking industry in supporting an orderly, market transition to a lower carbon economy? Within this, please include any further information on your firm's activities in green finance, such as green bonds.

4b) What do you consider to be the role of banking regulators in supporting an orderly, market transition to a lower carbon economy?

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