IPPR

REPORT

KNOWN UNKNOWNS

THE HIDDEN THREATS THAT CLIMATE RISKS POSE TO BRITISH PROSPERITY

Joss Garman and
Diana Fox Carney

Foreword by
Michael Jacobs

Second edition
March 2016

Institute for Public Policy Research

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IPPR
4th Floor
14 Buckingham Street
London WC2N 6DF
T: +44 (0)20 7470 6100
E: info@ippr.org
www.ippr.org
Registered charity no. 800065

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IDEAS to
CHANGE LIVES

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ABOUT THE AUTHORS

Joss Garman is formerly associate director for energy, transport and climate change at IPPR.

Diana Fox Carney is formerly director of strategy and engagement at IPPR.

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FOREWORD
TO THE SECOND EDITION

The Paris Agreement on Climate Change, adopted by 195 countries at the United Nations conference in December 2015, commits the world to a new economic pathway. In a rare display of collective will, governments have finally accepted what scientists have long been telling them: climate change poses an era-defining threat to the global economy and to human societies. If this threat is to be averted, the global economy will have to undergo a fundamental shift in direction.

The Paris Agreement spells this out in no uncertain terms. To hold the rise in global temperature to 2ºC above pre-industrial times – and if possible to only 1.5ºC – the agreement commits the international community to reducing net greenhouse gas emissions to zero in the second half of the century. To understand the radicalism of this goal, one only has to realise that it effectively spells a near end to the use of fossil fuels, the principal source of climate-polluting emissions. Yet today 80 per cent of the entire world's energy supply comes from these fuels. (The concept of 'net zero' acknowledges that some carbon emissions could remain, so long as they were captured and stored through either biological or geological means.) Weaning the world from 80 per cent to more or less zero in a period of only five or six decades will require a transformation in the way modern economies are structured.

Of course, an international agreement is only a piece of paper: it does not in itself change investments in energy supply, transport, land use or industry. But the Paris Agreement did not stand alone: it was accompanied by new national targets and policy commitments made by almost every nation in the world.

Over the last six years, such targets and policies have already begun to shift patterns of investment. More than half of all new power supply in the world now comes from renewable sources, particularly wind and solar. New technologies such as electric vehicles and energy storage are revolutionising old patterns of consumption. City planners have begun to design urban development around higher population densities and public transport rather than urban sprawl. Meanwhile, every country in the world is having to face those impacts of climate change which are already now occurring, with much higher risks of extreme weather events such as drought, flooding and coastal storm damage. Adaptation and resilience have become high priorities for both public policy and private investment.

So this is a new economic world we have entered. For UK businesses it poses significant risks. This report details them: the risks of climate change itself, including potentially huge insurance liabilities; and the risk that stronger climate policy makes high-carbon investments increasingly unprofitable and devalued. Yet as this report also shows, very few British businesses or asset-holders have properly understood these risks or factored them into their decision-making and strategies. This is not surprising: the uncertain and complex nature of climate risks make them hard to deal with. Public policy is an essential part of their management. But ignoring them will not make them go away. So the report also makes recommendations on how both businesses and government should respond.

But managing climate risk is only half the story. The reshaping of the global economy which will be accelerated by the Paris Agreement is not all downside. The opportunities are also enormous. As all the world's major economies simultaneously tighten climate policy, global markets for low-carbon and climate-resilient goods and services are expanding rapidly. Now estimated together to be worth around $5.5 trillion a year (many times larger than pharmaceuticals or aerospace), these markets offer myriad opportunities for businesses in many different fields. The UK has particular strengths in many of them, from low-carbon vehicle manufacture to engineering consultancy, from offshore wind to finance.

Climate change has, for many years, been seen primarily as a moral imperative. But it is now an economic one. If British businesses do not recognise the risks, they face adverse impacts over coming years. But if they grasp the opportunities, there is a whole world to be won.

Michael Jacobs
Visiting fellow and acting associate director
for energy, transport and climate
March 2016

SUMMARY

Britain faces the risk of major economic losses as a consequence of climate change. This fact was affirmed in September 2015 by the governor of the Bank of England, Mark Carney, who explained that 'climate change will threaten financial resilience and longer-term prosperity' and warned 'once climate change becomes a defining issue for financial stability, it may already be too late' (Carney 2015).

Risk 1: the low-carbon transition

There are risks associated with a disorderly transition to a low-carbon economy. If governments around the world take action to introduce stringent new climate and energy policies in the decades ahead, in line with their stated commitment to keeping global temperature rises below 2ºC, trillions of dollars in investments in some fossil fuel assets could lose value. Lord Stern has described this risk as a 'carbon bubble' resulting from a mispricing of fossil fuel reserves. This mispricing is due either to the failure of markets to account for future policy changes designed to curb rising global temperatures, the increasing potential of disruptive clean technologies to price out more-polluting energy sources, or the belief that policy commitments on climate change will not in fact be followed through upon. Evidence from the UN's panel of climate scientists has suggested that serious action on climate change would mean that between one-fifth and one-third of proven reserves would become 'unburnable' (ibid). In his speech, Carney (2015) warned that 'the exposure of UK investors… to these shifts is potentially huge'. CitiGroup has estimated that $100 trillion in assets could become 'stranded' (Chanell et al 2015).

A major study led by a number of former finance ministers and heads of government suggested that almost three-quarters of global fossil fuel assets that would be hit under such a scenario are owned by governments (NCE 2014). The indirect effects on governments could also be huge, since billions of pounds of revenues are generated from taxation related to polluting companies and polluting activities: the UK's oil and gas sector is the largest corporate taxpayer in the country (PwC 2012).

The prosperity of millions of British savers who are, perhaps unknowingly, invested in fossil fuel assets through their pension schemes could also be hit. Nineteen FTSE 100 companies are currently in natural resource and extraction sectors, and a further 11 are in power utilities, chemicals, construction and industrial goods sectors (Carney 2015). UK local authority pension funds alone are understood to hold £14 billion worth of fossil fuel assets (Platform et al 2015).

Risk 2: unchecked global warming

At the same time, there is a risk that the combination of international climate policy efforts and cleaner technologies are insufficient to prevent fossil fuel reserves being burned. The result would be dangerous global temperature increases of more than 2ºC. Such temperature rises would harm a different constituency of businesses: those that experience the direct and indirect effects of increasingly frequent and severe weather events on their infrastructure and global operations. The Stern review suggested that unchecked global warming could have an immense impact on the overall resilience of the global economy, with annual reductions in GDP of between 5 and 20 per cent (Stern 2006).

Insurance experts at the Willis Group estimate that insured losses from a single major European windstorm event, for example – something which is made more likely by a warming climate (UCS 2015) – could be in the region of €10–€30 billion, depending upon the return period.[1] Uninsured losses related to the same event could add up to 200 per cent to this figure,[2] and insured losses for the UK alone could range from €3–€17 billion.

And this is a single extreme event. A recent report produced for Aviva Investors put the possible cumulative losses that could result from a series of impacts of warming at $4.2 trillion globally (EIU 2015: 2). The UK could be particularly badly exposed because of the importance of the financial services sector to the British economy and because it is vulnerable to increased flood risk.

Risk 3: insurance liabilities

A third way in which climate change could impact upon financial stability is through liability risks, particularly to insurers. These could result from those who have suffered loss or damage from the effects of climate change seeking compensation from those they hold responsible (Carney 2015). This issue of compensation claims is already a major feature of UN negotiations on climate change. The UN Human Rights Council has warned that: 'A failure (by governments and other actors) to take reasonable preventative action to reduce exposure and vulnerability and to enhance resilience, as well as to provide mitigation, is a human rights issue' (quoted in Gonzalez-Pelaez and von Dahlen 2015: 7).

Is the business community aware of these risks?

Many business leaders readily acknowledge that climate risks such as these could have a major impact on economic value. Three-quarters of executives in one recent UK survey said they believed the effects of rising temperatures present 'bottom line risks', though they seldom talk about these risks directly (Carbon Trust 2015).

Regulators are similarly beginning to pay greater attention to such risks. In 2013, the UK became the first country in the world to introduce mandatory carbon reporting for listed companies. The largest companies are required to publish their carbon footprints to enable investors to make more informed decisions about the possible impact of future policy changes. Over the past year or so, both the Bank of England and the G20's Financial Stability Board have launched probes into climate risks to the financial system, as have the Swiss and German governments. In 2016, the French government is expected to 'stress test' financial institutions to gauge their vulnerability to climate risks.

Nevertheless, by and large, markets are still blind to climate risks. The EIU report for Aviva found that only 1.4 per cent of institutional investors have a target to reduce the carbon footprint of their investments (EIU 2015). Another survey of the top 500 global asset owners, who between them own $40 trillion in assets globally, found that nearly half of funds have done nothing at all to protect investors from climate change risks (AODP 2015).

This paper makes practical recommendations for policy measures that would begin to address this problem.

1 In correspondence with Willis Group, 2015.

2 These losses would accrue across northwest Europe, with some ultimately being absorbed by global reinsurers.

Key findings

Our research identifies three broad reasons why markets are currently failing to account for climate risks.

1. **Climate risks are seen as too distant to be relevant to financial decision-makers, who tend to focus on a short-term timeframe in which climate shocks are seen as unlikely to have a significant, financially material impact.** The governor of the Bank of England has described this problem as the 'tragedy of the horizon'.
2. **Climate risks are very uncertain – they are 'known unknowns'.** Scientists have identified some of the risks associated with different levels of increased temperatures, but it is still unclear what the actual temperature trajectory will be (in part because it is not clear how aggressive international policy measures to curb carbon pollution will be), how effects will be distributed across sectors and geographies, or how temperature rises will translate into economic impacts on specific companies and sectors.
3. **Climate change is widely acknowledged to be an ethical concern and a matter for public policymakers, but climate policies are not taken seriously by many businesses and investment managers.** There is no consensus on whether climate risks are a financially material factor, particularly in the short term, and therefore whether businesses and investment managers are legally obligated to take them into account. Many leaders in the private sector argue that it is a matter for governments to establish effective climate policies – such as carbon pricing and clean energy schemes – and that if they were to do so, then markets would respond. Currently, government signals to the market are insufficiently strong to drive large-scale investment away from highly polluting industries.

Our recommendations seek to respond to each of these arguments in turn.

Summary of recommendations

Objective 1

Build understanding of where the UK economy is vulnerable to climate risks.

- **Following the Paris summit[3] a cross-party group of MPs, such as the Environmental Audit Committee (EAC), should run a parliamentary inquiry to examine the preparedness of leading UK public and private sector institutions to deal with climate-related risks.** The inquiry should focus on the risks associated with the likely temperature increases based on commitments made by governments in Paris. It could also call for evidence from certain business figures and institutional investors to learn how their company operations are consistent with the carbon reduction targets implied by national climate change commitments.[4]

Objective 2

Ensure financial decision-makers have the information they need in order to account for climate risks

- **Building on existing UK carbon reporting, MPs should consider whether to require disclosure of climate risks and, if so, over what time period. This could be followed by regular climate-related stress testing of listed companies and financial institutions in Britain.** A stress test approach could use modelling of the kind used for decades by the insurance industry to test the potential financial impact of a maximum probable annual financial loss that an individual or organisation could expect once in a hundred years, based on the latest scientific evidence. This would reveal the likely level of resilience of different businesses.

3 The 21st session of the conference of the parties to the UNFCCC (COP21), 30 November–11 December.

4 That is, via 'intended nationally determined contributions' (INDCs).

- **National science research organisations – such as the Royal Society, Met Office, government chief scientists and research funding councils – should collaborate with private-sector risk and resilience modelling agencies to advance research that can usefully inform financial decision-making.** This would ensure that risk-assessment modelling within the financial services industry is based on the best and most recent scientific understanding.

Objective 3

Ensure asset managers do not ignore these risks in their decision-making.

- **The government should clarify the law governing fiduciary duty so it is clear that climate risks that materially impact upon the value of investments must be taken into account by institutional investors.**

Objective 4

To reduce the overall level of the risk that most businesses face as a consequence of climate change

- **The government should continue to deploy policies that incentivise investment in clean energy and reduce the relative economic attractiveness of the most polluting practices – for example, through carbon pricing and other carbon mitigation policies.** The Paris Agreement has sent a clear signal that the era of fossil-fuel-powered growth is coming to an end. But current national plans are not sufficient to achieve this. The UK should champion the strengthening of national climate targets in the first review of commitments under the agreement in 2020.

\\\

We learned from the financial crisis the importance of seeking out and exposing hidden economic risks to enable them to be better managed to protect individual and collective capital. It is time for us to follow this lesson again.

Alongside other policy signals designed to produce a stable and orderly low-carbon transition,[5] these practical steps can help better prepare the UK for the threat to our prosperity from climate risks.

5 For more, see previous IPPR reports *Brighter future* (Straw et al 2014), *Scuttling coal* (Aldridge and Straw 2015) and *When the levy breaks* (Garman and Aldridge 2015).

1. CLIMATE RISKS: WEATHER MAKERS, WEATHER TAKERS AND THE THREATS TO BRITISH PROSPERITY

There is a growing body of evidence that the UK faces significant risks to its security from climate change. This is true whether or not the world achieves the goal it originally established at the Copenhagen summit in 2009 of limiting global temperature increases to no more than 2ºC.

While the ambition of keeping global temperatures at these safer levels is crucial, and must remain in place, it is difficult to be confident that it will be achieved. Taken together, the national climate plans submitted to the UN ahead of the Paris conference are insufficient to secure 'climate safety'[6] (see Garman 2015).

Right now, it seems far more likely that we face a future of dangerous global temperature increases, of more than 2ºC, and therefore of increased climate-related risks. Evidence suggests that the levels of warming we could see in these scenarios would pose a dangerous threat to human health (CDCP 2015), our food and water security (Lloyds 2015), and even to our national security (CCS 2014).

This paper focusses specifically on the threat posed to British prosperity from climate risks. Crucially, these threats could materialise *whether or not* temperature increases are kept below 2ºC. Indeed, even at the relatively modest levels of temperature increase that we have seen so far – of around 1ºC, as recorded very recently (see Connor 2015) – there are already significant economic impacts.

Risks to prosperity if the world succeeds in keeping temperature increases below 2ºC

Even if the world succeeds in keeping global temperature rises below 2ºC, risks to certain UK businesses will remain, and different types of business will be affected in different ways.

Fossil-fuel companies and traditional energy utilities that use large quantities of fossil fuels stand to be directly affected by policy changes. This impact is likely to be profound. It has been estimated by scientists that between one-fifth and one-third of the world's proven reserves of oil, gas and coal must remain unburned if we are to avoid dangerous levels of warming of more than 2ºC (IPCC 2014: table 2.2). This could have various impacts.

- One analysis estimates $28 trillion[7] in lost revenues for the fossil-fuel industry alone over the next 20 years under a global 2ºC scenario (Zou et al 2015). Another, by CitiGroup, suggests that $100 trillion of carbon assets could become unusable, or 'stranded' (Chanell et al 2015).
- Research by Standard & Poor's has suggested that, even before 2017, new carbon constraints could begin to hit the credit rating of a number of small, non-diversified oil and gas producers (Zou et al 2015).

6 This is generally understood to mean keeping global temperatures rises below 2ºC.
7 In 2012 prices.

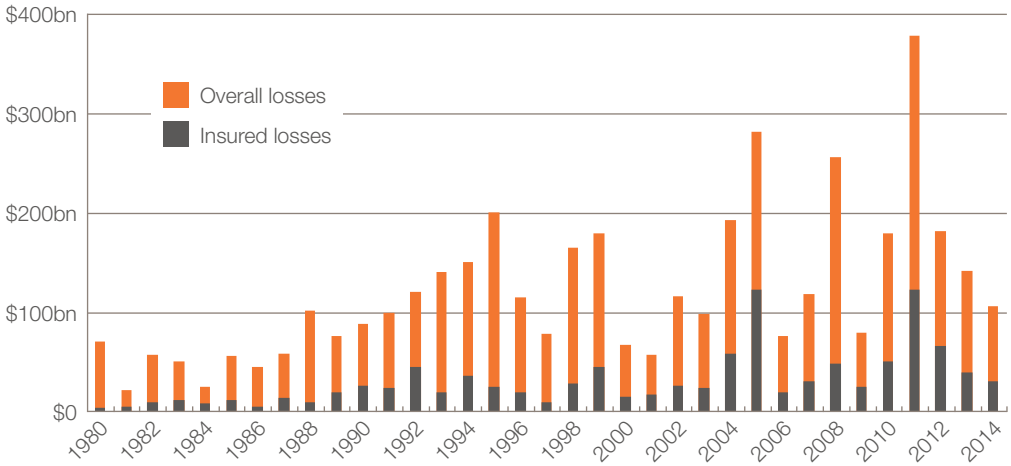
- Heavy industrial users of carbon-intensive energy (such as metals, mining, paper and chemicals companies) could be disproportionately affected by the introduction of stringent climate policies that would require significant shifts in their own corporate infrastructure and operations. For example, one study by McKinsey suggests that the aluminium industry could face losses of 65 per cent (Thoma et al 2015).

These direct impacts would, as in the following examples, feed through to investors, employees, and the UK economy as a whole, particularly if the transition is not well managed.

- The oil and gas sector in the UK is estimated to generate about 400,000 jobs and is the largest corporation taxpayer in the country (paying in 16.4 per cent of total corporation tax revenues) (PwC 2012). The sector also has a weighting of nearly 13 per cent within the FTSE 100 index and 11 per cent in the FTSE all-share index (FTSE 2015), meaning that any changes in value have the potential to significantly affect many index investors. The weighting of utilities in the FTSE 100 index is 4.4 per cent.
- In a detailed 2014 study of 23 major European pension funds, the Green European Foundation found that high-carbon assets (equities, bonds and commodities) made up a weighted average of 5 per cent of total assets (Weyzig et al 2014).

At the same time, UK companies will experience losses directly related to weather events. Two degrees is more than twice the warming we have already experienced and – as figure 1.1 shows – losses from climate-related events are already significant and rising.

Figure 1.1
The mounting cost of extreme events over the past 35 years
Loss events worldwide, 1980–2014, overall and insured losses



Source: Munich RE 2015a
Note: Losses adjusted to inflation based on country CPI.
Loss events include meteorological events (storms), hydrological events (floods and mass movements) and climatological events (extreme temperatures, droughts, forest fires).

Risks to prosperity if the world fails to keep temperature increases below 2ºC

Various estimates have been made of the economic costs of climate change impacts, both overall and for specific groups. A recent report by the Economist Intelligence Unit for Aviva estimates that, among the total global stock of manageable assets, there is $4.2 trillion of 'value at risk' from what it deems to be an 'average' warming scenario (EIU 2015). A decade ago, Lord Stern estimated the costs of unchecked climate change to be between 5 and 20 per cent of global GDP each year by 2050 (Stern 2006).

Different extreme events will bring different costs. Insured losses from flooding and severe weather events in the UK have cost an average of £1.5 billion per year over the past 20 years. In 2007, however, the costs were far higher: widespread flooding affected 55,000 homes, killed 13 people, and cost the economy £3.2 billion (of which £740 million was borne by business) (CCC 2015). Projected annual losses from flooding in the UK are expected to rise to £1.5–£3.5 billion by the 2020s, and again to £1.6–£6 billion by the 2050s (Defra 2012a).

Insurance experts at the Willis Group estimate that insured losses from a single major European windstorm event, for example – something which is made more likely by a warming climate (UCS 2015) – could be in the region of €10–€30 billion, depending upon the return period.[8] Uninsured losses related to the same event could add up to 200 per cent to this figure,[9] and insured losses for the UK alone could range from €3–€17 billion.

Table 1.1 highlights the scale of costs that can be incurred from extreme weather events: insured losses for the most expensive single event in 2014 totalled $3.1 billion, and if uninsured losses are added, this figure rises to $5.9 billion.

Table 1.1
The 10 costliest disasters of 2014
Largest worldwide loss events, by overall losses

Date	Event	Affected area	Overall losses (US$m, original values)	Insured losses (US$m, original values)	Fatalities
11–13/10/2014	Cyclone Hudhud, storm surge	India	$7,000m	$530m	84
07–16/2/2014	Winter damage, snowstorms	Japan	$5,900m	$3,100m	37
03–15/9/2014	Floods	India, Pakistan	$5,100m	$330m	665
03/08/2014	Earthquake	China	$5,000m	-	617
06/07/2014	Drought	Brazil	$5,000m	-	-
11–22/7/2014	Typhoon Rammasun (Glenda)	China, Philippines, Vietnam	$4,600m	$250m	195
18–23/5/2014	Severe storms, hailstorms	US	$3,900m	$2,900m	-
13–30/5/2014	Floods	Serbia, Croatia, Bosnia and Herzegovina, Romania	$3,600m	$70m	86
07–10/6/2014	Severe storms, hailstorms	France, Belgium, Germany	$3,500m	$2,800m	6
05–08/1/2014	Winter damage	US, Canada	$2,500m	$1,700m	-

Source: Munich Re 2015b

8 Correspondence with Willis Group, 2015.
9 These losses would accrue across northwest Europe, with some ultimately being absorbed by global reinsurers.

Who could be affected by the economic risks of climate change?

Huge numbers like this can be hard to relate to particular organisations and individuals, or to specific practical policy decisions to take effect in the immediate future. To help overcome this problem, we explain below how climate impacts could materially impact three crucial UK groups: businesses, the financial services sector, and individuals and families.

Businesses

The activities of businesses both affect and are affected by the climate, making many companies both 'weather makers' and 'weather takers'.

Recent research suggests that large parts of the business community *do* know that they face economic risks from the changing climate. For example, 76 per cent of business executives surveyed by the Carbon Trust said they see 'bottom line risks' from the direct impacts of climate change (Carbon Trust 2015). Another survey of global executives conducted by the consultancy McKinsey found that 60 per cent see climate change as strategically important (Whitman 2008).

Table 1.2 illustrates how extreme weather events can have a material impact on businesses.

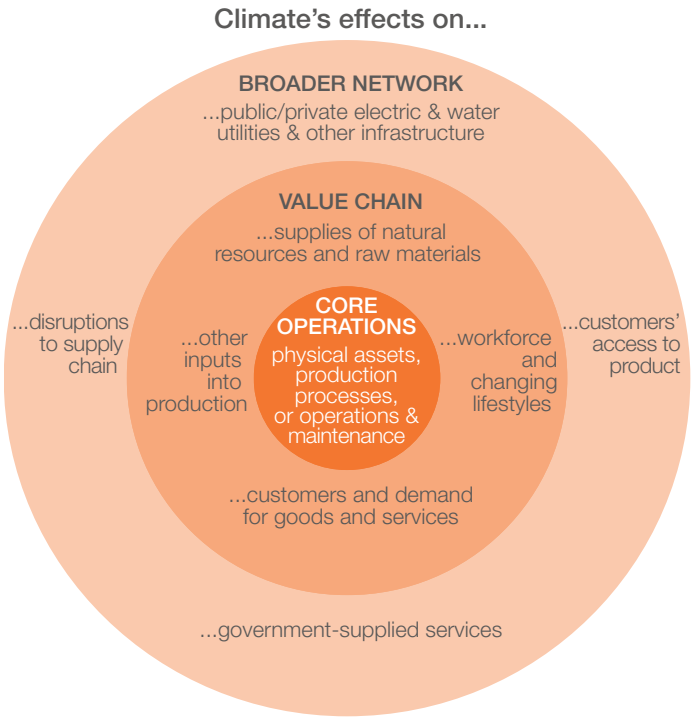
Table 1.2
Costs of recent extreme weather events

Sector	Impacts
Insurance	**Munich Re** received claims worth more than $350 million from severe flooding in Australia in 2010–11, contributing to a 38 per cent decline in quarterly profits. In 2011, property and casualty insurer **The Hartford** paid out $745 million in natural catastrophe claims – more than the combined average catastrophe losses over the previous 10 years. The 2007 floods cost UK insurers approximately £3 billion, while the floods of 2013–14 cost around £1.5 billion. The cost to Aviva alone was around £120 million.
Manufacturing	Hurricanes Gustav and Ike in 2008 caused temporary outages at several of **Dow Chemical Company**'s US Gulf coast production facilities, resulting in $181 million in additional operating expenses. **Honda** suffered a loss of over $250 million when heavy floods in Thailand inundated automobile assembly plants in 2011. **HP** estimates that more than half of the 7 per cent fall in revenue that it saw in the fourth quarter of 2011 was attributable to a shortage of hard-disk drives caused by the flooding in Thailand.
Utilities	Record-setting heat in Texas in 2011 forced **Constellation Energy** to buy incremental power at peak prices and led to quarterly earnings being reduced by about $0.16 per share. During the summer of 2012, **Dominion Resources** was forced to close one of two units at its Millstone nuclear plant in Connecticut because the temperature of the water being drawn from Long Island Sound exceeded its licence limits. The 2007 floods cost **UK power and water utilities** £0.33 billion.
Oil and gas	**Chevron,** the largest oil and gas producer in the Gulf of Mexico, was significantly affected by Hurricanes Katrina and Rita in 2005. Reduced crude oil and natural gas production, and added costs for repairs and maintenance of both offshore and onshore facilities, resulted in a loss of approximately $1.4 billion in the second half of 2006.
Mining	**Anglo American**'s copper production for the first half of 2011 fell by 8 per cent, due in part to severe disruptions to its Collahuasi mine in Chile caused by rainfall four to five times greater than the annual average. In 2011, **Rio Tinto**'s Australian operations were hit by cyclones and widespread flooding, leading to a train derailment and a reduction in earnings of $245 million.

Source: Adapted from Crawford and Seidel 2013

The ‘risk disk’ published by the Center for Climate and Energy Solutions (formerly the Pew Center on Global Climate Change) usefully illustrates the broad types of climate risk that different businesses face.

Figure 1.2
The risk disk



Source: Reproduced from Sussman and Fried 2008, in Crawford and Seidel 2013

Although climate risk is widely spread across many different sectors, some are particularly vulnerable. According to the European Commission, the sectors thought to be at greatest risk from climate change around the world (in addition to energy industries) are real estate/infrastructure, timber, agriculture, tourism and insurance.[10]

The British government’s advisers, the Committee on Climate Change, have considered the main risks to the UK from climate change, which they identified as coming from ‘flooding, changes in water availability, and the disruption of supply chains reliant on goods sourced in the UK and from overseas’. Their report also noted the potential importance of ‘disruption to infrastructure services’, presenting an exhaustive analysis of what proportion of our current transport and energy infrastructure is particularly vulnerable (CCC 2014).

Similarly, a 2012 climate risk assessment produced for the Department for Environment, Food and Rural Affairs (Defra 2012a) identified a number of bellwether sectors that are particularly vulnerable to climate risk in the UK:

- tourism (making up roughly 9 per cent of GDP)
- financial services (around 8 per cent)
- food and beverages (around 7 per cent)
- primary extractives, including oil, gas and mining (within this, energy is 3.5 per cent of GDP)
- chemical manufacturing (1.5 per cent GDP).

10 See: http://ec.europa.eu/clima/policies/adaptation/how/sectors/index_en.htm

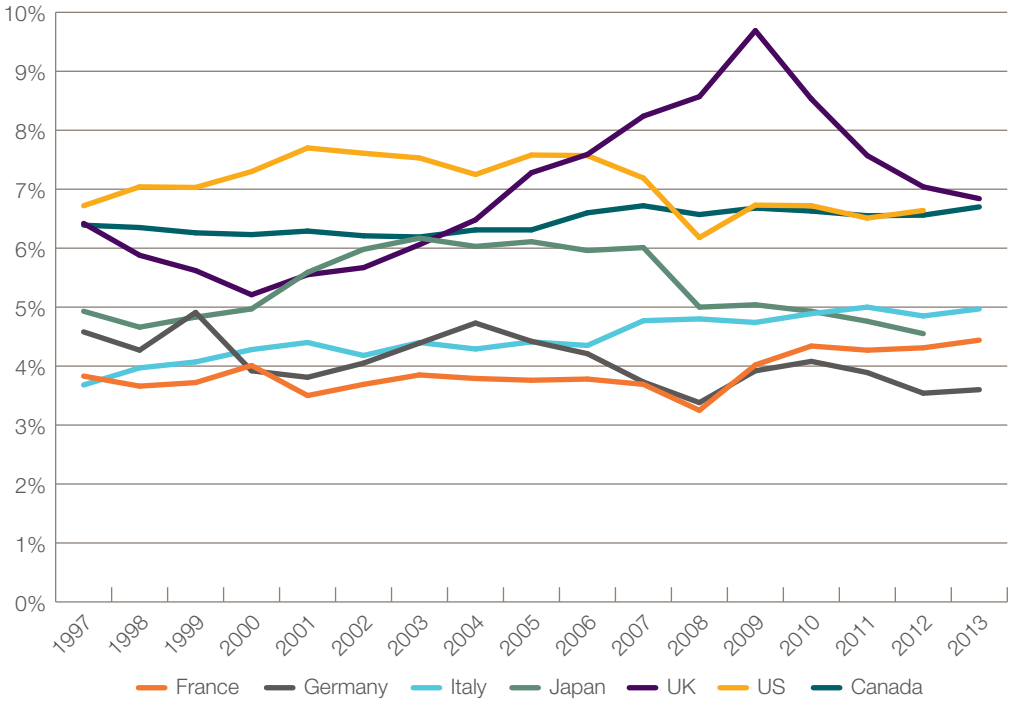
The vulnerability of these sectors stems from the following facts.

- They rely on large, fixed assets – for example, chemical manufacturing sites near major rivers or the coast.
- They have complex supply chains – for example, food and beverages or electronic goods.
- They rely substantially on natural assets – for example, tourism (Defra 2012a).
- They are broadly exposed to climate risk. This is especially the case for financial services, which are the focus of the following section.

Financial services

The financial sector and insurance industry are more important to the UK economy than is the case for any other G7 country. Yet the financial services sector as a whole – which in the UK accounts for 8 per cent of GVA and around 334,000 jobs – faces a worrying number of risks from climate change.

Figure 1.3
Financial services are more important to the UK economy than in any other G7 country
Financial and insurance output, % of nominal GVA, 1997–2013



Source: Banks et al 2014

As large-scale investors, financial services organisations face significant portfolio risks, due to the potential for change in the value of the underlying assets. One recent estimate has suggested that, in a plausible worst-case scenario in terms of climate damage (a rise of 4°C), the amount of value at risk in 2030 may be equivalent to between 5 and 20 per cent of portfolio value, compared to what it would have been without warming (Covington and Thamotheram 2015).

The UK has the largest insurance industry in Europe and the third-largest in the world (after the US and Japan) (ABI 2014). It accounts for more than one-fifth of the total gross value added (GVA) for the financial services sector. London-based insurance companies are focussed on insuring catastrophic risk and are therefore

particularly vulnerable to climate change impacts of the type detailed in table 1.1 above. Forty per cent of London insurance business is driven by natural hazards, and exposure is widespread, as two-thirds its written premiums originate from outside the UK and Ireland (LMG and BCG 2014).

The insurance industry is vulnerable to climate impacts for two other reasons.

- Insurance firms own UK assets worth £1.8 trillion (ABI 2014). Yet of $25 trillion in assets held by the insurance industry globally, less than 1 per cent is understood to be invested in climate-resilient infrastructure (UNCS 2014), so many UK investments are likely to be similarly exposed to climate risks.
- As liability insurers they stand to suffer from potentially huge exposure should there be a series of claims against companies that may be held responsible for climate change – that is, if they are held to account as the 'weather makers' (BoE PRA 2015).

Individuals and families

Individuals and families in the UK are economically vulnerable to climate risks in two key ways: through the impact that climate change could have on the resilience of our economy as a whole, and through changes in the costs of goods and services.

They are also significantly exposed as investors and pension-holders. There are 8.1 million people in Britain who are active contributing members of a pension scheme (ONS 2014). Many people (and most pensioners) are investors and therefore are vulnerable to changes in underlying asset value.[11] This fact was graphically illustrated when BP's oil spill in the Gulf of Mexico made it liable for more than $50 billion in claims over the period 2010–2015 (Ruddick 2015), causing its stock to more than halve in value (Tharp 2010). At the time it was estimated that more than 18 million people in the UK owned shares in BP, either directly or indirectly, mostly through their pension funds.

An analysis published in September by a group of environmental groups including Friends of the Earth identified that local authority pension funds in the UK collectively invest £14 billion in fossil-fuel companies (Platform et al 2015).

Another key concern for individuals is that property values may change dramatically as a result of climate impacts, such as flooding in vulnerable areas. Relatedly, it may become increasingly expensive or even impossible for individuals to secure property insurance for vulnerable, low-lying properties (Defra 2012b). While denying policies or imposing year-on-year cost increases is one way in which the insurance sector can protect itself from financial vulnerability, this transfers the burden to individuals. The Flood Re scheme has been introduced in the UK to begin to try to address this problem.[12]

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Having explored how climate change poses material risks to individuals, families and businesses – and to our financial sector in particular – the next chapter considers why these risks appear to be 'hidden' from the markets, and how policymakers can most effectively respond.

11 Those with defined benefit pensions are obviously not exposed in the same way: instead the risk accrues to those responsible for paying such pensions.

12 See https://www.abi.org.uk/Insurance-and-savings/Topics-and-issues/Flooding/Government-and-insurance-industry-flood-agreement/Flood-Re-explained

2.
HOW TO RESPOND TO THE ECONOMIC RISKS OF CLIMATE CHANGE

Financial regulators, such as central banks and finance ministries, can take a variety of steps to offset the kind of climate risks outlined in the previous chapter. When they identify a threat to the stability of the financial system as a whole, they can introduce macroprudential capital buffers to reduce the risk of market shocks and large-scale economic losses. They can also act through microprudential regulations to boost the resilience of individual institutions. Currently, however, they don't use these tools to respond to climate change risks. In fact, to date they have not considered climate risks within the frameworks that they use for measuring, assessing and managing comparable kinds of risk.

Similarly, businesses and asset managers weighing up the various risks to their investments and the costs they could face as a result do not usually consider climate change, despite the fact that it could be directly relevant to the value of companies and physical assets. Last year, a report on resilience to increasingly extreme weather by the Royal Society concluded:

> *'Business surveys, economic forecasts and country briefings that guide investment decisions and credit ratings are typically based on the availability of skilled labour, access to export markets, political and economic stability, and financial incentives, with little or no consideration of disaster risks. In addition, real estate markets largely ignore the risks associated with highly exposed locations.'*
> Royal Society 2014

Mats Andersson, the CEO of the AP4 – the Swedish national pension fund worth around £21 billion – has similarly commented:

> *'You can ask pension funds about traditional risk metrics, but ask them about their exposure to climate risk and I'm sure that 90 per cent will say they haven't got a clue.'*
> Quoted in EIU 2015: 17

For most mainstream financial institutions, climate change risks are simply invisible. As one asset manager who works for a number of pension funds told the *Financial Times*: 'Asset selection is not done with carbon risk in mind' (Marriage 2014). While many financial institutions acknowledge the risks from climate change, they still largely function as if the risks did not exist. This is because carbon-intensive industries remain investable and produce dividends in the short term, and so the risks are not seen as sufficiently large to warrant a seachange in investment practices. This led one market analyst, the CEO of Bloomberg New Energy Finance, to describe the financial sector as 'institutionally fossilist' (Business Green 2013).

Growing recognition of the problem

In response to mounting concern within parts of the financial community, particularly within the insurance industry and among some institutional investors, a conversation is now emerging among regulators and leading private-sector institutions about the need to both address the policy gap that is allowing climate risks to remain hidden, and raise the finance required to invest in the transition to climate safety.

- Bank of England governor Mark Carney wrote to parliament's Environmental Audit Committee to confirm that the Bank of England would now consider the risks of 'stranded assets' resulting from climate policy in its regular reviews of financial stability risks. The Bank has also agreed to consult with the Committee on Climate Change on climate risks. The Prudential Regulatory Authority of the Bank of England wrote to 30 insurance companies in the UK asking them if they knew when worsening extreme weather might begin to impact upon the viability of their business model, and in September 2015 published the findings of its inquiry (BoE PRA 2015).
- Following the inquiry launched by the Bank of England, G20 finance ministers ordered a probe by the Financial Stability Board into climate risks to the global financial system and ways they could be mitigated (Evans-Pritchard 2015).
- The US became the first country to require a form of climate risk disclosure. In 2009, its National Association of Insurance Commissioners (NAIC) – made up of the chief insurance regulators of the 50 states – took action, prompted by fears about how climate change could impact upon 'the availability and affordability of insurance for consumers' (Ceres 2009). It now conducts an annual survey of any insurance company with premiums in excess of $500 million, and produces comparative information on firms' exposure to climate risks, so that investors can gauge the extent to which different companies are vulnerable or prepared.
- In July 2015, France introduced a new law requiring listed companies and institutional investors to disclose climate risks, and the French finance ministry is currently devising its implementation (TDII 2015a). Those impacted by this law must also outline how their investment and business strategies are consistent with French legal targets on climate change. Because the French rules will apply to UK asset managers overseeing French money, of which there are likely to be many, the French standard could become the norm.
- The Brazilian central bank has produced guidelines for its financial sector on the consideration of environmental risks. This includes a recommendation that institutions keep a record of losses from environmental damages for a minimum period of five years (TDII 2015b).
- Similarly, the People's Bank of China has launched a research initiative into risks from climate change and other environmental risks (Chenet et al 2015).
- Governments, through the UN General Assembly, already support the principle of incorporating disaster risk management techniques into financial practices through the Sendai Framework for Disaster Risk Reduction (United Nations 2015). This framework calls on business and private sector financial institutions to 'integrate disaster management into business models and practices through disaster-risk-informed management', and for public–private collaborations to develop new frameworks and standards. Such thinking is also developing through the UN Environment Programme inquiry into the design of a sustainable financial system.

Why are markets currently failing to account for climate risks?

We have identified three main explanations for this apparent gap in awareness and recognition.

1. 'The tragedy of the horizon'

Many of the most serious climate risks are medium- to long-term, but most regulators and investors are primarily concerned with shorter-term cycles and trends. Bank of England governor Mark Carney has called this problem with the structure of the financial system 'the tragedy of the horizon'.

In thinking about risks and returns, fund managers tend to make buy and sell decisions with a time horizon of 1–3 years (Chenet et al 2015): less than a third of stocks in the market are held for longer than two years (TDII 2014). In many cases, fund managers are incentivised to focus on even shorter time horizons, from quarter to quarter.

Private equity and property investors may consider slightly longer time horizons, up to five years (ibid). Although these crucial time horizons vary between different groups of investor – pension funds and insurance companies, for instance, will typically invest on a 15-year horizon – these longer-term institutional investors may still be guided by the data that is generated by investors with a shorter-term focus.

Similarly, credit rating agencies, which assess the likelihood of a company or government being able to make good on its financial commitments, tend to focus on the short term, considering only risks that are expected to arise up to five years in the future. They also use methodologies that focus on near-term quantifiable risks as opposed to longer-term, systemic risks over 15 years or more (BNEF 2013). Perhaps this is not surprising, given that most credit is relatively short-term: bank loans have an average term of just 4.2 years (TDII 2014).

Since the financial repercussions of climate change are generally not perceived to be significant over these comparatively short timeframes, they do not translate into market signals and are not usually integrated into investors' decision-making. Climate risks (associated with either achieving or failing to achieve climate safety) are thought to be simply too distant to be a material consideration for most of the decision-makers who allocate capital and credit in the real economy today. In the event that ambitious climate policies were suddenly adopted, this approach might change – though this would pose another, different significant risk to the financial system of the kind explored above.

The other problem with the short-term focus of many investors concerns their reluctance to make essential capital investments in expensive clean energy projects that offer returns only in the long term. Investment in other sectors, including in some fossil-fuel companies, may produce greater returns over a shorter time period (ibid), reinforcing institutional bias against investing in low-carbon development projects.[13]

Although there are costly climate-related shocks that could occur at any time and cause major losses (as we highlighted in chapter 1), these are generally not captured in the risk assessment models of businesses, investors and regulators. The explanation for this is explored in the next section.

2. Known unknowns: exactly how big are these risks?

The changes in the climate that we are already witnessing are unprecedented. There is no historical data to feed into the models that are used to calculate the likelihood of certain outcomes or the potential severity of the associated financial risks. Instead, climate risk assessments must be based on uncertain projections, with lots of variables and wide data ranges.

Making matters more complicated, most of the authoritative analyses of climate risks that have been produced are concerned with the likely physical impacts of climate change at a global scale, over vast geographical regions and relatively long periods of time. The practical application of these analyses for financial institutions is not obvious or straightforward. Understanding how all these studies and scenarios, produced on a regular basis by both climate scientists and macroeconomists, can be translated into useful tools to gauge real-world risks and implications for individual companies and portfolios, or even for specific sectors of a national economy, is immensely complicated and intrinsically uncertain. The Royal Society, for one, has identified the need for more, and more relevant, information about extreme weather (and particularly about its local and regional impacts), and for more dialogue between those who generate this information and those who use it to inform their decision-making (Royal Society 2014).

13 Regulators may wish to consider introducing rules to stimulate investment in clean infrastructure, as they have already made similar moves to prioritise investment in small and medium-sized enterprises (SMEs). An example of this is through the EU's capital requirement regulations, designed to protect SME investment as a policy priority.

This problem is made more challenging still by the fact that the actual level of future temperature rises, and thus the particular set of climate risks that should be considered in investment strategies, is unknown. In part this is because of uncertainty around the scale and pace of the policy action that the world will take to curb the output of greenhouse gases – and these efforts are subject to a huge number of variables and may change over a relatively short period of time. Significant changes in the use of different energy technologies or in the resolve of governments to address climate change, for example, could shift our assumptions about possible or likely future damages very significantly.

As we set out in chapter 1, this is a twin dilemma: if decarbonisation ambitions are raised then this is likely to pose significant risks to the value of fossil-fuel assets; and if ambition is *not* raised then this will pose higher risks to other sectors of the economy, caused by increasingly frequent extreme weather events.

The exact nature of the risks we face is poorly understood, even among those financial regulators and investors who wish to take action.

3. Who is responsible for considering these risks?

A landmark 2005 report by the UN Environment Programme concluded that 'integrating ESG [Environmental Social and Governance] considerations into an investment analysis so as to more reliably predict financial performance is clearly permissible and is *arguably required* in all jurisdictions' (UNEP-FI 2005).

Currently, however, the governance regime for the financial sector does not make clear how this should be done or where responsibility for consideration of these risks lies.[14] Indeed, a major new survey conducted by the UN-backed programme Principles for Responsible Investing (PRI), has found that there are still misperceptions among some investment professionals that climate risks are purely ethical issues and thus a matter for public policymakers (Sullivan et al 2015). PRI has also identified widespread scepticism as to whether policy engagement would make any difference, a lack of understanding about policy processes, and concern about the costs of integrating these considerations into investment decision-making (Sullivan et al 2014). There is also a view that policymakers are not serious and so their commitments are not real.

How can investors and institutions improve the way they address climate risk?

Despite all these challenges, the expert debate has focussed on two 'pillars' of responsibility pertaining to the management of climate-related risk.

Fiduciary duties

Fiduciary duties are the legal standards that require all participants in the equity investment chain to put clients' interests first, avoid conflicts of interest, and disclose the direct and indirect costs of the services they provide (Kay 2012).

Some experts have argued that the existing rules governing fiduciary duties in the UK should already capture the need to address long-term risks to investments associated with climate change and other environmental concerns.[15] In contrast, others have cited them as the reason why these factors should *not* be considered (Sullivan et al 2015).

In practice, these laws are mainly interpreted as a narrow requirement for money managers to focus on maximising short-term returns for their investors over and above other considerations (Fair Pensions 2012). In his 2012 review of the equities

14 It is not clear that any single financial-sector organisation, at any stage in the investment chain, could be held to account in the event that climate change does cause major economic losses.

15 That is, that the law already captures these risks, or that it ought to be interpreted and applied as doing so.

market, John Kay identified this as a widespread misinterpretation, and argued that this misinterpretation, and a consequent misapplication of the rules, had become a barrier to more responsible investment (Kay 2012).

Similarly, Aviva Investors has argued that existing fiduciary duties are simply being misapplied:

> *'At the present time the law does appear to place the obligation on trustees to factor in long-term considerations such as sustainability. However, for a myriad of reasons… the letter of the law is not being followed and the majority of trustees are giving insufficient attention to this highly pertinent topic.'*
> Quoted in Law Commission 2014

Others take an opposing view, such as Norton Rose Fulbright senior knowledge lawyer Lesley Harrold, who has said:

> *'There are no legal duties for trustees to take into account climate change.'*
> Quoted in Baxter 2015

Bloomberg New Energy Finance has suggested:

> *'Because they [laws governing fiduciary duties] do not explicitly require trustees to take account of systemic risks such as climate change, or of performance on environmental, social or governance dimensions, investors have tended to avoid such analysis.'*
> BNEF 2013

In light of the confusion that exists on this issue, the Kay review argued that the rules governing fiduciary duties should be clarified as they apply to the investment community (Kay 2012). A subsequent inquiry by the Law Commission – prompted by Kay's recommendation – agreed that fiduciary duties on trustees are 'complex, difficult to find and not well known' and concluded that trustees:

> *'…may take account of any factor which is financially material to the performance of an investment, including environmental, social or governance factors… [and] we think the law goes further: trustees should take into account financially material factors.'*
> Law Commission 2014: 113

The Law Commission did not, however, seek prescriptions as to how investors should approach these factors, and rejected the need for changes to legislation (ShareAction 2015). The commission concluded:

> *'It is for trustees' discretion, acting on proper advice, to evaluate these risks. This will include an assessment of which factors are financially material and the weight they should be given. Trustees may sensibly decide to give factors which are more difficult to assess and quantify less weight than others.'*
> Law Commission 2014: 113

However, since the Law Commission published its findings, it seems that confusion continues to reign. It may be that a test case in the courts could prompt greater consideration of climate risks by fund managers. The CEO of one French pension fund has said:

> *'Because now it has really been made obvious that carbon is a risk, and it's a risk for business, it's now very difficult for anyone to say "Oh, I didn't know it was a risk".'*
> Quoted in EIU 2015: 18

In February 2015 it was reported that the British legal advocacy group Client Earth was planning to bring a test case to clarify fiduciary duties in this regard (see Wheelan 2015).

Reporting on climate risks

Even if investors accept the need to take account of climate risks, financial analysts can only take decisions if the relevant information is available to them.

Yet in the UK there are currently no explicit statutory requirements for listed companies, portfolio managers or any other financial institutions to disclose climate-related risks (or any other environmental risks that could materially affect them), or to 'stress test' their portfolios to gauge their vulnerability to these potential hazards (BNEF 2013). This is despite the fact that many institutional investors, which together own and manage assets worth trillions of pounds, as well as banks such as HSBC (HSBC 2015), have said they *do* view climate change as a material risk to their portfolios (GICCC 2013).[16] By contrast, they are required to reveal other types of shorter-term material risks, such as those related to public policy changes or ongoing legal disputes (EIU 2015).

The greatest step towards effective disclosure has been the various carbon reporting requirements and systems that are now in place. These do, however, have their limitations.

Carbon reporting

The principle behind carbon reporting has been neatly summarised by Lord Adair Turner, former chairman of the Financial Services Authority (FSA), who also advised previous British governments on how to respond to climate risks. He has said:

> *'The first step towards managing carbon emissions is to measure them because in business what gets measured gets managed.'*
> Quoted on CDP website[17]

The primary purpose of carbon reporting is to enable those banks, pension funds and other investors who want to reduce or avoid exposure to highly polluting companies in their portfolios to do so. This may also enable them to reduce their vulnerability to the impact of new climate policies that could reduce the value of their investments.[18] The problem is that there is little evidence to suggest that such data is having a systemic impact.

Information from carbon reporting should also assist regulators to design new incentives and other measures aimed at cutting pollution, and to assess the effectiveness of such measures. However, it is not at all clear that this is happening either.

The Economist Intelligence Unit report for Aviva found that just 1.4 per cent of institutional investors currently have a target to reduce their carbon footprint (EIU 2015). Another survey of the top 500 global asset owners, who between them own $40 trillion in assets, found that nearly half of funds have done nothing at all to protect investors from climate change risks (AODP 2015). This is despite the existence of voluntary initiatives seeking to change behaviour using this reporting information, including the Portfolio Decarbonisation Coalition[19] and the Institutional Investors Group on Climate Change.[20]

16 The CEO of HSBC, Stuart Gulliver, has argued that: 'Increasing the visibility of climate risk would reduce the incentive to maintain a heavy carbon footprint in an investment portfolio, and at the same time incentivise companies and financial institutions to measure and reduce their own carbon footprint' (Gulliver 2015).

17 See https://www.cdp.net/en-US/Pages/About-Us.aspx

18 For background information on mandatory carbon reporting, see http://www.carbontrust.com/resources/guides/carbon-footprinting-and-reporting/mandatory-carbon-reporting/

19 See http://unepfi.org/pdc/

20 See http://www.iigcc.org/

The UK has led the way as the first country in the world to introduce mandatory carbon reporting, introducing the main climate-related reporting requirement into law during the last parliament.[21] This requires certain UK companies[22] to measure and disclose through their annual reports the greenhouse gas emissions that are a consequence of their business practices (Defra 2013).

The government's impact assessment on these rules – published before they were introduced – stated that:

> *'Regulating to require greenhouse gas reporting will ensure that quoted companies have the information and tools to reduce emissions, and, by creating consistency of disclosure, will provide investors and shareholders with information on climate change risks to inform their investment decisions.'*
> HM Government 2011

Since the UK took this step, the EU has passed a new directive,[23] which should take effect in 2016, that will require other European countries to follow suit and ensure that companies disclose to their shareholders information relating to their environmental impact, including their greenhouse gas emissions. The US, Japan and Australia are among other countries that have also introduced similar carbon reporting rules for listed companies.[24]

In addition to this mandatory reporting, carbon reporting has taken place on a voluntary basis – and in varying degrees of detail – for around a decade. Still, a comprehensive study by *Corporate Knights* magazine last year concluded that only 39 per cent of the world's large listed companies disclose emissions information (Corporate Knights 2014).

Organisations such as the Carbon Disclosure Project (CDP) have helped to keep this sort of information available and up to date (EIU 2015). In the UK, 95 per cent of companies in the FTSE 100 provided this data voluntarily, through CDP, as did 79 per cent of the FTSE 350.[25]

In the UK, reporting enjoys the support of the Confederation of British Industry (CBI 2011). Elsewhere, the Montreal Carbon Pledge[26] – a project of PRI and the United Nations Environment Programme (UNEP) – has seen 100 institutional investors (with trillions of dollars' worth of assets under management) commit to measuring and disclosing their carbon footprints. Some European banks have also begun to voluntarily report the carbon emissions associated with their lending (Thoma et al 2015).

According to the Bank of England, there are now around 400 of these initiatives internationally. Governor Mark Carney has argued that the 'surfeit of existing schemes and fragmented disclosures means a risk of getting "lost in the right direction"' (Carney 2015). He said he would recommend to the G20 that a new 'Climate Risk Disclosure Task Force' should be established to ensure that carbon disclosures are:

- **consistent** in scope and objective across the relevant industries and sectors
- **comparable**, to allow investors to assess peers and aggregate risks
- **reliable**, to ensure users can trust data

21 Via the Companies Act 2006 (Strategic Report and Directors' Report) Regulations 2013.

22 All UK incorporated companies listed on the main market of the London Stock Exchange, a European Economic Area market, or whose shares are dealing on the New York Stock Exchange or NASDAQ. This definition captures approximately 1,000 British firms.

23 EU Directive on Non Financial Information, 2014/95/EU.

24 Respectively, the EPA GHG Reporting 2009, GHG Reporting Scheme 2006 and National Greenhouse and Energy Reporting Act 2007.

25 Correspondence with CDP, September 2015.

26 For more, see http://montrealpledge.org/

- **clear** – presented in a way that makes complex information understandable
- **efficient** – minimising costs and burdens while maximising benefits (ibid).

Carney clearly holds the ambition of making carbon reporting work more effectively:

> *'The logical starting point is a co-ordinated assessment of what constitutes effective disclosure, by those who understand what is valuable and feasible.'*
> ibid

Carney has indicated that his favoured approach would go beyond simply disclosing information about carbon emissions to encompass information about other climate risks as well. The aim is to ensure that the information is both higher quality and more usable.

Insurance industry risk analysis techniques
One initiative that potentially offers a more granular form of risk assessment comes from the insurance industry, which has a tried-and-tested approach. In November 2014 the Royal Society highlighted how the re/insurance sector has made considerable progress in evaluating the risks posed by extreme weather, and argued that the insurance industry's methods could be used more widely by organisations in the public and private sectors. This would mean organisations and firms stress-testing their financial exposure to extreme weather events by measuring their solvency against a 1-in-100 (1 per cent) per year risk level – that is, against the maximum probable annual financial loss from the kind of event they could expect to see once in a hundred years. Risks could also be assessed over a shorter timeframe (20 years) and a longer timeframe (200 years) to shine a light on other sensitivities (King et al 2015: 140–149).

This information could be disclosed to investors in a standardised, comparable format based on a shared methodology along the lines recommended by Carney. The information generated could be applied strategically to increase resilience and enable better management of risks.

This is an idea that now enjoys strong support within the financial sector, including among credit ratings agencies such as Standard and Poor's; leading insurance companies such as the Willis Group; and among accountancy firms including PwC (UNCS 2014).

In a report commissioned by the UK Foreign and Commonwealth Office, leading industry thinkers Rowan Douglas, Steve Waygood and James Cameron set out how this model could work to produce data that could be applied usefully by markets and regulators:

> *'Based on the insurance methodology it would be possible to design a common risk reporting framework that could be applied to all entities (public, private and mutual) including companies, cities and even countries. This would assess risks to each entity's interests under a common template of risk classes, probability thresholds, and periods of time, and translate this into annualised costs, which would be proportionately reduced with greater resilience or reductions in risk.'*
> King et al 2015: 144

There is now a credible precedent in the marketplace for stress-testing portfolios against climate risks. For a cost of £15,000–£20,000, the global consulting firm Mercer will offer investors a full portfolio climate-risk assessment, taking into account both risks from climate impacts, such as extreme weather, and risks from climate policies (Mercer 2015). This service is already provided to 12 large UK-based funds, and is now being extended to look more closely at the risk to real assets – such as

real estate or agriculture investments – from climate change, using many of the tools of the insurance industry that we have referred to above.[27] This sort of assessment could be incorporated into regular portfolio reviews, which consider strategic asset allocation rather than specific stock-picks and usually take place around once every three years. For funds worth several billion pounds, the costs associated with conducting this kind of stress-test are negligible, but the returns could be great: such a process would encourage and enable the risk-adjusted allocation of capital, which should in turn help to build resilience across the system.

Credit ratings agencies (including Moody's and Standard & Poor's) are understood to be developing their own climate risk assessment models based on a similar approach. Potentially, public science providers, such as the Met Office, could offer their expertise to help develop open-source risk modelling platforms too.

Despite this encouraging progress, challenges remain. There are technical questions about how information generated through these sorts of assessments should be linked to market incentives and decision-making related to asset allocation, particularly while the typical investor's time horizon remains comparatively short. More generally, this kind of approach is likely to face resistance within the investment community until there is a greater recognition that the risks involved are genuinely material. Nevertheless, these are challenges that could be overcome, particularly with the leadership of the Bank of England.

27 Correspondence with Mercer, August 2015.

3. CONCLUSIONS AND RECOMMENDATIONS

Chapter 1 of this paper set out the ways in which climate risks threaten the UK's prosperity and identified some of those who could experience the worst impacts.

Chapter 2 explains why markets do not currently take sufficient account of these risks: because they are seen as too distant to be a financial consideration; because the nature, scale and timing of risk events is unknown; and because there is a widespread belief that climate change is primarily an ethical concern and a matter for public policymaking rather than institutional decision-making.

To address these shortcomings in the market's approach to the risks associated with climate change, IPPR makes the following recommendations.

Recommendations to build understanding of where the UK economy is vulnerable to climate risks

Following the Paris summit, a cross-party group of MPs, such as the Environmental Audit Committee (EAC), should run a parliamentary inquiry to examine the preparedness of leading UK public and private sector institutions to deal with climate-related risks.

This new inquiry could help MPs to identify the UK's greatest areas of economic vulnerability and to understand how levels of preparedness vary across different sectors of the economy. Its focus should be on the risks associated with likely temperature increases based on the commitments made by governments in Paris.

Business leaders should be required to outline the climate risks they believe they are facing and how – as 'weather takers' – they are addressing them. They should also be required to disclose their strategies for meeting the global climate objectives set at the Paris summit – that is, how they will fulfil their responsibilities as 'weather makers'.

The enquiry could also call for evidence from certain business figures and institutional investors to learn how their company operations are consistent with the carbon reduction targets implied by national climate change commitments.[28]

Recommendations to ensure financial decision-makers have the information they need in order to account for climate risks

Building on existing UK carbon reporting, MPs should consider whether to require disclosure of climate risks and, if so, over what time period. This could be followed by regular climate-related stress testing of listed companies and financial institutions in Britain.

A stress test approach could use modelling of the kind used for decades by the insurance industry to test the potential financial impact of a maximum probable annual financial loss that an individual or organisation could expect once in a

28 That is, via 'intended nationally determined contributions' (INDCs).

hundred years, based on the latest scientific evidence. This would reveal the likely level of resilience of different businesses.

Work by the Royal Society, the UN Environment Programme and leading thinkers in the private sector indicates that it is now possible to run detailed modelling in order to understand the potential economic impact of climate risks. This information should be disclosed in a standardised, comparable format based on a shared methodology, to ensure consistency across the marketplace. Disclosure of this information would be particularly useful in helping financial decision-makers to assess and manage risk.

The French government legislated earlier this year to formalise best practice by requiring listed companies and institutional investors to undertake climate stress tests. MPs should consider whether rules like this should be introduced – or at least piloted – in the UK.

Furthermore, national science research organisations – such as the Royal Society, Met Office, government chief scientists and research funding councils – should collaborate with private-sector risk and resilience modelling agencies to advance research that can usefully inform financial decision-making.

This would ensure risk-assessment modelling within the financial services industry is based on the best and most recent scientific understanding. Uncertainty surrounding the reliability of scientific projections on climate risks can be addressed through targeted funding for, and greater dialogue between, those institutions funding and undertaking the research into risks and those who can usefully apply their findings within the real economy.

Recommendations to ensure asset managers do not ignore these risks in their decision-making

The government should clarify the law governing fiduciary duty so it is clear that climate risks that materially impact upon the value of investments must be taken into account by institutional investors.

Some have argued that the existing UK rules governing fiduciary duty already capture the need to address long-term risks to investments associated with climate change, but others claim that current rules mean these factors should *not* be considered. Overall, the availability of climate risk assessments increasingly indicates that there is an ability to take on board the material risks arising from climate change where there may not have been previously.

Recommendations to reduce the overall level of the risk that most businesses face as a consequence of climate change

The government should continue to deploy policies that incentivise investment in clean energy and reduce the relative economic attractiveness of the most polluting practices – for example, through carbon pricing and other carbon mitigation policies.

The Paris Agreement has sent a clear signal that the era of fossil-fuel-powered growth is coming to an end. But current national plans are not sufficient to achieve this. The UK should champion the strengthening of national climate targets in the first review of commitments under the agreement in 2020.

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