



# **Climate Risk Management for Financial Institutions**

*Prepared by the Actuaries Institute's Climate Change Working Group*

Lead authors: Alison Drill, Sharanjit Paddam & Stephanie Wong

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## Acknowledgements

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**Lead authors:** Alison Drill, Sharanjit Paddam (convener of CCWG), & Stephanie Wong (secretary of CCWG),

**Contributing authors:** Natalie Warren, Julie Sims, Wayne Kenafacke, Avanti Patki, Ignatius Li

**Reviewers:** Elayne Grace, Tim Andrews, Alissa Holz

## About the Climate Change Working Group

The Actuaries Institute published its public policy statement<sup>1</sup> on the *Economic Implications of Climate Change* in December 2015, and in January 2016 formed the CCWG as a working group under the Public Policy Practice Committee.

The CCWG purpose is to support the Actuaries Institute's public policy position by supporting and encouraging:

- The ongoing research into understanding and managing the financial and economic implications (risks and opportunities) of climate change, and informing the public debate
- The development of Government policy to improve resilience against natural disasters and to design funding mitigation and adaptation measures supported by comprehensive cost benefit analyses
- Measures, as per government commitments, for the reduction in greenhouse gas emissions, improved energy efficiency and the development of renewable energy sources. We also support the development of policy to address the significant implications for Australian business and society from the transition to a low-greenhouse gas economy.

As part of the first objective above, the CCWG has produced this paper. It is intended to be addressed to the boards and senior management of financial institutions, and to provide insight and understanding on how financial institutions can manage the financial and economic implications of climate change. The key question we are seeking to address is:

*How can Boards of Directors of financial institutions deal with the risks posed by climate change?*

In particular, this paper describes how existing actuarial methods, such as enterprise risk management, can be applied to manage the risks arising from climate change. This paper is also intended to be helpful to actuaries who may be working to assist financial institutions in managing climate risk, or who may be commenting within actuarial reports, such as financial condition reports, on any material climate risks to the financial institution.

The CCWG intends to continue its work to address the second two bullet points in 2017. Members of the Actuaries Institute and others are encouraged to contact the CCWG if they would like to be involved in the CCWG.

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## Imagine this... I

"How did this happen?"

"I'm sorry about all of this, but thanks for coming in to see me. It's been a while since we talked about your finances and the advice I'm providing you. But back to your questions about the home insurance for now: After that last east coast low, the bank did a review of all its home loans, and it's been enforcing the requirement for everyone to have buildings insurance, and I wanted to check how you were going with getting buildings insurance for your investment property?"

"After all the storms these last few years, the prices have skyrocketed for flood cover. Even the policies that don't cover us for flood are now nearly a third of the value of the home loan! We called the insurance company owned by our bank and they didn't want our business!"

"Yes, the bank has realised that it can't risk insuring the same properties it's on risk for with a home loan. You had an interest only loan – right?"

"Yes, so we could make the most of the tax deductions. We were going to use a lump sum from our super to pay it off when we retired, but that's all gone wrong too."

"Yes – I did want to talk about your super with you as well. What's the latest on that?"

"Well the class action lawyers think we have a good chance of winning the case against the trustees, but it's all down to insurance again. The trustee's insurance just doesn't cover the amount we all lost. Apparently there's lots of evidence that the trustees knew that climate change would have an impact on returns all the way back in 2016, but they did nothing about it! When the market turned so suddenly we all lost out. We all thought it was conservatively managed with blue chip stocks with high dividends, but those stocks turned out to be mainly mining companies and financial institutions that were invested in mining!

"And it's not like I had a lot in my super anyway, after they closed down the last coal power station, the coal industry came crashing down I've been doing odd jobs here and there for the past ten years trying to keep myself going. My back won't let me do that anymore, and I thought at least we have that investment property up in Queensland to keep us covered during retirement!"

"It's a huge mess, and everyone seems to be blaming everyone else. The insurers are saying it's the banks, they are saying it's the homeowners' problem, the homeowners are blaming the banks and insurers and the government. Sadly, with reductions in the aged pension again, there's a lot of people in the same position."

"I just don't know what we could have done different! We always took care of ourselves financially, but it's all come to nothing. Can we just sell the property and pay back the bank?"

"You could try, but it's very unlikely you'll get enough to cover the outstanding loan. Compared to 2016, no one wants to buy there, even though it's a beautiful spot. Unfortunately the bank had a lot of loans up there, and they had assumed that they weren't going to be at risk so many years after they'd written the loans, or that the property values would have fallen so much. I'm not sure the bank will survive anyway."

"There doesn't seem to be any good news."

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(See Imagine this ... II at end of this paper)

## Executive summary

### Climate risk poses a systemic holistic threat to our economy

Financial institutions play a critical role in our economy. They are the front line in managing all financial risks, including those posed by climate change<sup>2</sup>. The stability of our economy and financial system as a whole will depend on how quickly and deeply financial institutions adapt to the risks faced by the Australian economy from climate change.

Climate change is likely to directly impact economic sectors that make up nearly 50% of gross value added in Australia. Further, secondary effects, such as through financial institutions and employment opportunities, will result in an overall impact on the Australian economy that is substantial and material.

### Households and businesses face increasing and changing risks from climate change

Households are exposed to a variety of climate risks. People's homes, wages, superannuation, investments, insurance premiums, energy bills and home repair bills will all be adversely affected by climate change. Businesses are similarly exposed through their physical assets, to increased disruption to their own operations and throughout the supply chain, and finally through legal liability.

### The Paris agreement really changes everything

Since the Paris Conference of the Parties in 2015, the questions faced by Boards have changed rapidly. The ratification of the Paris Agreement on 4 November 2016 has provided certainty that governments will act to address the threat of climate change, and a growing realisation of just how much impact a transition to a low carbon economy will have on the world economy. While the time frames involved may be long and there is uncertainty around the extent of effects, there is little uncertainty about the fact that change will happen, and that financial institutions need to adapt to the evolving business environment in order to protect their enterprise value.

### There is no longer an option to ignore climate change

We have passed the point of considering whether or not Boards need to act. Recent legal opinion from leading members of the Australian legal profession<sup>3</sup> suggests that many climate change risks "would be regarded by a court as being foreseeable at the present time". It is possible that Australian company directors "who fail to consider climate change risks now could be found liable for breaching their duty of care and diligence in the future".

### It's about the customer, and the shareholder

Boards will need to identify, quantify and manage climate risk exposures across their operations, not only because of these legal issues, but also because of the material impact on their customers and shareholders.

### Make better choices using an Enterprise Risk Management framework

We discuss in our paper how financial institutions can establish and follow an Enterprise Risk Management framework to bring together the multiple ways climate change poses risks to all the company's stakeholders. This framework facilitates a rigorous cost-benefit analysis to compare adaption and mitigation strategies, and allows the company to actively manage and validate the plan over time.

### Financial institutions that meet their customers' needs will be rewarded

All these individuals and businesses have looked to the financial sector to help them manage their financial risks. For financial institutions that adapt quickly to the changing needs of their consumers, there is the potential to improve both profitability and stability. Financial intuitions that fail to adapt to the changing needs of customers will face increasing reputational and political risks, as well as reducing profitability and increased volatility in returns for shareholders.

# 1 What are the financial risks of climate change?

## 1.1 Types of financial risk

The Climate Change 2014 Synthesis Report of the Intergovernmental Panel on Climate Change (IPCC)<sup>4</sup> notes that “In recent decades, changes in climate have caused impacts on natural and human systems on all continents and across the oceans. Impacts are due to observed climate change, irrespective of its cause, indicating the sensitivity of natural and human systems to changing climate.” The report also states that “Climate change will amplify existing risks and create new risks for natural and human systems.”

Climate change poses financial risks through three main mechanisms, as identified by the Bank of England’s Prudential Regulation Authority (PRA)<sup>5</sup>:

- **Physical Risks:** the first-order risks which arise from weather-related events, such as floods and storms. They comprise impacts directly resulting from such events, such as damage to property, and also those that may arise indirectly through subsequent events, such as disruption of global supply chains or resource scarcity.
- **Transition Risks:** the financial risks which could arise for insurance firms from the transition to a lower-carbon economy. For insurance firms, this risk factor is mainly about the potential re-pricing of carbon-intensive financial assets, and the speed at which any such re-pricing might occur. To a lesser extent, insurers may also need to adapt to potential impacts on the liability side resulting from reductions in insurance premiums in carbon-intensive sectors.
- **Liability Risks:** risks that could arise for insurance firms from parties who have suffered loss and damage from climate change, and then seek to recover losses from others who they believe may have been responsible. Where such claims are successful, those parties against whom the claims are made may seek to pass on some or all of the cost to insurance firms under third-party liability contracts such as professional indemnity or directors’ and officers’ insurance.

All three risks pose issues for Financial Institutions, and we discuss each in turn below.

### 1.1.1 Physical risks

The physical risks of climate change arise from the expected changes to weather-related events from an increase in global mean temperatures. These weather-related events include floods, storms and cyclones, but also extend to droughts and bushfires. The natural catastrophes damage property and disrupt trade. General insurance companies provide coverage for property damage and business interruption to individuals and businesses, and their liabilities are directly exposed to climate change. However, other financial institutions, including investors in property (including superannuation funds and investment funds) and banks with mortgages on properties are also exposed to losses.

Rises in global mean temperatures can also have more subtle physical effects such as impacts on health<sup>6</sup> and consequently life expectancy. Thus life insurers and health insurers are also exposed.

### 1.1.2 Transition risks

Transition risks are financial risks that arise from a transition to a low-carbon economy. They are driven by two major forces:

- Government policy designed to mitigate the emission of carbon and other greenhouse gases in order to prevent rises in global temperatures, and
- Changes in technology which substantially reduce the demand for carbon intensive assets, such as improved battery storage.

The ratified Paris Agreement<sup>7</sup> is an example of policy driven climate risks. Signatory nations to the agreement have agreed to reduce their carbon and greenhouse gas emissions in order to limit global mean temperature increases to 2 degrees Celsius. In 2014, the Carbon Tracker Initiative<sup>8</sup> estimated that in order to stay below 2 degrees Celsius, 80% of the world's known carbon reserves will have to remain unburned. In order to remain below 2 degrees Celsius, we would need to ensure that we do not breach this carbon budget. There is therefore a significant risk that the value currently attributed to carbon intensive assets will never be realised. Those assets will become stranded assets.

The transition risk is that the energy markets fail to transition away from fossil fuels in an orderly manner. This includes the possibility that in the short term renewable assets may be overvalued due to low supply<sup>2</sup>, and the possibility that fossil fuel assets suddenly fall in value.

### 1.1.3 Liability risks

Liability risks arise in two major ways:

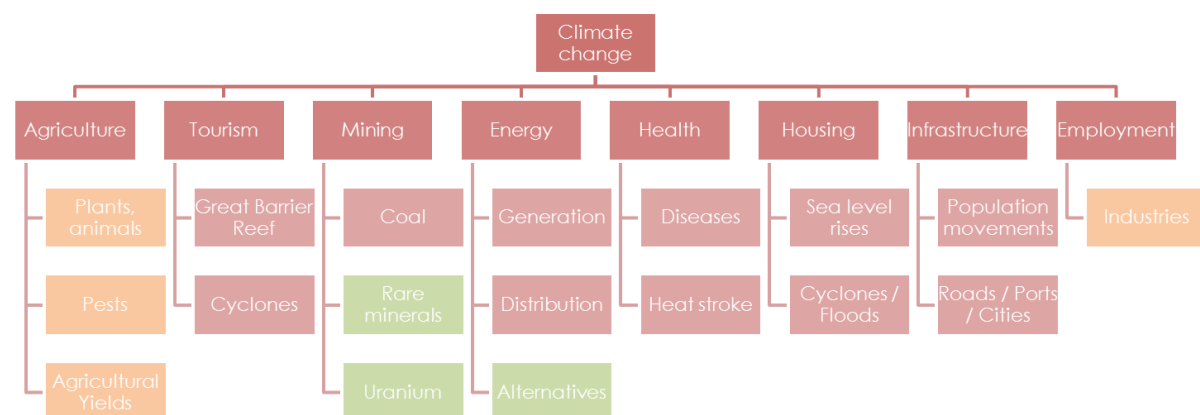
- Insured liabilities for losses arising from compensation for damage from climate change
- Legal actions against directors and companies for failing to adapt to or mitigate against climate change

Whilst those pursuing the actions described above have had limited success to date, it's important to recognise the systemic nature of this risk. Where a single legal decision establishes a precedent for liability, the flood gates may open to further claims. The latent nature of liability risks are particularly concerning for insurers providing liability coverage to companies and their directors & officers.

## 1.2 Economic sectors

Climate change will impact a range of economic sectors, through the types of risks described above. It will also provide opportunities for some economic sectors, such as renewable or nuclear energy. Figure 1 illustrates some potential impacts, which are discussed further in Section 4.

**Figure 1 Economic sectors affected by climate risks**



## 1.3 Economic impact of climate change

### 1.3.1 Review of economic models to date

In order to evaluate policy and strategic responses to climate change, a range of models have been developed in order to quantify the economic impact of climate change.

Integrated assessment models (IAMs) analyse the physical and socio-economic effects of climate change simultaneously in order to deal with the complex interactions between the physical risks and their financial impact.

Some models focus on a complete cost-benefit analysis of climate change mitigation in order to find the optimal policy with the highest net benefit, whilst others look at the cost-effectiveness of achieving a particular mitigation target with a given policy.

There are many difficulties in weighing up costs and benefits of any particular target scenario for future increases in global mean temperatures. These difficulties include the following.

- Balancing costs to the current generation against benefits to future generations, possibly many years in the future
- Countries will be affected differently, some may be lost completely as sea levels rise
- Probabilities for future temperature levels are difficult to estimate
- The impacts of those temperatures are difficult to value, particularly impacts like biodiversity loss and human health.

Despite these limitations, the British and American governments have relied on IAMs to generate estimates of the social cost of carbon and so to assist them to decide on an appropriate climate change policy. IAMs are also a key tool in the analyses of impacts of climate change performed by the IPCC.

At the time of the Garnaut review in 2008<sup>9</sup>, most Australian studies were aimed at estimating the costs of greenhouse policy, but not the benefits<sup>10</sup>. International studies to date give little information that is directly relevant to Australia as it is aggregated with other countries. The one Australian model that was capable at the time of estimating both costs and benefits, ABARE GIAM, did not have a sufficient range of climate change effects to give a realistic base case.

When Garnaut updated his review in 2011<sup>11</sup>, he concluded that “advances in climate change science had therefore broadly confirmed that the earth is warming, that human activity is the cause of it and that the changes in the physical world are likely, if anything, to be more harmful than the earlier science had suggested.”

IAM modelling of Australia was done in 2015 by McKibbin in consultation with the Department of Foreign Affairs and Trade<sup>12</sup>. This modelling assessed the economic impact of Australia’s 2030 commitment to reduce greenhouse gas emissions by 26% below 2005 levels. It found only a very modest reduction in GDP arising from the commitment.

However, recent papers have been very critical of the current generation of IAMs. In 2013 Stern<sup>13</sup> noted that although IAMs have produced valuable insights, they “generally leave out many effects, recognized as potentially very large, which are not easy to make precise or formal enough for integration into the modelling.” ... “Most IAMs struggle to incorporate the scale of the scientific risks, such as the thawing of permafrost, release of methane, and other potential tipping points. Furthermore, many of the largest potential impacts are omitted, such as widespread conflict as a result of large-scale human migration to escape the worst-affected areas. Because the IAMs omit so many of the big risks, social cost of carbon estimates are often way too low.”

In 2013, Pindyck<sup>14</sup> went further: “IAMs are of little or no value for evaluating alternative climate change policies and estimating the social cost of carbon.”

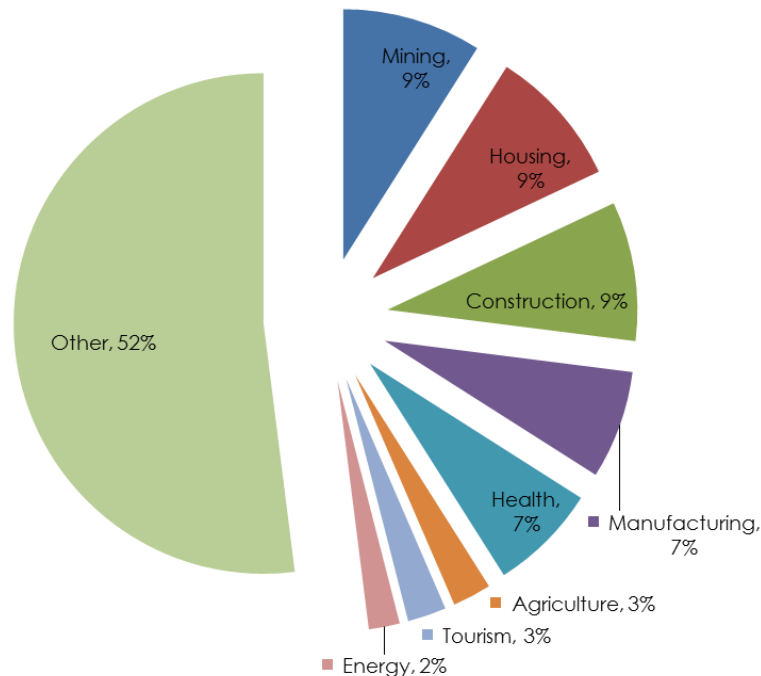
However, despite these criticisms, these authors do not consider that we should wait until there are better models available. Rather, they recommend a price on carbon should be set now using the best available means, and revised as better cost estimates become available.



The lack of bipartisan agreement on action in Australia adds further difficulty. Taylor, in CEDA<sup>15</sup> says, “Policy uncertainty will hinder the changes that Australia undoubtedly needs to make, since it increases perceived risk attached to actions that individuals or organisations may take, and so increases the cost of change and reduces the amount of change achieved.”

### 1.3.2 Economic impact by sector

Figure 2 Proportion of gross value added



Source: ABS

Figure 2 shows the proportion of gross value added by economic sector based on ABS statistics. Combining this with Figure 1 suggests that more than 50% of economic activity may be directly impacted by climate change.

Under this categorisation, the Financial Services sector would be impacted on a secondary basis, through the mechanisms discussed in Section 1.1.

The remainder of this paper addresses the financial services sector. It discusses how financial institutions are exposed to climate risk, and proposes a framework for how financial institutions can better manage these risks.

## 2 How are financial institutions exposed to climate risk?

- Climate change is a material financial risk. Boards of Directors of financial institutions need to understand the different ways in which climate risk can emerge, assess their company's exposure, manage the risks, and make appropriate public disclosures on these risks.
- Failure to do so could constitute a breach of directors' legal obligations, but will also lead to material financial risks for the financial institution.
- Households and businesses, who are the customers of financial institutions, will face financial challenges due to a combination of the economic impacts of structural change, and decreased affordability and increased volatility of expenses.
- Increased uncertainty in the values of both assets and liabilities leads to more potential for earnings volatility and higher capital requirements. This can affect the share price of a financial institution.
- There is a risk of contagion impacts flowing through the economy, especially through the supply chains of businesses and financial institutions.
- Investors are increasingly seeking information on the exposure of financial institutions to climate risk

Financial institutions should complete a climate risk exposure assessment to understand the extent to which their company is exposed. This chapter examines how Customers, Shareholders and Management could be impacted by climate change. The likelihood of the risks occurring and the severity of the impact will depend on the level of risk mitigation and management undertaken by both by governments and the underlying company.

### 2.1 Household customers

#### 2.1.1 A household customer's balance sheet

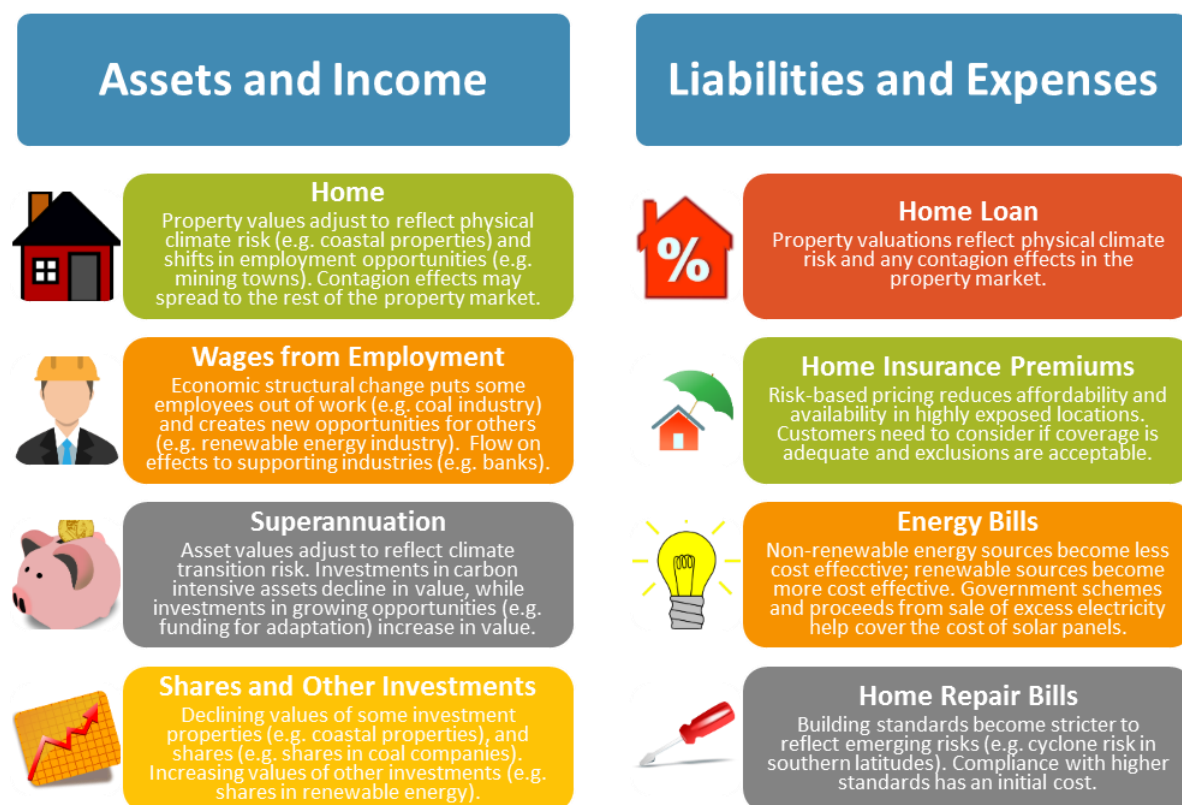
- Climate change has the potential to put strain on the household budget of some through its impacts on property values, employment, investment returns and other household costs. These effects can flow on to financial institutions through the behaviour and purchasing decisions of customers.

Customers of financial institutions often have relationships with multiple financial service providers, and may be impacted by multiple events, all of which originate from climate change. The preface to this paper illustrates one example of how individuals could be adversely affected if financial institutions do not undertake risk mitigation and management actions. Financial institutions will need to respond to climate change because the risks of climate change directly affect their customers, and those customers look to financial institutions to provide products and services to manage their financial risks.

The behaviour and purchasing decisions of customers will take into consideration climate risks and how they affect the household budget. For example, a customer may choose to take on more self-insurance by choosing a higher excess on their insurance policy in exchange for a lower premium. This could lead to volatile household expenses from covering the cost of natural peril events – using a financial institution's financial statements as an analogy, this means higher volatility of household 'profits'. It also means households will need more savings to cover unexpected costs – that is, increased requirements for household 'capital'.

Figure 3 illustrates how climate change affect different parts of a typical household's 'balance sheet'. Sections 2.1.2 to 2.1.9 explains how each of these items are exposed, as well as the implications on financial institutions of their customers' climate risk exposures.

**Figure 3 Potential climate change impacts on household ‘balance sheet’ in the absence of risk management and mitigation actions**



### 2.1.2 Home

#### House prices

Climate change has the potential to cause a home or piece of land to become uninhabitable, leading to a fall in value. This may occur in an orderly manner over time, as the property market gradually factors in increasing understanding of climate risk, or it may occur as a sudden price correction driven by an extreme event.

The department of Climate Change and Energy Efficiency estimated that coastal erosion poses a threat to Australian property of up to \$63 billion in 2008 dollars<sup>16</sup>, a figure which The Climate Institute estimates would be \$88 billion after adjusting for the increase in value of residential dwelling stock to 2015 levels<sup>17</sup>.

#### Contagion risks

The Climate Institute<sup>17</sup> further points out that while climate change may directly impact only a small proportion of properties (e.g. coastal properties), contagion effects may spread more widely throughout the property market. The falling price of coastal properties may well give falling prices for non-coastal properties.

#### Communities

Communities that have been built around carbon intensive industries, such as the Hunter Valley in NSW, are particularly exposed to the risk of a fall in property values driven by an economic transition away from these industries.

### 2.1.3 Future wages from employment

#### Economic activity and employment

As the economy adapts to climate change and to the concept of a carbon budget (see Section 1.1.2), we expect to see major structural change across many economic sectors, including agriculture, tourism, mining, energy, health, housing and infrastructure. Appendix A gives further detail on how each of these industries will be affected. Structural change will have secondary impacts on other parts of the economy that rely on the affected sectors or provide services to these sectors.

#### Social risks

The human impact of a shift to a low-carbon economy is increasing unemployment for people currently working in the affected industries. Communities like Latrobe Valley in Victoria, which contain 500 years' worth of brown coal under the ground and support Australia's four brown coal-fired power stations, fear that they will be displaced if the power stations continue to be shut down<sup>18</sup>. This can lead to the affordability of housing, insurance and other financial products becoming an even more important issue for those affected. As illustrated in the preface to this paper, unemployment could conceivably affect households at the same time as other climate impacts, further exacerbating the negative consequences.

#### Opportunities

The upside of the economic transition to a low-carbon economy is that new employment opportunities will arise in growing industries such as renewable energy, energy storage, infrastructure to support climate risk adaptation, and financing of adaptation projects.

### 2.1.4 Superannuation

#### Disclosure

The Asset Owners Disclosure Project has estimated that 55% of superannuation and pension funds are invested in high-carbon assets, or industries exposed to climate change impacts<sup>19</sup>. Despite the risks of stranded assets (see Section 1.1.2), the Asset Owners Disclosure Project found that only 5% of asset owners disclose measuring the impact that stranded assets scenarios may have on their investments<sup>20</sup>.

#### Duties of trustees

Members of superannuation funds expect the trustees to protect their interest and make decisions which generate returns on their investment over the long term. The stranded assets problem means that climate risk not just an environmental issue, but a financial risk which could have a material impact on investment returns. Members who experience financial loss due to mismanagement of climate risk by trustees may seek to recover losses on their investments through legal action. One example where this has occurred in the United States is the Arch Coal pension fund, described in Case Study 3.

#### Transparency and additional disclosure

Superannuation fund members are increasingly calling for transparency of portfolio holdings so that members can judge for themselves whether their fund is invested in the types of industries and companies they want to be invested in. Disclosure is expected to become mandatory in mid-2017, when the Australian government's proposed disclosure laws are scheduled to commence<sup>21</sup>. This information could be used by activist groups to put pressure on funds to lower their exposure to fossil fuel investments, and is a source of reputation risk for funds which are heavily invested in high carbon assets.

## 2.1.5 Shares and other investments

### Equity investment

36% of the adult Australian population own shares either directly, through listed investments, or through unlisted managed funds, outside of superannuation funds<sup>22</sup>.

Figure 4 ASX 200 market capitalisation by sector (as at Aug 2016)<sup>23</sup>

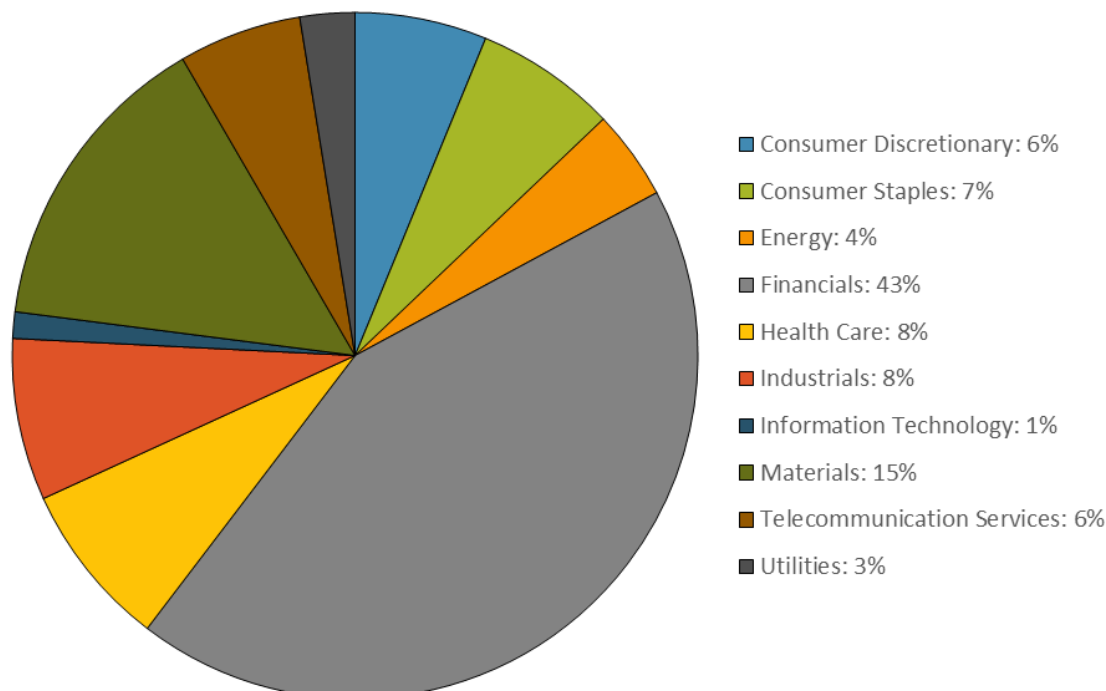


Figure 4 shows the composition of the ASX 200 by sector. Large sections of the share market are potentially exposed to climate risk, either directly or indirectly.

- The energy sector is expected to experience major impacts from climate change, as described in Appendix A.
- The materials and industrials sectors, which together make up 23% of the index, are exposed to potential future changes in carbon regulations that may have an impact on demand for their products or the costs of running business. They are also exposed through provision of materials and services to other businesses directly exposed to climate risk.
- The financial sector, which is the largest ASX sector, takes on risks through lending and selling insurance to directly exposed businesses.

Climate risk exposures may have flow on impacts to the share prices of the affected businesses, which will affect the investment returns to shareholders.

There is also potential for investment gains to be made from industries that may benefit from climate risk, such as the renewable energy sector.

Individual businesses within each of these sectors would experience varying degrees of impact depending on how they operate and how they have managed their climate risks. Climate risk management is discussed further in Section 3.

## Fixed income investments

Corporate debt and other fixed income investments will face similar risks to equity investments as discussed above. Further, Australian sovereign debt, at a Commonwealth, State and Local level may also be impacted by climate change. There is a particular risk due to Australia's carbon-intensive economy, as well as our limited fiscal options due to existing levels of debt. Further, transition risks may result in reduced taxes and royalties from carbon-intensive sectors such as mining and electricity generation.

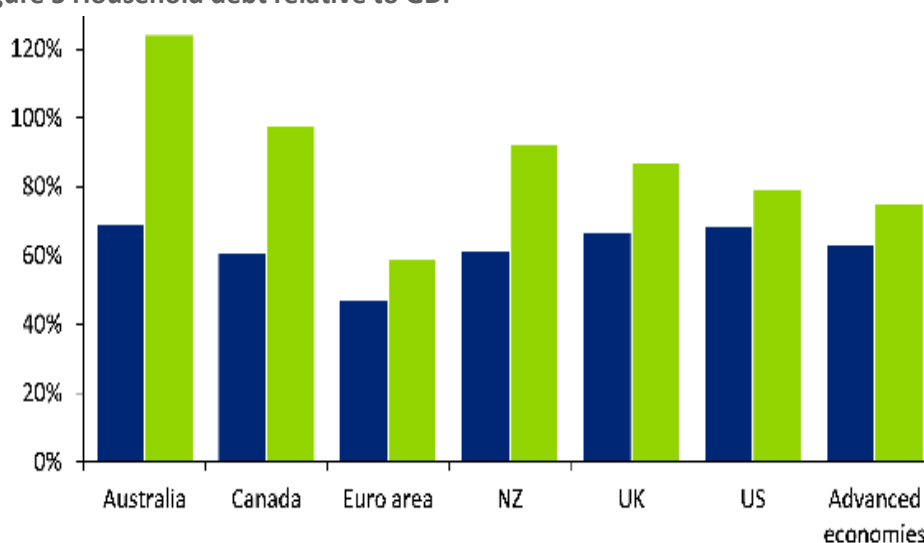
## Property investment

Some people also have investment properties, which carry similar risks to residential properties and home loans, as described in Section 2.1.6. There may also be climate change-related effects on affordability and availability of landlord insurance, as described in Section 2.1.7. These factors all have the potential to impact returns to investors from property investments.

### 2.1.6 Home loans

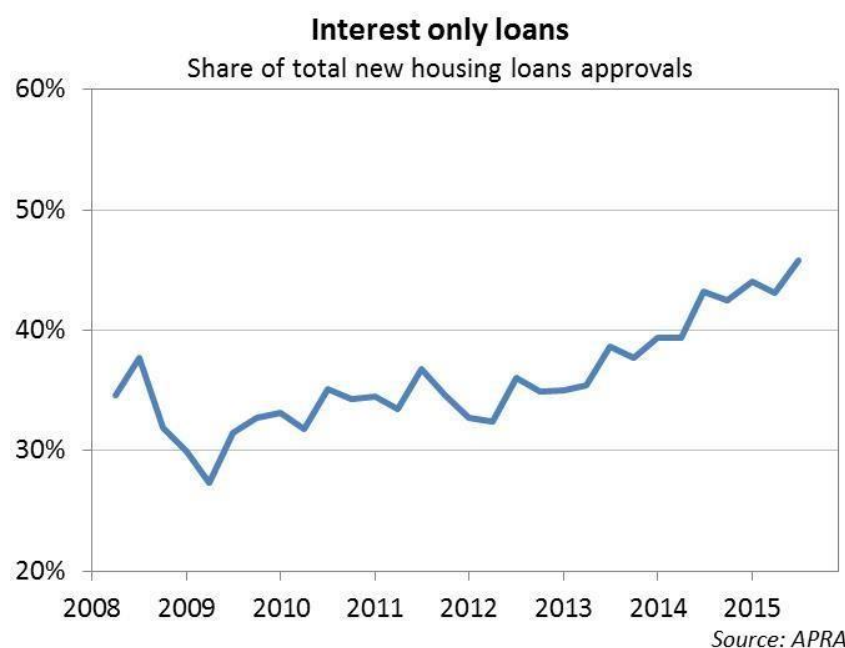
Australia's level of household debt is currently amongst the highest in the developed world, with the highest ratio of household debt to GDP out of the 44 countries reported on by the Bank for International Settlements. Figure 5 shows that in 2015, Australian household debt reached more than 120% of GDP. Deloitte Access Economics notes that much of the increase in Australia's household debt has been driven by house price growth, which has risen faster than national income over recent years<sup>24</sup>.

Figure 5 Household debt relative to GDP<sup>24</sup>



Interest only home loans have grown over time as a proportion of new lending, partly because investors have become a larger share of total housing loans, and partly because both investors and owner-occupiers have been increasing their use of interest-only lending<sup>25</sup>. Figure 6 shows interest only loans as a proportion of total new housing loan approvals over time.

Figure 6 Interest only loans as a share of total new housing loan approvals<sup>25</sup>



### Negative equity

Customers who have taken out interest only home loans are particularly at risk due to fact that their equity in the property does not build up over time, unlike a traditional home loan. This means there is increased risk of falling into negative equity (where the outstanding amount of the loan is greater than the value of the home), either due to general property market devaluation or a catastrophe event. For example, following the Christchurch earthquake, many home owners were offered government buy-outs of their property at values well below what they paid for their house and suffered substantial financial losses<sup>26</sup>.

Most Australian mortgages are issued on a 'full recourse' basis, which means that even if borrowers have negative equity because property values have fallen to be lower than the outstanding home loan, they are still obligated to repay their loan. The risk of property devaluation remains with the borrower, and provides a level of financial protection for the bank.

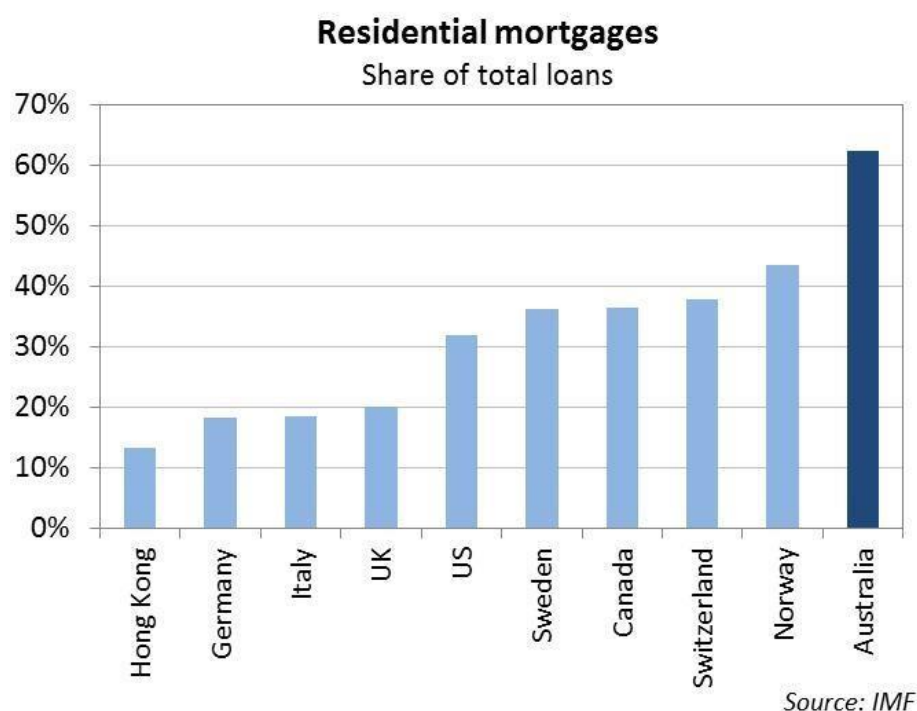
### Reputational risk

However, recent negative media attention on lenders' mortgage insurers chasing customers to recoup losses<sup>27</sup> demonstrates the potential for reputational damage, even if banks and insurers have the means to protect themselves from the financial consequences of customers defaulting. If customers who are forced to pay back negative equity loans feel that they have been treated unfairly, they could similarly generate publicity that results in reputational damage to their lenders. The potential losses stemming from negative public opinion could exceed the financial losses from the bad debt, which means in such a situation, banks may choose to write off loans ex gratia.

### Banking sector

Lending for housing has grown over time to become the largest business line for many Australian banks<sup>28</sup>. Currently, housing lending represents about 60% of Australian banks' domestic lending<sup>29</sup>, and 40% of the banking industry's assets<sup>25</sup>. High concentration in this single business line means climate impacts on home loans has significant implications for banks, building societies and credit unions.

Figure 7 Residential mortgage share of total loans over time<sup>25</sup>



Mortgage contracts are long term, typically with terms of 20 to 30 years. This means banks are already exposed to financial and reputational risks of climate change today from their existing portfolio, even if the actual events do not occur until 20 years into the future.

As banks increasingly take climate risks into account in property valuations, customers may also find it increasingly difficult or expensive to obtain loans for properties in geographical locations with high exposure to physical climate risk. This represents another potential source of reputational risk for financial institutions.

### 2.1.7 Home insurance premiums

#### Affordability of insurance

One way in which households will directly experience the physical impacts of climate risk on their household expenses is through increasing insurance premiums for buildings and contents. The perceived affordability of home insurance premiums therefore represents a significant reputational risk for insurers.

Even if the premiums charged are an accurate reflection of the level of risk, if individual customers experience financial distress due to increasing unaffordability issues in relation to insurance, negative media attention could still be directed at the insurance company. This was recently experienced in Northern Australia when a series of cyclone events prompted insurers to reassess cyclone risks, resulting in public outcry over large premium increases over a short period of time<sup>30</sup>.

Typically, insurers set risk-based prices for natural hazards cover by:

- Selecting an Average Annual Loss (AAL) representing a view on the long term average cost for each natural peril.



- Then allocating the cost according to an assessment of the relative risk of each insured property, taking into account physical, engineering and meteorological factors. For example, the premium to cover cyclone risk may be allocated according to distance of the insured property to the coast, which is a measure of how likely the property is to be hit by a cyclone, and the material that the building is constructed from, which is a measure of how much it would be damaged if a cyclone did hit it.

Harwood et al<sup>31</sup> estimate climate change impacts are likely to be minimal for the median household as most Australian homes do not have significant bushfire, flood or cyclone risk, but the worst affected homes could see buildings premiums equating to approximately 38% of annual income by 2100. This means that households in high risk areas will bear a disproportionate amount of premium increase, which could lead to insurance premium affordability issues.

### Availability of insurance

Insurers may choose to pull out of providing cover for certain areas. This may be due to the frequency or severity of events occurring being considered too high without appropriate adaptation actions being undertaken. One example of where this has occurred is in Roma, Queensland, where Suncorp placed an embargo on new home and contents insurance policies for 16 months following three successive years of flood events, until construction work began on a levee to protect the town<sup>32</sup>.

### Political risk

In other instances, the premiums charged may be so high that in effect, insurance becomes unavailable. Pressure on the government to intervene with a solution to lack of availability of insurance, which may be seen by some as market failure, becomes a source of political risk for insurers.

### Coverage and exclusions

Home insurance policies typically provide cover for buildings and contents, but not the land itself. For example, actions of the sea are excluded by some insurers in the Australian market<sup>33</sup>. The recent astronomical high tide at the time of the June 2016 east coast low which affected Collaroy and other areas highlights the threat to coastal properties, and the potential reputational damage if the public blame the insurance industry for failing to provide adequate cover. These exclusions leave the customer or the mortgage provider exposed to the risk even if insurance is purchased on the property.

If the level of coverage offered by existing products no longer meet customers' needs, then customers may see little value in buying building insurance at all.

### Assessing natural peril risk exposure

In the past, it was difficult for owners of residential properties to assess their natural peril risk, especially climate change-related impacts which may change over time. More recently, tools have been developed which allow homeowners to access some of this information, including:

- Coastal Risk Australia BETA – interactive map illustrating predicted coastal flooding resulting from climate change under a range of sea level rise scenarios<sup>34</sup>
- NRMA Safer Homes – assesses fire, theft, water leaks and bushfire risk for individual properties, as well as providing advice on how to reduce the risk<sup>35</sup>
- Queensland Flood Mapping Program Interactive FloodCheck Map – interactive map with likely extent of floodplains, historic floodlines and flood simulations<sup>36</sup>

## Self-insurance

To some extent, there is potential for customers to reduce the cost of insurance by self-insuring more of the risk, for example by accepting more policy exclusions, taking on higher excesses or choosing lower sums insured. Customers may also choose full self-insurance by not purchasing insurance. However, if an event did occur, the cost of rebuilding would exacerbate the affordability problem.

## Product opportunities

There are opportunities for insurers to develop new products or product features to recognise the benefits of risk mitigation. For example, Suncorp's Cyclone Resilience Benefit recognises features and mitigation measures that have been undertaken in Northern Australian homes and offers a premium discount to eligible customers to reflect their reduced risk. This also has the additional benefit to the community of encouraging preparedness and risk mitigation before a natural hazard event occurs. Further examples of new product opportunities arising out of climate risk mitigation are discussed in Section 3.5.2.

### 2.1.8 Energy bills

The cost of electricity, gas and fuel are likely to increase initially as the environmental impacts of energy generation become incorporated into the price of energy via emissions trading schemes, taxes or other regulations.

Over time, as renewable energy generation, transmission and storage technologies becomes more developed and more cost efficient, renewable energy costs are expected to decrease. Advances in battery storage technologies such as the Tesla Powerwall and Redflow also have the potential to make solar panels more cost efficient by allowing solar energy to be stored for use at night. Australia has already seen a very high take up of rooftop solar, and batteries are also expected to be popular, not least because they can prevent blackouts in the event of a power outage across the grid.

Government schemes such as the Small-scale Renewable Energy Scheme<sup>37</sup>, encourage installation of solar panels, wind turbines and hydro systems in private homes. Households are able to receive money for Small-scale technology certificates created by their renewable energy systems, as well as sell excess electricity fed into the power grid for a feed-in tariff<sup>38</sup>. This helps to cover the cost installing the solar panels, and reduce household energy bills.

### 2.1.9 Home repair bills

The quality of construction and any adaptation measures incorporated into a building's design are significant factors in determining how much damage the building will take in a natural hazard event. The Australian Building Codes Board sets minimum standards for buildings to 'withstand extreme climate related natural hazard events'. If the standards prove to be insufficient, as was identified following Cyclone Althea in 1971 and Cyclone Tracy in 1974, then building standards will be upgraded to ensure adequate levels of safety<sup>39</sup>.

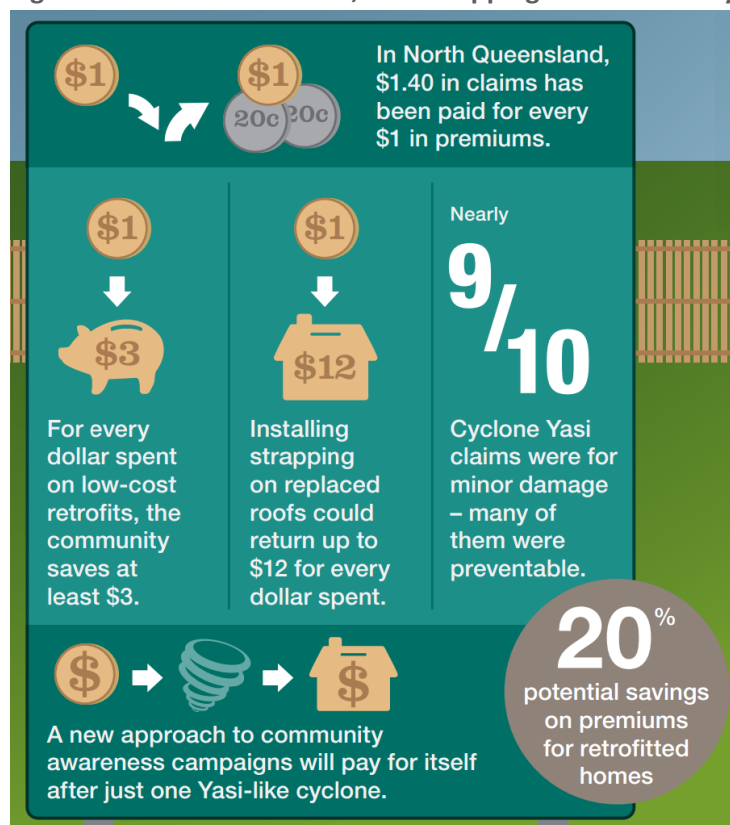
Newer buildings are generally built to higher standards than older ones, and incorporate adaptation features such as:

- Improved ability withstand high winds, consistent with updated cyclone building standards introduced in 1982
- More bushfire resistant buildings in bushfire prone areas
- Contemporary energy efficiency standards that reduce the impacts of extreme heat and heat stress<sup>40</sup>.

A report by the ABCB found that existing building standards are ‘reasonably adequate’ for climate-related hazards anticipated in 50 years’ time, under a low emissions scenario. However, the study also indicates that under a high emissions scenario, the current building codes ‘may be deficient in some areas’ (ABCB, 2013).

Figure 8 illustrates how simple low-cost retrofits, roof strapping and community awareness campaigns can have significant benefits that could ‘pay for themselves’ relatively quickly.

**Figure 8 Benefits of retrofits, roof strapping and community awareness<sup>41</sup>**



Even if such adaptation measures do not become mandatory, households that recognise the benefits may voluntarily adopt them. While households will have to fund the initial cost outlay, they may also receive immediate financial benefits that offset some of this cost, such as reduced insurance premiums if these risk reduction measures are recognised by their insurer.

Section 3.4 discusses risk mitigation and adaptation strategies and how cost/benefit ratios can be used to prioritise adaptation measures. Local councils and individual home owners could also apply a similar methodology to select which adaptation measures are worth adopting.

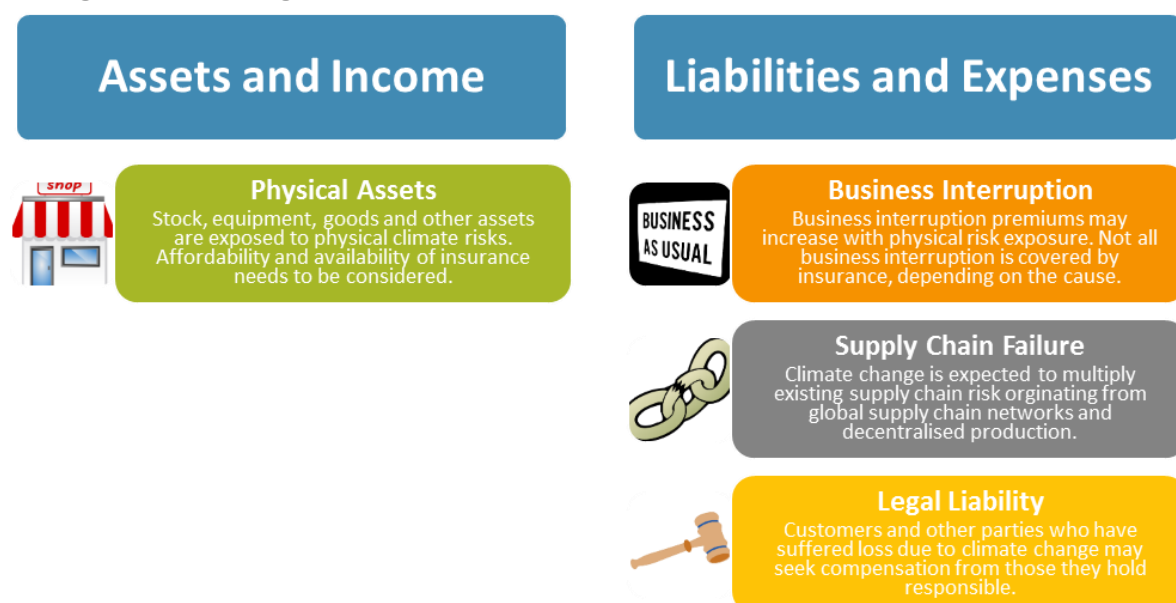
## 2.2 Business customers

- Many of the climate risks that are relevant for a household are also relevant for businesses across a wide range of industries. Business customers have additional commercial aspects to consider, including stock and equipment, business interruption, supply chain risks and legal liability.

### 2.2.1 A business customer's balance sheet

Figure 9 illustrates how climate risks may affect a business's balance sheet, in addition to the considerations already discussed in Section 2.1 for household customers. These aspects apply in varying degrees depending on the type of business and size of business being considered.

**Figure 9 Potential climate change impacts on business 'balance sheet' in the absence of risk management and mitigation actions**



### 2.2.2 Physical assets

The physical assets of a business are exposed to physical climate risks. The issues discussed in Section 2.1.7 concerning the affordability and availability of property insurance, as well as any exclusions, are also applicable to businesses. For example, following the 2008 flood of Bowen Basin coal mines which cost insurers over \$500 million in flood damage and business interruption claims, BHP moved to self-insurance of the affected mines<sup>42</sup>, perhaps because insurance coverage could no longer be purchased at a viable price.

Stock, equipment, goods are also at risk of physical damage. Even if the physical value of these are insured, business need to consider the cost of business interruption following from any damage.

### 2.2.3 Business interruption

What is perhaps more significant than the physical damage caused by a natural hazard event is the subsequent impact on businesses' ability to continue carrying out their operations.

Business interruption insurance is an important aspect of business continuity. According to a 2010 Cameron Research report, only 40% of Australian businesses had business interruption cover<sup>43</sup>.

Businesses are exposed to possible increases in business interruption risk insurance premiums if their location is exposed to increased natural hazard risk, or if they are exposed to other disruptions such as electricity failure that are also covered by the policy.

#### Coverage issues

Even if a business has business interruption insurance, indirect interruptions may not be covered, depending on the policy wording. For example, following the Brisbane flood in 2011, some small business owners had their business interruption claims denied because their buildings were not directly inundated during the flood, even though they lost business because parts of the city were inaccessible<sup>44</sup>.

## Business continuity planning

In addition, businesses should be aware of other business continuity planning considerations, including IT recovery strategies, such as offsite backups of important data, and communications with customers and employees in the event of a natural disaster.

## Economic impacts

Broader influences on the economy may also affect the revenue of businesses, even if they are not impacted directly. For example, a downturn in the tourism industry following a natural disaster could flow on to slower growth for travel agencies and related businesses. Such slowdowns are unlikely to be covered by business interruption insurance.

### 2.2.4 Supply chain

The interconnectedness of global supply chain networks and the trends towards decentralised production means that a natural disaster in one area can have indirect impacts across the global economy. The effect that the 2011 Thailand floods had on global hard drive prices, described in Case Study 1, is one example of how this could occur.

Non-physical risks can also cause supply chain failure, for example if a major supplier is impacted by transition or liability climate risks (as described in Section 1.1.3). Climate change is expected to have a 'multiplier effect' on any existing supply chain risk<sup>45</sup>.

Supply chain risk in the particular context of financial institutions is discussed in further detail in Section 2.4.2.

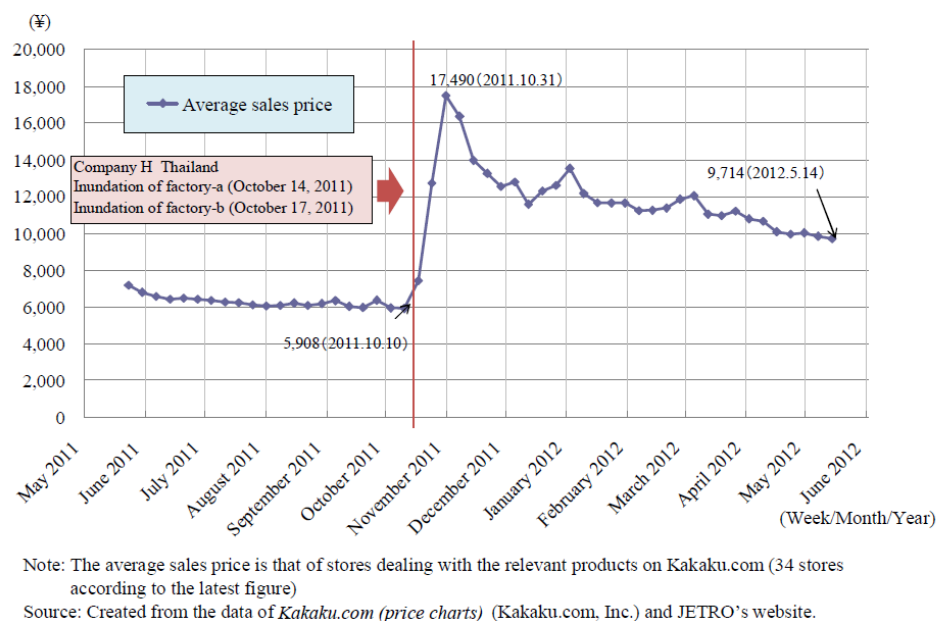
### Case Study 1: 2011 Thailand floods and HDD prices

The 2011 Thailand floods are an example of how a local disaster can have indirect impacts that flow through the global economy through the supply chain.

In November 2011, flooding of the Chao Phraya River in Thailand caused extensive damage to the industrial sector. Prior to the floods, Thailand produced approximately 43% of the world's hard disk drives (HDDs)<sup>46</sup>. The flooding caused factories of major manufacturers of HDDs to be inundated, leading to loss of stock and loss of production facilities<sup>47</sup>.

The shortage of HDDs had impacts on consumer prices across the globe. For example, analysis by METI indicates that the price of HDDs in Japan nearly tripled immediately after the flood, and remained higher than pre-flood levels for months after the event<sup>46</sup>.

**Figure 10 Average sales price of HDDs in Japan before and after the Thailand flood<sup>46</sup>**



This further led to impacts down the global supply chain on businesses relying on Thai suppliers, with Intel losing \$1 billion of revenues as a result, and set-top box manufacturer Pace issuing a series of profit warnings<sup>48</sup>.

Auto parts makers were also substantially affected by the same flood event, leading to production disruptions for car manufacturers like Toyota, Honda and Mitsubishi<sup>49</sup>.

Since these floods, many manufacturers have diversified their production, for example by opening facilities in nearby Philippines. Diversification of the production chain is an example of a strategy to manage risk – further examples are discussed in Section 3.5.

### 2.2.5 Legal liability

Businesses also face liability risk arising from climate change, from customers and other parties who have suffered loss due to the effects of climate change seeking compensation from those whom they hold responsible.

Some possible scenarios include:

- Coal extractors and coal-fired power stations being sued for contributing to climate change via carbon emissions.
- Local governments being sued for failing to undertake adequate mitigating actions (see Case Study 2: Farmers Insurance sues local governments for ignoring climate change).
- Property developers being sued by homeowners for developing on flood plains, along coastlines and in other areas which are highly exposed to climate risk, after a climate event happens and causes property values to fall.
- Brokers selling unsuitable policies to customers without explaining that certain risks, such as actions of the sea, are not covered.
- Investment managers and superannuation trustees being sued for continuing to invest in assets exposed to the risk of becoming 'stranded assets' (see Case Study 3 Arch Coal Pension fund investment in coal shares).

Insurance companies are exposed to the above risks via their customers, through commercial liability and directors and officers insurance claims. Banks who have offered loans to commercial customers are also at risk if the customer goes bankrupt as a result of the legal action.

#### **Case Study 2: Farmers Insurance sues local governments for ignoring climate change**

In 2014, Illinois Farmers Insurance Company filed a number of lawsuits arguing that local governments in the Chicago area knew that climate change would lead to heavier rainfall, but failed to prepare adequately to prevent future flooding<sup>50</sup>.

It was alleged that the local governments did not do enough to increase the capacity of sewers and stormwater drains, which therefore led to flooding during two days of heavy rain in April 2014. 'By adopting "the scientific principle that climate change has caused increases in rainfall," the Plaintiffs insist that the Defendants acknowledged a causal link between climate change and heavier rainfall. In short, the Defendants allegedly knew that the infrastructure was insufficient and failed to cure it.'<sup>51</sup>

Trent Frager, a spokesman from Farmers Insurance, stated that Farmers 'hoped the suit would encourage cities and counties to do more to reduce the risks of future flooding'<sup>52</sup>.

Michael Gerrard, director of the Centre for Climate Change Law at Columbia Law School in New York, says that these lawsuits are the first of their kind, and that "we will see more and more cases" like this<sup>53</sup>. They also raise the question of how local governments should manage their budgets to prepare for natural disasters, especially if climate change increases their frequency or intensity.

Maxine Burkett, an associate professor at the University of Hawaii Law School, says that this lawsuit draws to attention the risk that municipalities and other entities are taking by continuing to build in dangerous areas with regards to climate change<sup>54</sup>.

Farmers subsequently voluntarily withdrew the litigation<sup>51</sup>.

## **2.3 Shareholders**

Climate risks will impact shareholder returns via the investment assets, liabilities, profits and capital requirements of financial institutions. They present a challenge for Boards of Directors to develop a strategy to maximise shareholder value and manage reputation risks within a changing economic environment.

If these climate risk exposures are not assessed and managed by individual financial institutions, there is potential for accumulations across the industry to threaten the stability of the financial system as a whole.

### 2.3.1 A financial institution's balance sheet

Figure 11 illustrates potential climate risk impacts on a financial institution's own balance sheet, in addition to the effects of any behavioural changes flowing from events that affect their household or business customers. Below, we discuss how the exposures of insurance companies, banks and superannuation funds to climate risks, and how these risks may affect their finances and strategy.

#### Correlated risks

It is important to highlight that the overall risk of climate change is compounded by the fact that the impacts could hit both sides of the balance sheet at the same time – a drop in investment asset value (e.g. fall in value of a financial institution's holdings of coal mining company equities) is likely to happen at the same time as a blow out in liabilities (e.g. increase in a banks' bad debt provisions due to a fall in property values in coal mining towns), since the underlying causes are all related to climate risk and regulatory or economic responses to climate risk.

Figure 11 Potential climate change impacts on financial institution 'balance sheet' in the absence of risk management and mitigation actions





### 2.3.2 Investment assets

#### Range of asset types

All financial institutions are potentially exposed to climate risk via the movement of investment asset values in response to physical, liability and in particular, transition risks. This includes investments in Australian and international equities, corporate bonds, infrastructure and property, as well as managed funds which hold these underlying assets.

#### Transition to low-carbon economy

As the economy undergoes structural shift to adapt to climate change, some investments, such as those in carbon-intensive industries, are expected to fall in value. Material impacts are now already being felt in some industries, driven by a combination of factors, including climate change and environmental policy decisions made both in Australia and globally. Tim Buckley from the Institute of Energy, Economics and Financial Analysis (IEEFA) commented that “If you are investing in coal companies in the last five years, in America you would have lost 99 per cent of your money. In Australia, you probably would have only lost 70 per cent of your money.”<sup>55</sup>

#### Opportunities

At the same time, new investment options are expected to benefit from the shift in the world’s economy and energy markets, including new and emerging renewable energy investments.

#### Secondary impacts

These effects will flow through the economy to investments in industries that are indirectly exposed, such as those that provide finance or services to the affected industries.

#### Timing issues

What makes this effect difficult to quantify is that the timing and magnitude of the shift in asset values is uncertain, depending on the greenhouse gas emissions trajectory, the resulting impact on the global climate, the desire for companies to diversify into cleaner technologies and how quickly the financial markets respond. As explained in Section 1.1.2, assets which are recognised as being stranded due to increasing acceptance of a global carbon budget may devalue quickly and suddenly once financial markets price in this risk.

Financial institutions who act early to manage their portfolios against climate risk are at an advantage, as they divest of climate risk-exposed assets at a higher selling price than others who only divest after demand for these assets has already fallen. Research by Mercer<sup>56</sup> indicates that the average annual returns from the coal subsector could fall by anywhere between 18 and 74 percent over the next 35 years.

Conversely, institutions who act early to take advantage of the opportunities offered by emerging industries will benefit from investing at a lower price before others ‘jump on the bandwagon’. Mercer’s research indicates that the average annual returns of the renewables sector could increase by between 6 and 54 percent over the next 35 years<sup>57</sup>.

#### Measure, monitor and act first

Financial institutions should measure and monitor the climate risk exposures of their investment portfolios in order to understand any accumulations of risk and to confirm their investment risk is within the institution’s risk appetite. This includes both direct exposures through holdings of bonds, equities and other investments, as well as indirect exposures through managed funds.

Institutions who are able to act early are at an advantage compared to those who act only after the financial markets have priced in carbon constraints and climate impacts.

### 2.3.3 Liabilities

#### Policy terms

The majority of Australian general insurance policies have a 12 month period of cover, which means that the insurer is only exposed to risk for the next 12 months, whereas the owner or resident will be exposed to longer term trends and risks, such as climate risk.

Banks, however, typically issue mortgages with terms of 20 to 30 years. Although full-recourse loans in Australia means most of the risk associated with a fall in house price due to climate change remains with the individual, banks are still exposed to the flow-on credit risk if individuals subsequently default. It is important to note that even though we are considering events that may or may not happen in 20 years' time, the risk already exists on the balance sheets of banks today, due to the long term nature of loan contracts.

#### Bad debt provisions

The recent commodity price crash illustrates how financial impacts can easily flow from low commodity prices in the resource sector into increased bad debt provisions in the banks' balance sheets via business lending. In March 2016, ANZ flagged an increase of \$100 million in bad debt provisions from \$800 million, driven by exposures to the resource sector, particularly Peabody Energy and Arrium<sup>58</sup>.

#### Property values

The value of properties in mining towns has also fallen as mines close down or scale back operations. One recent example is the mining town of Moranbah in Queensland, where the median value of residential land has fallen by more than 40% in the year to March 2016<sup>59</sup>. Investors who bought property during the mining boom now unable to sell because there are few willing buyers. This has led to bankruptcies and bank repossession of houses, but the banks also face difficulties with realising the value of the loan collateral due to lack of willing buyers. In a mining downturn, similar scenarios could occur across a large number of mining towns at the same time, with impacts on bad debt provisions of housing lenders.

The banking sector will be affected by bankruptcies and bad debts from both personal and commercial loans due to both physical climate risks and the economic impacts of structural change away from carbon-intensive industries. Section 3.3 gives an example of how a bank could measure and quantify their exposures by combining the information on their book of properties with natural catastrophe models borrowed from the general insurance industry, then overlay non-performance and default assumptions to capture other economic impacts.

### 2.3.4 Earnings volatility

The revenues and costs of a financial institution don't respond in the same manner to climate change risks. For example:

- Home insurance premiums are a fixed amount for the term of the contract, whereas the volatility of claims cost will change over time due to the physical effects of climate change.
- Loan acceptance and pricing are determined at the time the loan is taken out, whereas bad debt expenses are affected by climate change impacts on employment and on property values.

Consequently, the profit of a financial institution will become more volatile from year to year, which means its dividends may also become more volatile. In order to compensate for this additional risk, shareholders would typically demand a higher return. If the equity market recognises this increase in future risk at a particular point in time, this could lead to a sudden drop in share price at that time, whether or not the risks do eventuate in future.

Options exist for financial institutions to reduce earnings volatility while operating within the same risk appetite, such as purchasing additional reinsurance. However, there is a financial cost to transferring risk this way in the form of reinsurance premiums, which will flow into lower expected profits.

Volatility of earnings also has implications for liquidity management of a financial institution. There is a trade-off between higher investment returns on less liquid assets and the need to hold enough liquid assets to cover unexpected occurrences like claim payments for extreme weather events.

**Box 1: Managing earnings volatility**

Some considerations for the Board of a financial institutions in understanding and managing the volatility of its profits include:

- Is the level of earnings volatility in line with the Board's risk appetite and shareholders' expectations?
- Is the existing reinsurance strategy appropriate as a tool for managing earnings volatility under a climate change scenario?
- Are the current limits on the holdings of liquid assets sufficient for meeting cash flow needs if earnings volatility increases under a climate change scenario?
- Are there any concentrations of risk which could amplify volatility of profits?

### **2.3.5 Strategic/Economic risks**

The implications of climate risk on shareholder value as discussed in Sections 2.2.1 to 2.2.4, combined with the expectation that climate risk effects will flow through the whole economy, means it poses a significant strategic risk to financial institutions. As the economy adapts to the concept of a carbon budget, certain markets will contract, while others will grow.

**Box 2: Adapting business strategy to a climate change world**

A successful financial institution needs to adapt its business plan and objectives in anticipation of changes to its business environment, rather than wait until the changes occur before reacting.

Some of the strategic considerations relating to climate risk include:

- Any industries or geographical locations that the institution no longer wants to lend to or insure because the risk is beyond its risk appetite.
- The composition of investment assets taking into account the climate risk exposure of the issuer and the sector of the economy it is in. This includes looking through to the underlying assets held by external fund managers.
- Opportunities to innovate to take advantage of emerging risks by selling new products and investing in new investment instruments, such as those examples described in Section 3.5.2.
- Encouraging and helping customers to invest in adaptation to reduce their exposure to climate risk, hence reducing mortgage defaults, and both physical and liability insurance claims. This helps prevent contraction of the size of the market (due to the risks increasing beyond the financial institution's risk appetite) at the same time as improving reputation by helping the community.
- Lobbying governments to invest in adaptation works (e.g. flood levees) that both benefit the community and reduce the financial institution's exposure to physical climate risks.

We address these considerations in Section 3.5.

### 2.3.6 Reputation risk

With increasing public awareness of the risks associated with climate change, investments or management actions that contribute to increased climate risk, for example financing a coal mine, may increasingly be seen as socially irresponsible.

The world's largest investment funds, including Norway's Norges Fund (\$800 billion) and Australia's Future Fund (\$100 billion) have already chosen to divest their investments in coal in response to pressure from stakeholders<sup>60</sup>. There are opportunities for financial institutions that integrate environmental, social and governance factors into their decision making to satisfy their shareholders' ethical criteria.

Australian banks have in the past also been targeted for lending to carbon-intensive industries such as coal projects, despite making statements in support of the 2 degree Celsius warming target. There have been calls for banks to stop new lending to coal projects in order to allow the current \$8 billion of coal-related loan book to run off over the next five years<sup>61</sup>. This presents a possible opportunity to gain credibility with customers and shareholders and hence improve reputation.

The possible reputational impacts of insurance coverage and affordability issues are discussed in Section 2.1.7, and those of banks' actions on negative equity home loan defaults are discussed in Section 2.1.6.

### 2.3.7 Capital requirements

Climate risk has implications on the capital requirements of a financial institution. Adequate capital is required to ensure the company has a buffer against uncertainty, and to protect the interests of customers.

## Banking capital requirements

The Switzerland-based Basel Committee on Banking Supervision is handing down recommendations on the increased counting of mortgages to capital and APRA has acted on these by increasing the risk rate and overall capital requirements. However, this is based on the current perception of the quality of the mortgage debt and not on the possible future devaluation of properties due to climate risks.

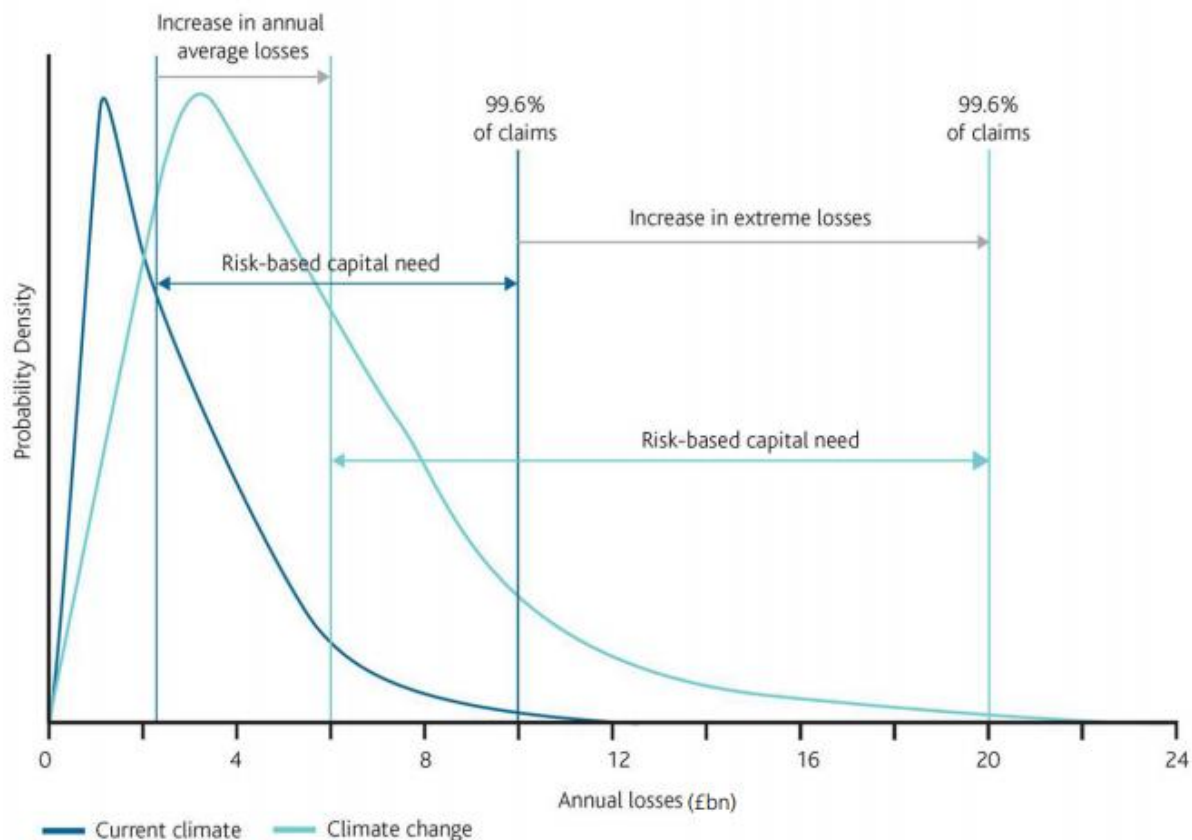
## Insurance risk

In order to determine risk based capital requirements, an insurer needs to consider:

- Average Annual Losses: the expected losses over a 'normal' year, which is a key component of setting the insurance premium
- Extreme Losses: the losses occurring in a 'bad' year, e.g. if a significant catastrophe occurs.

Capital is required to cover the gap between expected and extreme losses, to ensure the insurer can pay its claims even after a significant catastrophe<sup>62</sup>. Figure 12 shows that an increase in average and extreme losses due to climate risk will increase the amount of risk based capital required to support a given level of risk appetite.

**Figure 12 Increase in risk based capital required to support increase in average and extreme losses<sup>62</sup>**



To illustrate the potential size of the increase to risk based capital, the Association of British Insurers' study indicates that under a high emissions scenario, a total of \$76 billion of additional capital could be required to cover the gap between extreme and average losses from tropical cyclones in the US and Japan<sup>62</sup>.

## Credit risk

In order to understand their exposure to climate risk, banks should consider whether their credit risk models adequately capture exposure to concentrations of residential lending to coastal properties and concentrations of commercial lending to carbon-intensive industries. Contagion effects in related industries and throughout the broader economy also need to be considered.

## Market risk

All financial institutions also need to consider the potential impacts of climate change transition risk on their investment assets, as described in Section 2.3.2, as well as what additional capital may be required to support the market volatility.

## Rating agency considerations

Financial institutions also need to consider the impact of climate risks on their credit rating. Moody's Investors Service, an International credit ratings agency, has announced that it will use national climate action commitments put forward by countries in the April 2016 Paris Climate Change Agreement in its baseline scenario for analysing the credit implications of carbon transition risk analysis. Brian Cahill from Moody's explains that the adoption of the Paris Agreement “substantially increases the likelihood of coordinated and effective policies to reduce carbon and other greenhouse gas emissions over time, which has in turn the potential to become a significant ratings driver in a broad set of industries”<sup>63</sup>.

Moody's has identified the following categories of carbon transition risk that it will use to in assessing credit implications:

- Policy and regulatory uncertainty regarding the pace and detail of emissions policies;
- Direct financial effects, such as declining profitability and cash flows, due to higher research and development costs, capital expenditure and operating costs;
- Demand substitution and changes in consumer preferences; and
- Technology developments and disruptions that cause a more rapid adoption of low-carbon technologies<sup>63</sup>.

Moody's also considers physical climate risks in their credit risk assessments, however due to the high uncertainty and long time frame, physical risks are not currently a material credit rating driver.

The incorporation of climate risk into credit ratings has direct impacts for financial institutions and other corporations because it affects the cost of borrowing, due to investors demanding compensation for taking additional credit risk. Credit ratings affect shareholder confidence and the ability of a corporation to raise capital. Financial institutions may also be required to satisfy credit rating targets in their risk appetite statement.

**Box 3: Capital strategy and management**

Some considerations for capital strategy, taking into account the capital requirements to support the uncertainty associated with climate risk, include:

- Are the risk exposures of the company still in line with the Board's risk appetite?
- What are the capital requirements of the company in order to satisfy its risk appetite?
- Can the company generate enough return on required capital to satisfy shareholders?
- Are there opportunities for the company to generate higher returns (e.g. encouraging policyholders to take risk-mitigating actions that reduce the severity of claims)?
- Can required capital be optimised through risk management (e.g. underwriting to reduce exposure to geographical areas exposed to extreme climate risks)?
- Is the existing reinsurance strategy appropriate under a climate change scenario?

## 2.4 Management

- Senior management of financial institutions also need to consider operational aspects that will affect the day to day management and running of the company. These include legal liability issues, supply chain risks, cost of operations as well as governance and disclosure requirements.

### 2.4.1 Liability of management and directors

Directors and trustees of corporations, including financial institutions, have legal obligations to act in good faith in the best interests of their company, as well as act with due care and diligence that a reasonable person in the role would be expected to show<sup>64</sup>.

Due care and diligence can be demonstrated by actively identifying and assessing the material physical, liability and transition climate risks on all aspects of the institution's finances and operations. Where material risks are identified, suitable mitigation actions or risk management plans need to be considered. Section 3 provides further details on how climate risks can be identified, assessed and managed using an enterprise risk management framework.

If a Board of Directors fails to take adequate action, they may face the risk of being held legally accountable by their shareholders and members. The Arch Coal pension fund case described in Case Study 3, provides one example of where this has already occurred in the United States.

### Case Study 3 Arch Coal Pension fund investment in coal shares

The Arch Coal Inc Employee Thrift Plan was established by Arch Coal, Inc., the second largest US coal producer<sup>65</sup>, to provide for the retirement income of its employees. It has over US\$546 million in plan assets<sup>66</sup>.

In 2015, members of the employee pension plan sued the trustees and individual directors and officers of the retirement plan, seeking compensation for the drop in value of pension funds invested in Arch Coal's stock. The lawsuit covers the three year period from the beginning of 2012 to the middle of 2015, over which Arch Coal's stock price dropped roughly 97% from \$13.87 to 44c per share<sup>67</sup>.

The plaintiffs allege that the trustees and directors breached their duty of due care and diligence because they did not consider whether company stock continued to be a prudent investment for the employees' retirement savings. They allege that the trustees didn't consider the structural decline of the coal industry, and didn't take into account the economic indicators of the company, including mine closures, credit rating agency downgrades and increased debt to equity ratio<sup>68</sup>.

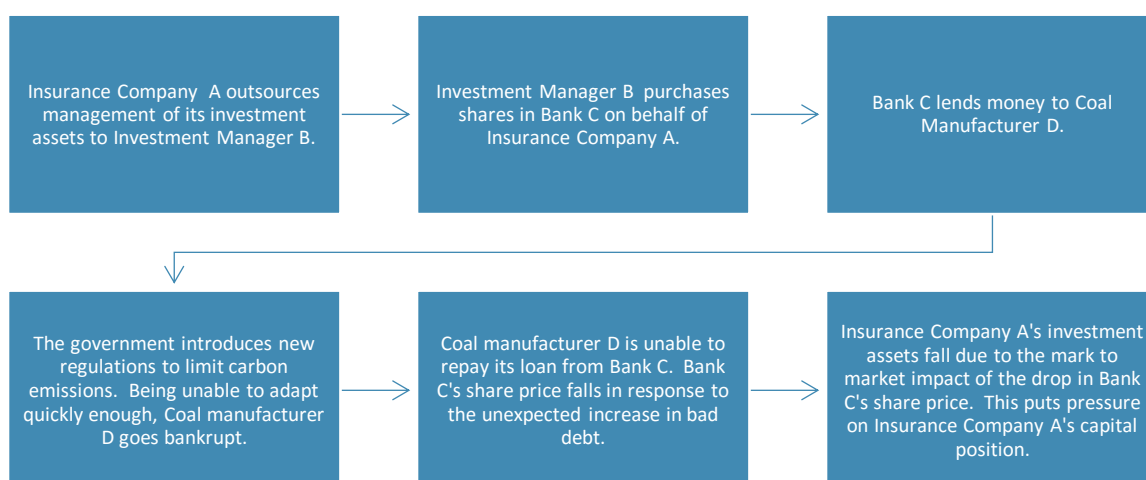
Some of the underlying drivers, such as the downturn in the Chinese economy leading to decreased demand, were not related to climate change. Others, including increased competition from renewable energies and tightening of emission regulations and pollution controls, can be directly linked back to climate change<sup>68</sup>.

Sarah Barker from MinterEllison Lawyers notes it is significant that the words 'climate change' are never explicitly mentioned in the claim. This illustrates how the issue of transition risk and stranded assets can be treated as financial issues, independent of environmentalism or ethics.

This means there is potential for a breach of the duty of due care and diligence if a director or trustee does not consider the financial implications of climate change, and whether this is consistent with the best interests of the corporation. In other words, a director or trustee who chooses to do nothing could be in breach of the law.

## 2.4.2 Supply chain

Figure 13 Supply chain risk





Supply chain risks arising from the interconnectedness of global supply networks are described in Section 2.2.4. Even though financial institutions are less affected by direct physical supply chain risks than other businesses due to the nature of their operations, they are still exposed to mismanagement of climate risk by their suppliers.

Figure 13 illustrates one hypothetical scenario of how climate risk can be transmitted up the supply chain to financial institutions.

Since the customers and shareholders of financial institutions will hold the Board of Directors to account for the way they manage climate risk, directors will also need to consider whether their company may be exposed to mismanagement of climate risk by their suppliers or service providers. Will they be able to hold their suppliers to account the way their customers and shareholders will hold them to account?

### 2.4.3 Operations and costs of running business

The physical impacts of climate change may affect the operations of a financial institution, and the type and severity of impacts will vary greatly by geographical location. Any operations that are customer facing, including sales, claims assessment, repairs and customer service, may be hampered by weather events occurring in the area. There have been instances in the past of natural disasters such as flood impacting banks' ATMs, and therefore their ability to support the community, in particular in Pacific Island communities.

Management need to consider business continuity plans and prepare appropriate backups for any critical operations that may be exposed.

The costs of running a business, including electricity, rent and other supplies, may also be affected by any future changes in government regulation, including emissions trading schemes, taxes to cover the cost of mitigation, and any mandatory adaptation projects.

### 2.4.4 Governance and disclosure

The Australian Stock Exchange (ASX) has continuous disclosure requirements which listed companies must satisfy. This includes disclosing any information that "a reasonable person would expect to have a material effect on the price or value of the entity's securities"<sup>69</sup>. This means existing regulations for listed companies already require disclosure of climate-related impacts if they are deemed to have a material financial impact.

In addition, Recommendation 7.4 of the *Corporate Governance Principles and Recommendations* (2014) states that "A listed entity should disclose whether it has any material exposure to economic, environmental and social sustainability risks and, if it does, how it manages or intends to manage those risks."<sup>70</sup> While these recommendations are not compulsory, a Board that chooses not to follow them must provide an explanation of why not.

Financial markets are increasingly appreciating the need for climate-related risks to be publicly disclosed, and linked to regular financial reporting:

- The Montreal Carbon Pledge, with over 120 investors and \$US10 trillion in assets under management, commits investors to measure and publicly disclose the carbon footprint of their investment portfolios<sup>71</sup>.
- The Climate Disclosure Standards Board (CDSB) was formed as a special project of CDP with the aim of integrating climate change-related information into corporations' mainstream financial reporting<sup>72</sup>.

- In 2015, the global Financial Stability Board (FSB) established the Task Force on Climate-related Financial Disclosures with the mission of developing “voluntary, consistent climate-related financial risk disclosures” to help financial markets and investors understand, measure and respond to climate change risks<sup>73</sup>.

These efforts reflect the increasing demand for access to information on climate-related risk exposures by financial market participants.

Except for financial impacts that are deemed to be material, additional disclosure on climate risk by corporations is voluntary at this stage. However, as it becomes increasingly accepted that climate change has the potential to cause abrupt corrections in financial markets, regulators concerned about financial stability may progressively formalise regulations on climate risk disclosures.

#### **Box 4: The future of climate risk disclosure**

It is expected that disclosure requirements will become increasingly standardised and more comprehensive in order to enable investors and other stakeholders to perform more extensive analysis and to make comparisons across companies.

Corporations that fall behind the evolving global standards of disclosure risk losing stakeholder engagement.

At the same time, more detailed reporting comes with cost and effort which corporations will need to prepare themselves for.

In December 2015 the French Treasury has issued a decree relating to Article 173 of the Energy Transition for green growth law dramatically increasing disclosure of climate risk for all businesses

EU wide Disclosure requirements are due in early 2017, entities subject to these decrees must disclose both physical and transitional risks.

### 3 How can financial institutions better manage their exposure to climate risk?

- Financial Institutions should establish and follow an Enterprise Risk Management framework which identifies and quantifies climate change risks and use a rigorous cost-benefit analysis approach to compare adaption and mitigation strategies. The Financial Institution's Board and management should then use this framework to design a climate change plan consistent with its overall business plan and implement actions in accordance with this plan. This plan must be actively managed and validated, and require regular revision, as knowledge and available solutions will expand over the long-term time horizon of climate change.
- Risk quantification starts with risk identification where exposure can be broadly identified using risk statements with management and stakeholders. A risk assessment process then assigns a risk score, used to prioritise by materiality and impact. Ideally both the physical exposures and potential impact of these on physical and non-physical assets as well as non-physical asset risks should be modelled. Stress testing of models under extreme "tail risk" scenarios then complete the picture.
- Strategies to reduce exposure to risk for financial institutions will be targeted towards increasing financial security, whilst adaption should also include rapid recovery planning after events.
- Governance and disclosure regulations will evolve over time and financial institutions have a role in advocating for positive change.
- Resilience to climate change risk not only involves stress testing a business plan but also the development of products or business opportunities that arise from climate change.
- Tools available to the financial institution can be focused on helping customers, shareholders and other stakeholders. A key part of the cost-benefit analysis would be to identify those strategies that the financial institution can implement directly or influence indirectly and then measure the benefit/cost from all viewpoints.
- The communication strategy will be a key component of a financial institution's plan to manage climate risk.

#### 3.1 Introduction

Section 2 described a myriad of ways that climate change can impact financial institutions, including by impacting its household and business customers, shareholders and management.

Climate risks – i.e. the risks generated by climate change – are systemic and pervasive for financial institutions and therefore they require a holistic approach. Below, we discuss how an Enterprise Risk Management (ERM) framework can assist financial institutions in managing the climate risks identified in section 2.

#### 3.2 Enterprise risk management framework

- Financial Institutions should establish and follow an Enterprise Risk Management framework which identifies and quantifies climate change risks and use a rigorous cost-benefit analysis approach to compare adaption and mitigation strategies as well as actively manage and validate the plan over time.

We recommend financial institutions use an Enterprise Risk Management (ERM) framework to manage their climate change risk in a systematic manner. ERM is consistent with the Actuarial Control Cycle approach, and APRA's Prudential Standard CPS 220 for Risk Management.

Under an ERM approach to climate change, a financial institution's risk management function reviews its business plans and risk appetite statements and then undertakes a climate change risk assessment. This assessment can be part of the overall ERM process, or as an additional step to update the existing ERM framework.

Based on this analysis, the financial institution constructs a planned response and then carries out continual monitoring and re-assessment, with the following stages:

Risk identification and quantification	Cost benefit analyses	Resilience plan	Implementation	Monitoring
<ul style="list-style-type: none"> <li>• Including assessment of the potential outcomes and the probabilities of those outcomes.</li> <li>• Potential risks are discussed in Section 2.</li> </ul>	<ul style="list-style-type: none"> <li>• Allows the comparison of different risk mitigation and adaptation strategies</li> </ul>	<ul style="list-style-type: none"> <li>• Based on the prioritised strategies and the financial institution's risk appetite, design an institution wide resilience plan taking into account all key stakeholders</li> </ul>	<ul style="list-style-type: none"> <li>• Implement cost-effective adaptation and mitigation measures set out in the plan</li> </ul>	<ul style="list-style-type: none"> <li>• Monitor performance against plan and iterate plans based on outcome of monitoring</li> </ul>

There are a number of well-developed frameworks for assessing climate risk and building response strategies and we refer to the reader to some examples of frameworks<sup>74</sup>. Below we discuss pertinent issues that may arise in implementing these frameworks.

Figure 14 A framework for assessing and addressing total climate risk<sup>74</sup>



### 3.3 Risk quantification

- Risk quantification starts with risk identification where exposure can be broadly identified using risk statements with management and stakeholders. A risk assessment process then assigns a risk score, used to prioritise by materiality and impact. Ideally both the physical exposures and potential impact of these on physical and non-physical assets as well as non-physical asset risks should be modelled. Stress testing of models under extreme "tail risk" scenarios then complete the picture.

The steps of risk quantification and assessment may be theoretically straight-forward, but different stakeholders within a Financial Institution may have widely different (and strongly held views) on climate change. Instead of developing new assumptions, global standards in assumptions on climate change, such as the reports produced by the IPCC, can be used as a starting set of assumptions.

Climate risk exists for all institutions, and climate change may be viewed as an influencing factor, but any action that addresses climate change will most probably also have value for managing and mitigating current levels of climate risk.

#### Risk identification

Risk identification starts with management and stakeholders making *risk statements* to as broadly identify potential exposure as possible. An example of a risk statement might be "we face a risk from increasing levels of drought impacting our agricultural clients and their ability to repay loans".

#### Risk assessment

From this risk statement, the risk assessment will usually try to assign a *risk score* equivalent to the likelihood of the risk multiplied by the impact of the risk. The result of this risk assessment will be a table of risks with risk scores based on varying levels of likelihood and materiality of impact. Key stakeholders will then form a collective view of the priority of the focus areas, and a plan will be developed in response to these focus areas. Non-priority risks can still be identified and monitored going forward, and this forms an important part of the ERM process.

In assigning risk scores, the risk assessment process will attempt to model the physical exposures and potential impact of exposures on physical and non-physical assets related to the financial institution. Ideally both the frequency and severity of the hazard are assessed. Physical assets directly owned by the financial institution are important but risk managers should also consider assets owned by customers and funded by banks, as well as third party assets.

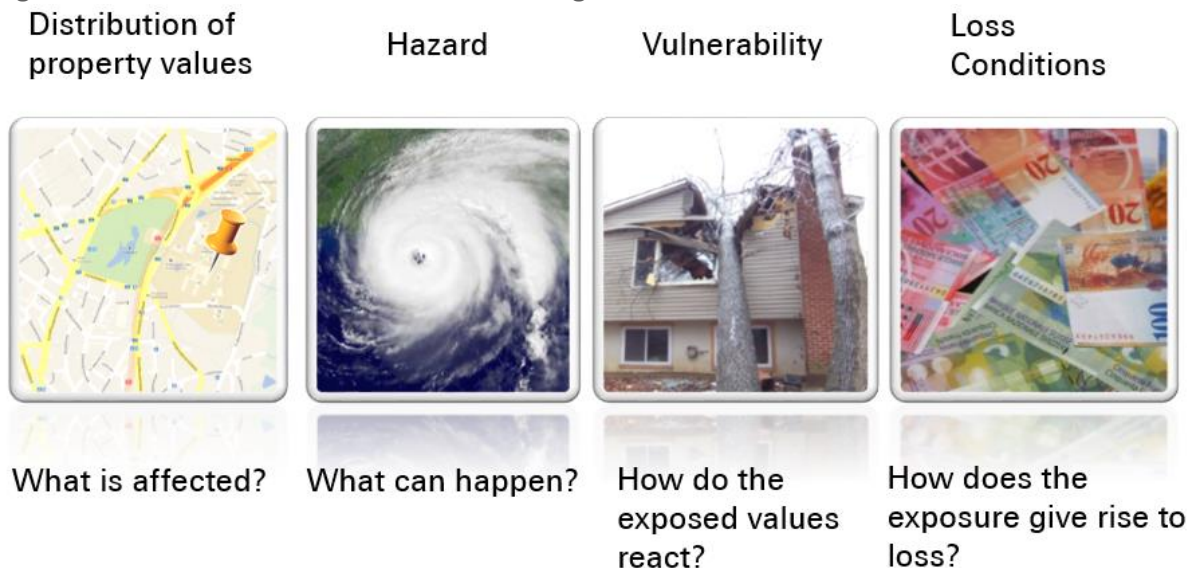
#### Example: Residential lending

For example, Section 2.1.6 sets out the risks that climate change poses to residential mortgages (home loans) issued by banks. Banks should store adequate information on the properties backing the mortgages, such as geocoding location detail, type of construction and risk mitigants, in addition to property value and loan amount. This exposure information can be combined with the natural catastrophe models<sup>75</sup> with climate change scenarios as used by P&C insurers to determine potential future losses from property catastrophe events, with and without climate change.

Banks can then apply additional assumptions regarding the non-performance and defaults on loans in the case of such events, to quantify claim change cost scenarios. As with insurance risk analysis, all financial institutions should analyse the tail risk of the more volatile events of the modelled losses from catastrophic events.

Difficulties can arise as most existing catastrophe models are only designed for short term forecasts – e.g. over the next twelve months, rather than for 20 to 30 year timeframes. In addition many models may not have the resolution to assist with decision making at a localised level. New models are emerging that take a more granular approach, and a longer term approach allowing for changes in climate and weather dependent climate risks.

**Figure 15 Risk assessment for residential lending**



### Time frames

Careful selection of time frame is important, and internal discussion will focus on the likely lifetime of the equipment and physical stock, the time horizon of creditors and shareholders, but also more esoteric but important questions regarding the role of the financial institution in society.

For example, if a bank is considered an integral part of the economy and society, does it have ethical responsibility to ensure its assets and the infrastructure which it finances to develop will be resilient beyond any normal investment payback period?

### Non-physical assets

Risks beyond immediate physical assets exposures are very important to quantify if possible. These risks are discussed in detail in Section 2 and include:

- Customer & Staff safety
- Financial Exposures, includes market risk, and key risk for banks
- Insurance premiums for protection of physical assets and directors & officers liability, which requires an extrapolation of insurance costs for many years in the future to get clear view of future climate risk
- Responsible Investment and corporate social responsibility
- Reputational risk and loss of shareholder value

### Quantification

Quantification of non-physical asset risks such as pure loss of economic value of stranded assets may significantly more difficult and stakeholders must consider value chain impacts to reach a reasonable estimate. Due to untested theories of causation through a value chain, there will be higher uncertainty in quantifying such risks, and at best any quantification will be a rough estimate.

Transition risks and liability risks require careful thought, since there is no obvious data history or precedence to verify the loss assumptions. The recently established Task Force on Climate-Related Financial Disclosures (see <https://www.fsb-tcfd.org/>) considers this issue and provide a useful framework approach to quantifying climate change risk for disclosure purposes.

Stress tests under extreme tail risk scenarios are vital to consider; quantifying the risk should not just mean the expected loss change, but the range of extreme scenarios, including low probability but high severity events such as Category 5 tropical cyclones. This is similar to the Realistic Disaster Scenario modelling required by Lloyd's of London.

### 3.4 Risk mitigation and adaptation strategies

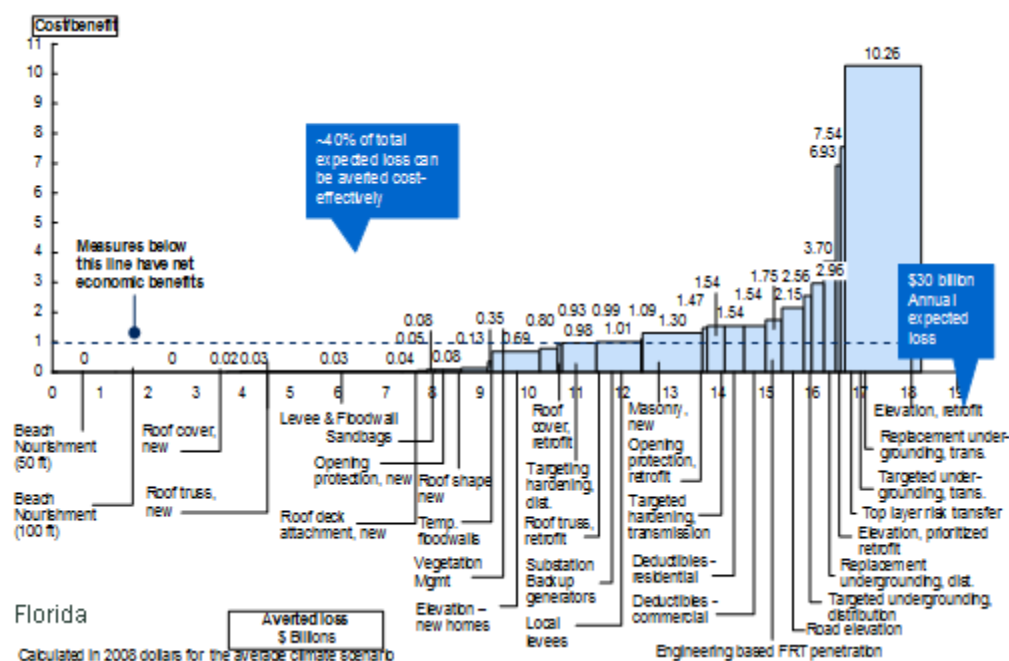
Strategies to reduce exposure to risk for financial institutions will be targeted towards increasing financial security, whilst adaption should also include rapid recovery planning after events.

Governance and disclosure regulations will evolve over time and financial institutions have a role in advocating for positive change.

Resilience to climate change risk not only involves stress testing a business plan but also the development of products or business opportunities that arise from climate change.

Risk mitigation and adaptation strategies should be mapped along a cost/benefit curve in order to make ready comparisons. Those strategies with a cost/benefit ratios below 1, i.e. net economic benefits, should be given higher priority. Figure 16 provides an example of a cost/benefit curve for the state of Florida.

Figure 16 Locally specific adaptation cost / benefit curve for Florida<sup>76</sup>





Generally, the strategies available to financial institutions include the following.

### Mitigation

Mitigation is a strategy to reduce exposure to risk. Mitigation for financial institutions will be targeted towards financial security, but can also consider risk such as reputation and shareholder value. Reducing the financial institution's own carbon footprint is a component of mitigation which should also be considered as part of this strategy. While the carbon emissions of an individual entity is not material overall, if many companies and industries move to carbon neutral position, this will have material impact in aggregate.

### Adaptation

Adaptation is strategy to reduce damage or cost after exposure. Financial Institutions should consider not only strategies to reduce financial impact but work towards fast recovery after events. Examples of adaptation may be encouraging all residential mortgage holders to purchase adequate property insurance to prepare for severe weather impacts.

### Resilience

We use the term resilience for adapting the business plans of the financial institution to climate change.

The key question is to consider if the business plans adequately address climate change risk. A properly constructed risk framework would also consider potential future impact on the financial institution's economic capital requirements. For example, in order to withstand severe weather events that have flow-on financial impacts, it may be appropriate for financial institutions to hold an additional capital buffer.

Credit rating agencies are already collecting additional data on the climate change exposures of financial institutions, and the logical next step would be to specifically include climate change risk as a ratings factor to determine credit ratings.

Financial institutions should also consider the development of products or business opportunities that arise from climate change. Examples include weather risk financial derivatives, or insurance for renewable energy solutions such as solar panels or offshore wind farms. This has potential to provide a natural hedge to the business growth, and also to provide benefit to customers and society.

### Transfer or hedge

The obvious means of transferring climate risk to third parties would be through insurance. However, the short term nature of property insurance products and weather risk derivatives, which are normally for 12 months, limits the effectiveness of this strategy. Repricing of climate risk each twelve months is likely to lead to unaffordable costs of insurance in the longer term. Longer term products are uncommon and usually expensive, but may become more common in future.



Figure 17 Roadmap for the TCFD's Phase II Work



Governance includes reporting & monitoring. Financial institutions need to consider disclosure in public accounts and also internal planning and frameworks. For instance, the National Association of Insurance Commissioners in the USA in 2010-14 introduced mandatory disclosure of financial risks faced by insurers from climate change. Additionally, financial institutions can consider if they are able to influence climate change policy in positive ways for the value of the enterprise. As discussed above, the Task Force on Climate-Related Financial Disclosures (<https://www.fsb-tcfd.org/>) is in the process of creating useful guidance on best practice climate change disclosures.

For insurers, if climate risk is assessed as being a material risk to the financial institution, then Appointed Actuaries should also discuss in their Financial Condition Reports the quantification of the risk and make recommendations on how it should be managed.

### 3.5 Risk management tools

Tools available to the financial institution can be focused on helping customers, shareholders and other stakeholders. A key part of the cost-benefit analysis would be to identify those strategies that the financial institution can implement directly or influence indirectly and then measure the benefit/cost from all viewpoints.

The communication strategy will be a key component of a financial institution's plan to manage climate risk.

#### 3.5.1 Financial tools to help customers

Financial institutions can consider the following opportunities to help customers reduce climate change risks.

##### Building standards

Improvement to building standards will mitigate climate risk as residential and commercial buildings are engineered and modified to be more resistant to climate risk damage.

##### Collaboration

Financial institutions can work with government to encourage climate conscious policy decisions and the development of infrastructure to improve resilience, such as flood levees. Insurance companies and banks are increasingly active in the area of public policy and influence as they come to understand that effective mitigation and adaption activity requires legislative changes and community influence. For example, the role of government in allowing residential development in flood plains or in coastal areas exposed to sea surge is important for sustainable housing choices, and also for the insurability of the home.

##### Pricing

Financial institutions can encourage adaptation by reducing insurance prices when customers deploy adaptation measures. For example, insurers can decrease insurance premiums or otherwise give favourable pricing to buildings which have been made more resilient through retro-fitting to a higher building standard.

Financial institutions, including banks and general insurers, may also consider investing in more detailed geographic analysis of their risks in order to better price risks by location. This would encourage customers to live in lower risk areas.

##### Financing

Banks can offer loans to customers to fund adaptation measures. While most banks do not seem to have specific policies in this area, there are a number of innovative non-banks which have developed funding mechanisms so companies can fund mitigation activities now from future energy or other savings. For example, some financial institutions will provide finance for replacing lighting in older buildings with LEDs and other more efficient solutions, and the savings in energy bills can be used to repay the loan over time.

### Improved product choices for customers.

The Future Super Fund was recently established as Australia's first superannuation fund that does not invest in fossil fuel companies or companies that provide services or finance to significant fossil fuel projects<sup>77</sup>. Other Australian superannuation funds, including Local Government Super, First State Super, HESTA, Uniting Church and Unisuper, have taken steps to limit or reduce their exposure to fossil fuels<sup>78</sup>. These products allow customers the opportunity to directly reduce their exposure to transition risks.

### Education

By educating customers on their exposure to climate risk, financial institutions can encourage customers to reduce risks, which in turn can reduce the risk to the financial institution. For example, by informing home loan customers about physical risks from climate change to their property, and encouraging owners to undertake adaptation, banks can reduce their exposure to climate risk.

#### Case Study 4: Response by a bank

Westpac Group is one of the leading Australian banks in terms of communication and response to climate change issues for their clients. Their public documentation and activity on the issue has been illustrated by their early membership in the Australian Business Roundtable on climate change. Published on their website<sup>79</sup> is *Climate Change and Environmental Position Statement and 2017 Action Plan* and the second key element of its 2017 action plan is about *Supporting Customers* with the following elements:

Our greatest opportunity to reduce climate and environmental impacts and be part of the transition to a clean economy is through partnering with our customers and supporting innovative solutions.

#### **We will:**

- Develop and evolve our products and services to help our customers adapt to environmental challenges;
- Make available up to A\$6 billion in lending and investment to CleanTech and environmental services;
- Partner with our customers to develop innovative solutions which address sustainability and environmental challenges for key industry sectors; and
- Work with our customers to better understand and manage their exposure to physical climate risks.

In practice, it would very difficult to determine if the actions which Westpac undertakes are more or less successful than other banks (although they are equally criticised by observers for funding fossil fuel companies and their subsidiaries), but the "green" nature of their message certainly enhances their reputation.

### 3.5.2 Financial tools to help shareholders

Financial Institutions also need to consider the opportunities directly under their control to help shareholders and other investors manage climate change risk. Shareholders may benefit either by improvements in the financial institution's return and earnings, such as from new products or investment opportunities, or from the reduction of risk, which should result in lower volatility of returns or lower capital requirements.

#### Environmental Social and Governance investments.

Financial institutions can increase their investments in assets which are better for the climate. This can be both a benefit to customers and to shareholders, for instance Westpac note in their half year sustainability report<sup>80</sup> 2016 that it has achieved "More than \$6.3 billion lent to the CleanTech and environmental services sector as at 31 March 2016, exceeding our commitment to make available up to \$6 billion by 2017".

#### New financial instruments

Climate change also brings opportunities to invest in or offer innovative financial instruments designed to have a positive impact on the climate at the same time as providing an investment return. These include lending instruments like green bonds, as well as insurance instruments like Energy Savings Insurance, as described in the case studies below.

##### **Case Study 5: Green bonds**

Green bonds are bonds which fund projects with positive environmental or climate benefits. As with traditional bonds, they can be issued by governments, banks or corporations. The main difference from traditional bonds is that the proceeds from the bond sale go towards funding climate-related projects, such as emission reduction, renewable energy plants or climate change adaptation.

The World Bank Kangaroo Green Bond, the first Australian dollar-denominated green bond on the Australian market, was issued on 16 April 2014. The bonds were placed with 15 asset managers, superannuation funds, insurance companies and banks, who all had specific interests in supporting socially responsible investments in their investment mandates<sup>81</sup>. World Bank Green Bonds are a subset of the World Bank's sustainable investment opportunities that focusses on climate change issues that have a direct impact on developing countries<sup>82</sup>.

Some examples of projects supported by World Bank Green bonds include:

##### **Climate change mitigation projects**

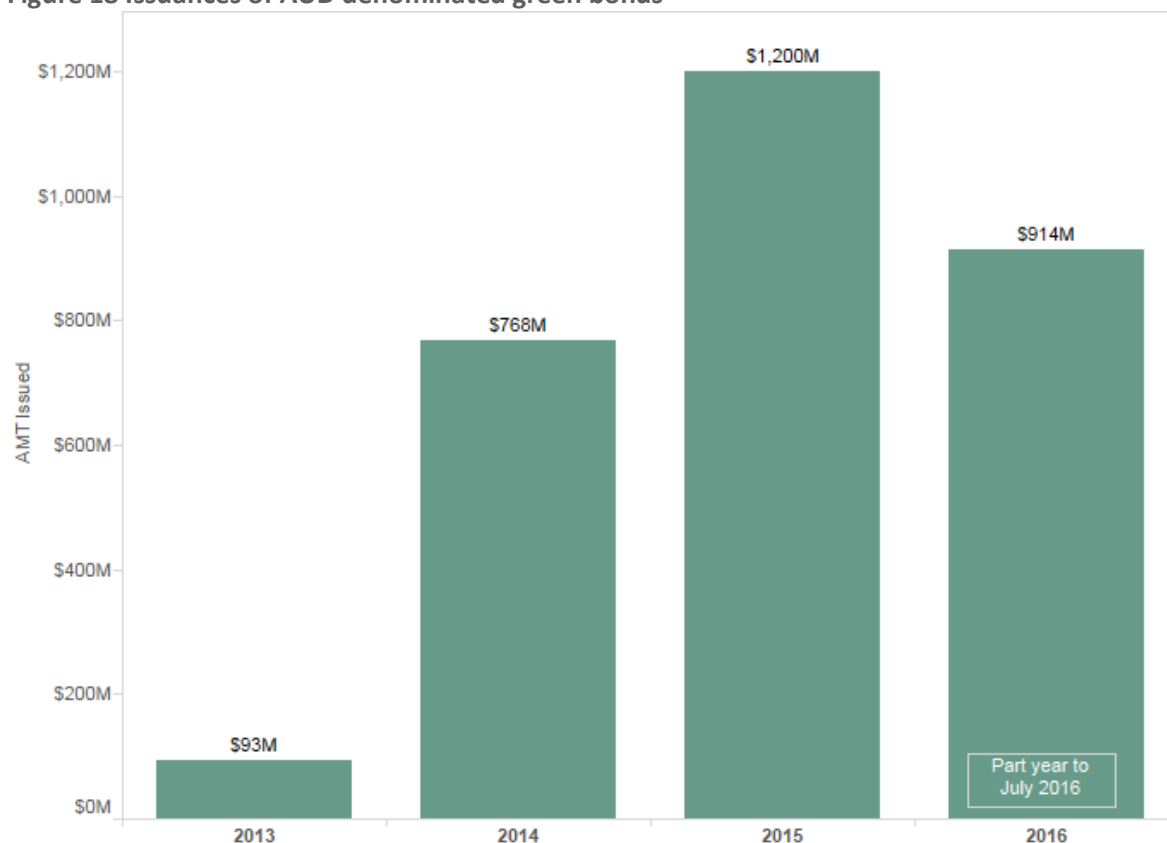
- Solar and wind installations
- Funding for new technologies that permit significant reductions in greenhouse gas emissions
- Rehabilitation of power plants and transmission facilities to reduce greenhouse gas emissions
- Greater efficiency in transportation, including fuel switching and mass transport
- Waste management (methane emission) and construction of energy-efficient buildings
- Carbon reduction through reforestation and avoided deforestation

##### **Climate change adaptation projects**

- Protection against flooding (including reforestation and watershed management)
- Food security improvement and implementing stress-resilient agricultural systems (which slow down deforestation)
- Sustainable forest management and avoided deforestation

The green bond market has seen increasing demand over the past few years, supported by pension funds carrying mandates that require minimum levels of environmentally friendly investments in their portfolios. Traditional fossil fuel companies are expected to contribute to growth of the Australian market in future, due to growing pressure from consumers to diversify their energy base<sup>83</sup>. Figure 18 illustrates the issuances of green bonds denominated in AUD over the past 3.5 years.

Figure 18 Issuances of AUD denominated green bonds<sup>84</sup>



### Underwriting

Underwriting to take into account climate risk: property insurance, banking products, construction insurance to consider climate sensible construction and other aspects. For example, Australian banks are currently criticized of paying little or no attention to the sea-level rises and likely loss of property values and housing stock along the coast line; introduction of a mortgage underwriting guideline to require this at time of mortgage issuance or re-financing would be a practical example of using underwriting to reduce climate risk.

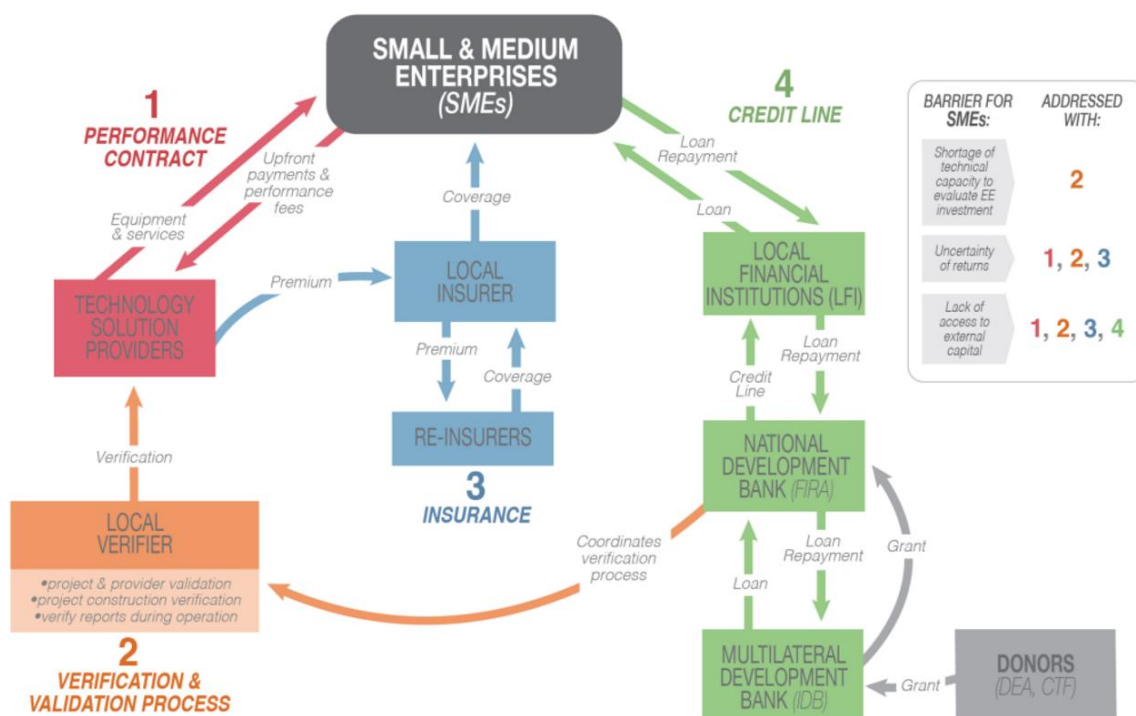
### Case Study 6: Energy Savings Insurance

One of the barriers to uptake of energy efficiency upgrades by small and medium-sized businesses in developing countries is the long payback period and uncertainty in the amount of energy savings that will result from the investment. If both local businesses and local banks lack the technical expertise to assess the costs and potential benefits of energy efficiency investments, then there will be limited investment in more capital-intensive technologies.

Energy Savings Insurance addresses these barriers by providing an insurance payout if the projected value of energy savings is not met. This makes it more attractive for businesses to invest in energy efficiency upgrades with longer payback periods and uncertain benefits. Technology solutions providers purchase the insurance to back their contractual guarantees to clients on the performance of their energy efficiency products<sup>85</sup>.

Energy Savings Insurance was launched by The Lab in Latin America in 2015. It is currently being considered by the Green Climate Fund for funding in El Salvador and by other institutions in Africa and Asia<sup>86</sup>.

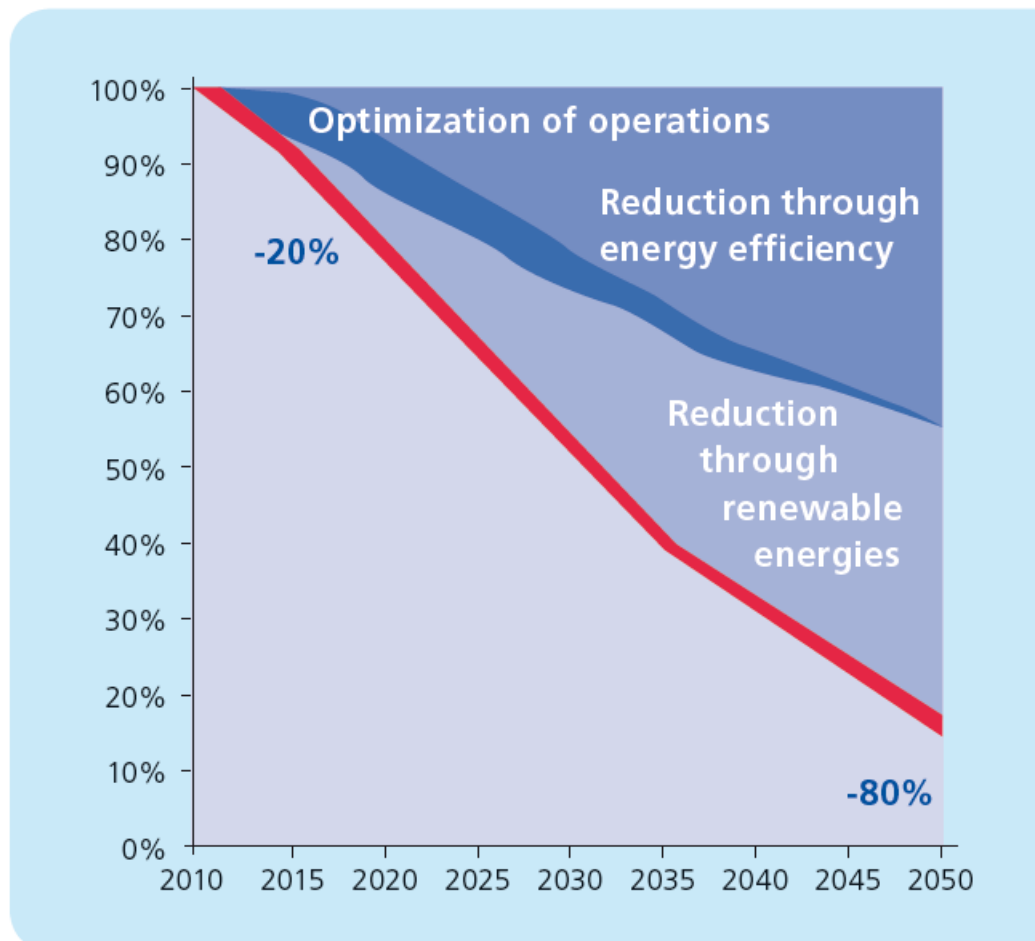
Figure 19 Energy Savings Insurance<sup>87</sup>



### Direct action

Financial institutions can undertake direct actions to reduce their own carbon footprint, such as choosing to own or lease energy efficient buildings. Zurich IMRE AG has implemented this approach not only with the properties it occupies, but also through the investment properties which it holds in its asset portfolio. Its sustainable real estate management goal is to reduce greenhouse gas emissions from 2010 levels by 20% by 2020 and 80% by 2050, using a range of methods including re-investment into green housing stock. Zurich ties this goal back to its long term investment goals, both in terms of return and "a positive impact on the environment, economy and society"<sup>88</sup>.

Figure 20 Zurich's strategy to lower energy consumption and greenhouse gas emissions



### Funding research

Financial institutions can also fund research into climate risk assessment and mitigation or adaptation strategies, including behaviour finance interactions with customers.

### Financing solutions

Financial institutions can also finance solutions to offset potential climate losses, such as a whole of life approach to loss of property due to sea-level rise. Here the homeowner pays premiums over a long period of time and when the property is longer inhabitable, the proceeds are used to fund the purchase of a new property.

### Long term strategies

Financial institution business models are heavily weighted towards considering long term assets and liabilities, e.g. 30 year home loans. Therefore, financial institutions are better placed than most sectors to consider how business will change going forward. However, there remain some key questions that will need to be resolved, including:

- **Risk appetite and decision making:** What is insurable? What risks will become uninsurable, and when?
- **Holistic risks:** Financial institutions will need to consider risks across all parts of their business, including sales, claims, operations, and underwriting, and the interactions between these.

- **Funding:** Financial institutions will be at the forefront of funding of adaptation to increased climate risks, as this ties back to the equity and cost which must be shared between customers and shareholders.

### Communication

Finally, when a Financial Institution constructs its strategy and plan to manage climate change risk, its communication strategy should be a core component.

Due to shareholder actions and other adverse publicity, many boards of financial institutions are keenly aware of the potential risks arising from mishandling (or the perception of mishandling) of climate risk and the adverse impact on reputation with customers, investors and government.

However, the communication strategy should not stop with strategies to reassure customers and shareholders; given the long term nature of their business, it is very important that financial institutions raise awareness about climate changes risks with stakeholders, and thereby try to encourage action on both adaptation and mitigation.



## 4 Financial risks of climate change on economic sectors

In this section we discuss some of the potential financial risks on different economic sectors as a result of climate change.

### 4.1 Agriculture

Agriculture is one of the industries most threatened by climate change due to the impact of temperature and precipitation changes on crops and stock. Studies on the impact of climate change show that some areas may become lost to farming uses as combination of warming temperatures and reduced rainfall, particularly increased frequency and severity of drought events. Temperate zones suitable for farming may move southwards, but the impact of climate change is unpredictable.

Likely causes of climate change on agriculture at 2 degrees C mean temperature change include:

- Drought events more common and more severe, with resulting crop failures, lack of feed for stock and damage to soil and ground cover
- Increased salinity and resulting lack of arable land as the water table rises
- Heat stress on plant and animals, with greater loss of stock and crops in high temperatures
- Lack of water for irrigation of horticulture, as has already been observed in the Murray-Darling basin
- Weakened natural resistance of crops and stock to pests.

The chief negative impacts will be the combination of lower rainfall and higher temperatures, as described in detail in the IPCC reports<sup>4</sup>. A 20% reduction in rain in southern Australia is like to reduce pasture productivity by an average of 15% and live weight gain in cattle by 12%<sup>89</sup>.

This impact has been rigorously evidenced in numerous studies. For example, a study of the Fitzroy Basin showed that even under the "best case" IPCC projections to 2035, suitable cropping area was likely to decline by 20% and grazing area by 38%<sup>90</sup>. We can expect similar outcomes across Australian peak farming productivity zones.

Agriculture is also one of the industries which potentially has much to gain from participating in climate change mitigation actions, such as growth of carbon forests and carbon sequestration projects, although the programs and subsidies to access this funding are complex and can be variable due to political forces.

### 4.2 Tourism

The Great Barrier Reef stretches 2,300km from the northern tip of Queensland in north-eastern Australia to just north of Bundaberg. The reef consists of 3,000 individual reefs and 600 islands and is so large it can be seen from space. The diversity of marine life is of a scale found nowhere else on Earth. It is home to over 1,600 species of fish, over 130 species of shark and 600 different types of coral.

Two million people visit the Great Barrier Reef each year and approximately 70,000 people are employed directly or indirectly within the tourism industry related the reef. The industry is worth in the region of \$6bn annually and employs a huge variety of people; hospitality staff, sailing and flight tour operators, diving instructors and a myriad of other occupations with one thing in common; facilitating access to the wonders of the Great Barrier Reef.

The Great Barrier Reef faces many threats; epidemics of crown of thorns starfish eat hard coral, poor management of agricultural effluent and sediment runoff degrades the quality of the water catchment, sediment from port dredging chokes the coral, hazardous cargo spillages at sea pollute the water and tropical cyclones leave trails of destruction. But the greatest threat to the reef is a warming climate. Coral is extremely sensitive to ocean acidity and temperature. When water temperatures are too warm the coral will expel the algae living in their tissues, which causes the coral to turn white. If the water temperature reduces back to a normal temperature quickly the algae can recolonise the coral and can recover over the course of a few months. However if the temperatures remain warm for longer than 4-6 weeks the coral may die.

The southern hemisphere summer of 2015-16 was extremely hot and coincided with an El Nino event. Ocean temperatures around the Great Barrier Reef were extremely warm for most of 2016, which is likely to be the hottest year on record, breaking the record set only last year by 2015. The coral on the GBR began to bleach in January and by May 2016 of the 800 reefs surveyed only 7% showed no sign of bleaching. Coral mortality has been estimated at 50% in the far north section of the reef, reducing to 3% in the Townsville - Whitsundays Islands region.



“‘The hard corals were dead and covered in algae, looking like they’ve been dead for years,’ says Richard Vevers, underwater photographer and chief executive of the Ocean Agency. ‘The soft corals were still dying and the flesh of the animals was decomposing and dripping off the reef structure.’”  
The Ocean Agency

Bleaching events have occurred on the reef previously but the 2016 bleaching is the most severe and widespread ever recorded. As the oceans warm each year the frequency of these bleaching events will increase and may occur annually on the GBR by 2030. This will in all likelihood mean the eventual complete loss of the Great Barrier Reef. And when the reef disappears the whole industry which supports it will also vanish, leaving at least 69,000 people unemployed and a \$6bn hole in Queensland’s annual budget<sup>91</sup>.

The GBR is of course not the only drawcard attracting tourists to Australia's Eastern seaboard, but a survey commissioned by the Australia Institute in June 2016 found that \$1bn of the \$6bn annual tourist dollar spend was at threat due to this year's bleaching event.

Other industry and employment opportunities besides tourism are scarce in some areas of Far North Queensland and will be disproportionately affected by the loss of tourism in the area. At the same time, jobs in other sectors (agriculture and mining) also likely to be under threat due to the effects of climate change.

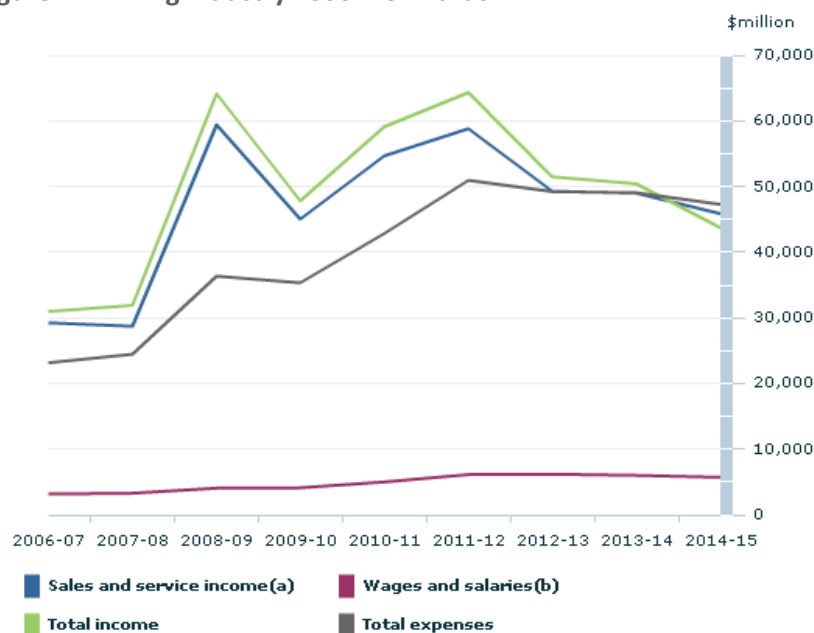
### 4.3 Mining

Australia has vast reserves of natural resources deposits. Exploiting these natural resources is big business and contributes significantly to Australia's economy through royalties, taxation and employment. 173,000 people are employed in the mining industry today but this has declined from a peak of 200,000 in 2011.

The largest and most valuable extractive industry in Australia is coal mining, with Australia providing around 30 per cent of the world coal trade<sup>92</sup>. In 2011, Australia was the world's largest exporter of metallurgical coal and the second largest exporter of thermal coal. Australia is also the fourth largest producer, and has the fifth largest resources of black coal in the world. Coal mining directly employs 40,000 Australians.

As shown in the figure below, in 2014-15 the expenses from coal mining were higher than the total income generated. This trend is set to continue with falling commodity prices worldwide and increased production from renewable energy sources.

**Figure 21 Mining industry 2006-7 onwards<sup>93</sup>**



Coal contributes 38% of global human induced CO2 emissions. Australia contributes to this directly, by burning domestic coal to produce electricity and by exporting thermal coal to the rest of the world to burn. The exported CO2 is not included in Australia's global carbon footprint, but is recorded in the footprint of the nation who burns it. Australia is one of the highest CO2 emitters per capita globally. Coal exports will be threatened significantly by the COP21 global agreement to keep global warming to below 2 degrees. Carbon pricing increases the cost of fossil fuels globally, if not in Australia. Demand for fossil fuels is reducing year on year due to the growth of the renewable energy sector<sup>94</sup>.

Coal mining in particular is susceptible to transition risk as the global economy moves away from fossil fuels. The 40,000 people directly employed by coal mines will inevitably lose their jobs and will need to be transitioned into new employment. The federal and state governments will have to adjust their budgets to reflect the reducing royalties paid for the natural resources which will no longer be mined in such quantities. As coal mines are shut down the government may have to step in to pay for their rehabilitation of the land, since the incentives for mining companies to do this are low and generally not enforced under state laws.

#### 4.4 Infrastructure

All sectors of the economy are directly or indirectly dependent on infrastructure. This means that the exposure of infrastructure to climate risk also puts other parts of society and the economy at risk.

The lead times required to build and operate major infrastructure are long, and many existing infrastructure assets are still maintained according to standards based on historic climate patterns.

The following table illustrates some of the risks and impacts that could occur due to the physical effects of climate change.

**Risks and potential impacts of climate change on infrastructure**  
Summary of information from ATSE, 2008<sup>95</sup>.

Infrastructure Type	Risks and potential impacts
Water	<ul style="list-style-type: none"> <li>• Risk of flooding if capacity of storm water, drainage and sewer infrastructure is not enough to cope with more extreme rainfall events</li> <li>• Increased ground movement and changes in ground water accelerate degradation of materials and structures</li> <li>• Less rainfall in some areas cause less reliable local supply and water shortages</li> </ul>
Energy	<ul style="list-style-type: none"> <li>• Electricity generation and transmission infrastructure may be affected by extreme weather events</li> <li>• Extreme heatwaves create an increase in peak demand for electricity, at the same time as reducing efficiency of transmission due to reduced conductivity</li> </ul>
Telecommunications	<ul style="list-style-type: none"> <li>• Outages and disruption caused by damage to infrastructure from extreme weather events</li> </ul>
Transport	<ul style="list-style-type: none"> <li>• Higher frequency and severity of extreme rainfall cause flooding of roads, rail bridges, airports and tunnels</li> <li>• Coastal roads, rail and tramways are at risk of inundation due to sea level rise</li> <li>• Storm surges in combination with sea level rise damage ports and coastal infrastructure</li> <li>• Extreme wind events cause damage to rail, bridges, airports and ports</li> <li>• Heatwaves cause buckling and damage to rail tracks</li> </ul>
Buildings	<ul style="list-style-type: none"> <li>• Increased frequency and intensity of extreme rainfall, wind, and lightning events causing damage to buildings</li> <li>• Combination of storm surges and sea level rise increasing rebuilding and maintenance costs for coastal buildings</li> </ul>

- Increased ground movement, changes in ground water, and increases in temperature accelerates degradation of materials, increasing maintenance costs and reducing life expectancy of buildings

The risks are greater for infrastructure that are:

- Located in vulnerable areas such as coastlines, near rivers, and bushfire-prone regions
- Already stressed by age, or by demand levels exceeding what they were originally designed for<sup>96</sup>.

There is also potential for a cascade of system failures due to interdependencies in infrastructure which mean when one element is damaged, there are flow on effects to other infrastructure. For example, the Melbourne heatwave in 2009 led to an explosion in a power substation, at the same time as increased use of air conditioning was causing a surge in demand for electricity. As a result, train and tram services were cancelled, and roads were congested because traffic lights in the city stopped working.

## 4.5 Life & Health insurance

### Impact on mortality and morbidity

The impact of a warmer climate is expected to have an adverse impact on both incidences of mortality and morbidity. Some of these impacts are direct while others are indirect, being secondary impacts of other direct impacts. Clearly, there will be broad implications for life and health insurers arising from the nature and severity of the risks that they are covering.

A change in the climatic conditions, and in particular the advancing of the tropics into regions further and further away from the equator, will increase the areas of the world susceptible to water borne diseases and diseases transmitted through insects. This would lead to increases in the incidence of diseases such as malaria and heat stress. The warmer temperatures would also increase the frequency of extreme temperatures which increases the rate of cardiovascular disease.

Changes to the climate also impact on the ability to grow crops. Changes in food production and access to clean water may become more difficult leading to more restricted diets. This in turn impacts on the affordability of food leading to additional issues of malnutrition.

The warmer climate also impacts on the wellbeing of the individual. In particular, more extreme temperatures discourage outdoor activity and a more sedentary lifestyle would lead to higher rates of obesity. The stress of dealing with climate change will exacerbate mental illness.

Overall, the combined impacts, both direct and indirect have been estimated by some to lead to an additional 250,000 deaths per year with global health costs expected to be between US\$2b to US\$4b per annum higher.

### Impact on life and health insurers

As awareness of changes to morbidity and mortality rates emerge, the types of products that insurers would look to sell and their target markets will need to adapt. In particular, we may find that insurers deem people with certain characteristics much more uninsurable than today. This could be based on geography as well as genetic markers that indicate predispositions to certain conditions in a warmer climate. Certain products may become more popular. For example, permanent disability insurance due to the higher rates of mental illness and general lack of wellbeing.

Another consideration for both life and health insurers is around predicting the future rates of mortality and morbidity incidence. The unpredictable nature of climate change renders the past to no longer be an adequate gauge for the future. Life insurers' traditional reliance on past mortality and morbidity tables may not be able to react fast enough to reflect the rapid changes arising from climate change. Well-entrenched analysis techniques may no longer produce reliable results.

Life and health insurers may need to compensate for this increased uncertainty by improving their data collection systems. This may catalyse insurers to begin harnessing non-traditional real-time sources of data to uncover rating factors (in life insurance) and to price risk more accurately. Health insurers (although currently unable to risk rate in Australia) will also need to consider how it can augment its existing data with external data that can provide a more complete picture of their member's health (e.g. linking their data to utilisation of medical care providers, level of physical activity). In the future, we may see that health insurers transitioning to more of a health partner, and not purely a funder for health finance risk.

Aside from the implications on product and underwriting, other aspects of life and health insurer's operations may be impacted by climate change. For example:

- The change in the duration profile of an insurer's liabilities will have consequences for the way they set their investment strategy.
- The increased volatility and uncertainty of liabilities may lead regulators to require insurers to hold higher levels of capital.
- The way in which insurer's interact with their customers may need to be more proactive to help their members mitigate some of the risks.
- The attractiveness of certain customer and or geographic segments may lead private insurers to exit those markets leading to strategic considerations for those who remain. This has implications for pricing approach and the effectiveness of reinsurance to provide a solution.

As we have shown, there are risks to the incidence of mortality and morbidity. Life and health insurers will need to consider a wide range of issues, covering the spectrum of their operations.

### Climate change impacts on demographics

"Climate change is the biggest global health threat of the 21<sup>st</sup> century." So began a report in 2009, jointly authored by the UK medical journal the Lancet and the London Institute for Global Health Commission<sup>97</sup>. The report predicted a wide variety of implications of climate change for health, including some with demographic links such as increased frequency of extreme weather events and implications for food security and migration patterns.

### Aging populations

In developed nations one of the biggest demographic issues of the 21<sup>st</sup> century is that of aging populations. This is likely to be widely understood and acknowledged by readers of this paper. Readers are also likely to understand that climate change is expected to lead to an increased frequency of extreme weather events such as heatwaves, tropical cyclones, droughts and flooding.

The health consequences of these extreme weather events are much higher for the young, elderly and those with existing health problems, than they are for the rest of the population. With an aging population, a greater proportion of the population will be at risk.

As an illustration, the heatwaves of 2003 in Europe are estimated to have caused up to 70,000 deaths, especially from respiratory and cardiovascular causes<sup>98</sup>. Both the aging population and climate change are likely to have long-term implications for the economy and require significant changes to government revenues and expenditures. They cannot be sequenced and dealt with one at a time, they will need to be addressed concurrently in the coming decades.



## Geographic distribution

Across the globe, climate change is likely to have demographic implications, as it impacts where and how it is feasible and attractive to live and grow food. It is likely that the implications of this will be greater on developing nations, less able to afford mitigation adaptation strategies such as seawalls and dikes, with obvious health impacts. A well-known impact of climate change is rising sea levels and the implications of this for coastal settlements. The most vulnerable regions to rising sea levels are predicted to include the Southern Mediterranean, West Africa, India, Sri Lanka, Bangladesh, South-East Asia and the Pacific and Indian Ocean islands. All told this covers 2 billion people, with one half of these living on US\$2 per day or less<sup>99</sup>. Many will be subject to more frequent flooding, with higher baseline water levels meaning the reach and impact of storm surges will significantly change. Some less predictable implications of climate change relate to food security. Put simply, with changing climates, the areas that are suitable for growing particular crops, or the crops that can be grown in particular areas, will change.

Some changes may be beneficial, many not, but the change itself and the unpredictability of the change leads to food insecurity. Similarly the areas susceptible to particular health issues, such as malarial carrying mosquitos, will also change. All of these changes will make some areas more or less attractive for human habitation, with implications for migration and other demographic considerations. For example, the government of Kiribati in 2014 began purchasing land in Fiji with an initial purchase of 2,000 hecatres. While initially used for agricultural and fish-farming projects to guarantee the nation's food security, in time this land could be used to re-settle the 110,000 residents of Kiribati. "We would hope not to put everyone on [this] one piece of land, but if it became absolutely necessary, yes, we could do it," President Anote Tong told the Associated Press<sup>100</sup>.

## Imagine this ... II

"Thanks for coming in to see me. It's been a while since we talked about your finances and the advice I'm providing you. How is the investment property going?"

"I have to say it's working out very well. Our tenants wrote to us the other day to say how thankful they were for the new levee. It's meant that they suffered very little flood damage when that massive storm came in last week."

"That's great to hear. It seems like a lot of people were saved by that levee."

"Yes – After our bank realised they had significant exposure in the area, they teamed up with the local council to fund that levee to protect all of us in that area. I must say I was really taken that they had done all the research to see how we were exposed and to come up with a financing arrangement to share the cost of putting up that levee across all the affected residents and the council. The savings we got on our flood insurance were more than enough to cover the extra loan payments. I think everyone lucked out, the insurers, the bank, the council and most of all us!"

"It's amazing what can be done. I was going to talk to you about other products, but it sounds like you wouldn't want to move from that bank?"

"No way! Not only did they help protect our investment property, they also came up tops with their super plan. I'm so glad we moved to their green investment fund and away from all the mining before the coal price collapsed. Unlike some of the others, they'd gone through and managed down their exposure to fossil fuels and increased their investment in green energy over a number of years."

"So how are the plans for retirement going?"

"Fantastic. I was so grateful back in 2020 that the government had put in place a transition plan to train us up in the skills needed for the renewable energy industry. When that coal power station went down, I thought our local community would too, but it felt like everyone just walked across the road to the solar plant, and we're still thriving down here. But now it's time to hang up my hat and enjoy my retirement. We're going to sell up down here – I think we'll get a good price as lots of people are moving into the area to work at the new solar plant – and move into the investment property next year. It'll be sea fishing for me!"



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