Mechanisms to finance climate change adaptation in Australia

The supply and demand for climate change adaptation finance in Australia and potential adaptation finance mechanisms

Final Report

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The views expressed herein are not necessarily the views of the Commonwealth or NCCARF, and neither the Commonwealth nor NCCARF accept responsibility for information or advice contained herein.

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1. Introduction

This study was led by Griffith University in response to a call by the National Climate Change Adaptation Research Facility to review financing mechanisms for climate change adaptation, including consideration of insurance, disaster preparedness and recovery, betterment and innovative financial instruments. The study provides a comprehensive review of the state of financing for adaptation in Australia and around the world, including a review of the role of the insurance industry in driving financing.

Climate adaptation finance refers to public and private sector financing from national, regional and international sources for climate change adaptation actions. Climate adaptation finance is a subset of the broader concept of climate finance, which refers to financial flows that aim for 'reducing emissions, and enhancing sinks of greenhouse gases and aims at reducing vulnerability of, and maintaining and increasing the resilience of, human and ecological systems to negative climate change impacts' (UNFCCC 2014a p.5). **Adaptation to climate change** covers activities that 'intend to reduce the vulnerability of human or natural systems to the impacts of climate change and climate-related risks, by maintaining or increasing adaptive capacity and resilience' (OECD 2011 p.4). On the ground, adaptation materializes as activities that range from the construction of large-scale new ('green' and/or 'sustainable') infrastructure and coastal protection works, to modifications of existing infrastructure and buildings to make them more resilient to the effects of climate change (referred to as 'climate-proofing' among some private sector financiers), to very small-scale activities such as householder strategies to combat heat waves.

The anticipated impacts of climate change on Australia's coasts are varied, but from a finance perspective it is useful to distinguish between impacts that are i) slow-onset, with a level of certainty that they will occur although uncertainty remains over their exact extent (e.g. sea level rise, temperature rise) and ii) extreme weather events, that are unpredictable in terms of timing and severity (e.g. more frequent intense storms with increased rainfall and dangerous winds). Uncertainty surrounding the impacts of climate change carries implications (i.e. a form of Knightian risk) for the way that the finance sector, and particularly the insurance industry, can address climate change adaptation (see for example Dobes and Chapman 2011).

Financing and funding are terms that are often used interchangeably, but they are not exactly the same and it is useful to distinguish between them. In the financial literature, financing and funding are considered to be quite distinct processes, while in the realm of infrastructure finance for example, funding refers to revenues raised through rates (see Box 1). The definition provided in this report seeks to capture what financing and funding mean to stakeholders in adaptation finance in Australia at all levels of government, but particularly for local governments, investors, financiers and economists. Implementing adaptation initiatives requires resources (including financial and human resources) while the benefits that justify those costs accrue over time. This is not a new dilemma for governments and traditionally the costs of projects with long-term paybacks have been met by expending taxation revenue.

- Funding: money available to spend, which may or may not be subject to an agreement. For local governments this covers taxation, user-charges and grants, etc.
- Financing: money available on the basis of an agreement with the expectation to be repaid via funding (often with interest and usually provided by an external entity such as a financial intermediary).

Box 1. Most sources in the financial literature distinguish funding from financing, emphasizing that funding is i) usually provided by government or other organisations based on an agreement and ii) it does not carry an expectation for pay back (e.g. a government grant or philanthropic donation). In contrast, financing must be repaid and the repayment usually covers an interest, in addition to the capital. When it comes to funding infrastructure, funding may be considered as a pre-requisite of financing. For example, funding is provided by the community, through the payment for services (e.g. fares) or through taxes and rates collected by local government. The funding provides the economic foundations for the uptake of financing.

For the adaptation finance agenda to move forward requires mutual respect and understanding of the ability of all actors and the boundaries to their authority.

1.1 Aims and scope

The ultimate aim of this study is to lay the foundations of a meaningful conversation about the current state and, perhaps more importantly, the prospects of adaptation finance in Australia. Due to the problems in financing climate adaptation, this conversation involves many different actors from the public and private sector. On the demand side, local governments play a key role in implementing adaptation actions, while state and federal governments are crucial in facilitating adaptation through funding and policy support. On the supply side, a range of different public and private sector organisations play a role and must

also be involved in delivering adaptation initiatives ‘on the ground’ and offering financial and professional support.

The focus was on summarising and synthesising knowledge – both from the literature and through expert interviews – about climate adaptation finance practices and prospects primarily in developed countries, with a particular focus on adaptation finance in Australia. Specifically, the study aimed to:

- develop a common language by clarifying key concepts and proposing new definitions, where needed
- provide a framework of thinking about climate adaptation finance that facilitates financial flows for adaptation needs
- identify and define the main issues in Australia
- identify limitations of certain actors in providing or accessing finance
- propose possible mechanisms to finance adaptation
- provide recommendations to advance the adaptation finance agenda.

The study does not cover or compare (economic) valuation techniques that could assist decision-makers with ‘costing’ or selecting adaptation options. This important task is fulfilled name and link and will complement the issue of finance examined in this report.

1.2 Structure of the report

The report has seven chapters. The first chapter introduces some key concepts and describes the aims and the methodology used in the study, its scope and limitations and the remaining structure of the report. The second chapter is a literature review that provides background information on climate adaptation finance and the role of the insurance industry. This chapter has a global scope, as adaptation finance is a new concept and the literature on adaptation finance practices in Australia is limited. The literature on the role of the insurance industry in the broader scope of climate change is more extensive and this is reflected in the detail of discussion of the options in the insurance industry. Chapters 3-7 report on the results of the study. Chapter 3 includes discussion of the type of adaptation projects that need to be realised, highlights the responsibility of local government in implementation and describes the funding and financing models used in Australia. This chapter draws on legislation and relevant literature to explain current modes of funding and financing. This background assists with interpreting the views of, and information provided by interview participants. Chapter 4 focuses on the understanding of climate adaptation finance among financiers (primarily lenders and institutional investors) and those who advise

financiers and the insurance industry. Chapter 5 describes the potential for select mechanisms to finance climate adaptation in Australia including insurance mechanisms that could incentivise the implementation adaptation options for the public. This chapter draws on grey literature to describe some of the more innovative mechanisms that are not applied in Australia. Chapter 6 highlights those features of adaptation initiatives that are important to know and consider in seeking and determining financing and funding options. Chapter 6 also includes a discussion on the barriers to climate adaptation finance. Final conclusions and recommendations are provided in Chapter 7.

1.3 Methodology

The study involved desktop research and semi-structured telephone interviews with 29 stakeholders from 25 organisations in the public and private sector[1]. The following main activities were carried out:

1. Desktop research to capture current knowledge on adaptation finance, examples, identifying gaps and framing key questions.
2. Two workshops with Expert Advisory Panel members (see Table 5) that provided a platform to share and reflect on preliminary findings and assisted with identifying interview participants
3. Semi-structured telephone interviews with 29 stakeholders representing 25 different organisations
4. Qualitative data analysis through coding and confirmation by interviewees
5. Reporting.

The study had a six-month timeframe and was completed between November 2015 and May 2016. Monthly reports to NCCARF, including an interim report, were also completed.

The desktop research was conducted through Internet based searches (e.g. Google and Google Scholar) of peer-reviewed publications in academic literature as well as industry reports prepared by financial institutions, industry bodies and associations and international agencies. The results were collated in a report that was reviewed and discussed by members of the Expert Advisory Panel (Table 1). The findings further guided the research methods both in terms of identification of potential participants and interview questions.

[1] The study obtained ethical clearance from Griffith University, the Human Research Ethics reference number of this project was 2015/870.

Table 1. Members of the Expert Advisory Panel and their role

Name	Organisation	Role on the Panel
Professor Susanne Becken	Griffith University	Project Leader, provide expertise in climate change adaptation and the tourism industry
Dr Zsuzsa Banhalmi-Zakar	Griffith University	Principal Investigator
Mr Dan Ware	Griffith University	Principal Investigator
Mr Ian Edwards	Griffith University	Research Assistance, provide insurance industry expertise
Dr Justine Bell	The University of Queensland	Provide legal expertise
Professor Ron Cox	University of New South Wales	Provide expertise in coastal management, including financing
Professor Brendan Mackey	Griffith University	Provide expertise, specifically in international deliberations of climate change and in conservation
Dr David Rissik	NCCARF	Provide advice and clarify stakeholder needs
Mr Donovan Burton	Climate Planning	Provide advice on adaptation in the public sector, particularly local government

Two Expert Advisory Panel workshops were held. The first one was at the start of the project in November 2015 and its purpose was to discuss the proposed methodology, the interview questions and set the boundaries of the study. The second workshop was held mid-way through the project at the end of January 2016, and it focused on discussing the implications of the literature review and the experiences from the first interviews and assist with identification of further potential participants.

Fifty-one representatives from 37 organisations[2] were contacted primarily through email, but also via telephone and face-to-face contact at industry events. Potential stakeholders were

[2] Organisation in this context also includes different departments in large organisations engaged in different areas of finance/funding, so the insurance department and the

identified through consultation with the Expert Advisory Panel in the first instance, followed by snowball sampling, a method where interview participants identify further potential participants to include in the study. Interviews continued until data saturation was reached, whereby no new information was gathered, or new participants were no longer identified. The aim was to get an even representation from the public sector, as the group who need funds to realise adaptation initiatives, and financiers (from the private and public sectors), as those who have the means to provide funds through various mechanisms and the insurance industry, which has been identified as a potentially powerful player in climate change adaptation (Mills 2009). Obtaining input from stakeholders across the country was also a goal.

Twenty-nine stakeholders from 25 organisations were interviewed. The breakdown of the different groups of stakeholders that participants represented is shown in Figure 1.

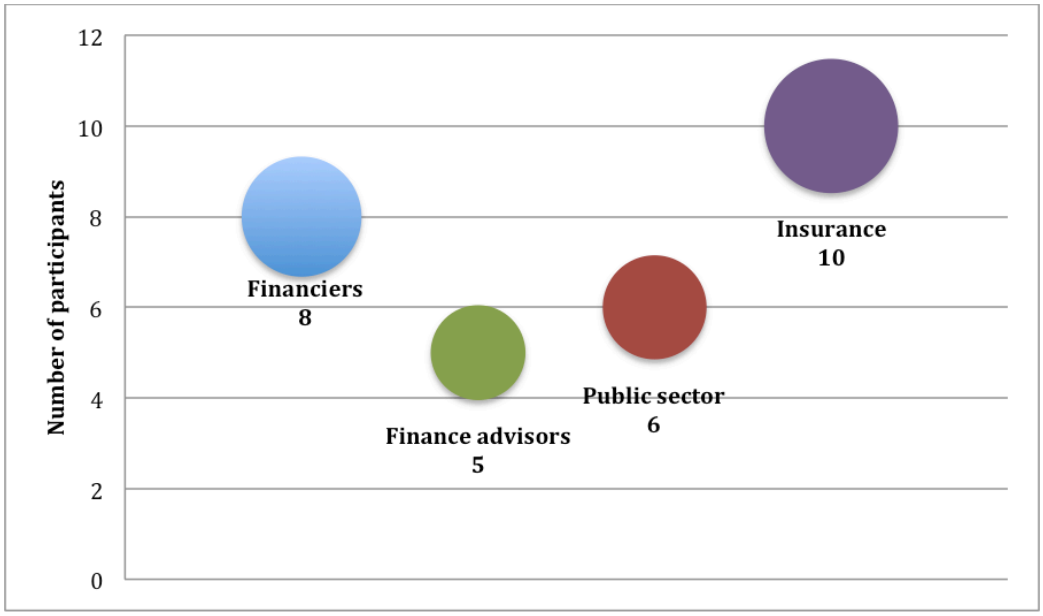

Figure 1. Number of participants in the study in four main stakeholder groups. Source: Developed by author.

Participants represented four stakeholder groups, based on the nature of their role in financing adaptation:

- Financiers (private and public) that included senior-level representatives from banks (2), institutional investors (3), private investors (1) as well as state treasury (1) and federal fund (1).

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investment department of a financial institution would be regarded as two different organisations.

- Finance advisors, who provide expert advice on climate change issues to financiers and/or fulfil an advocacy role for the consideration or integration of climate change into portfolios including climate change specialists in major consulting firms (2), senior or executive members of advisory groups (2) and law firm (1).
- Public sector, which included representatives from local (2), state (1) and federal (1) government and local government associations (2).
- Insurance industry representatives from general insurance (4), reinsurers (4), actuarial specialists (2).

All of the participants were based in Australia, except for a finance advisor, who was a senior member of an international climate finance organisation. This participant was interviewed to offer insights on international practices. Several participants are recognised experts in the area of climate finance in Australia and internationally and possess intimate knowledge of specific mechanisms which they acquired through working on these instruments (e.g. climate bonds).

Many participants had indicated their desire to stay completely anonymous, while others were open to part or full disclosure of their identities. Individual preferences have been considered in the report, whereby quotes by some participants appear in an identified form, while others are completely de-identified.

The majority of the interviews were conducted over the telephone, except for two: one was conducted in-person and one was a video-conference call. Interviews lasted between 30-50 minutes on average. The semi-structured interviews consisted of seven questions (Table 2). Additional questions were asked to clarify concepts or issues when needed. Interviews were recorded and transcribed by a professional service, prior to analysis.

Table 2. Interview questions

What does climate change adaptation finance mean to your organisation?
What parts of your organisation is climate change adaptation finance relevant to?
Can you think of any barriers or enablers to adaptation finance that you have encountered as part of your role within your organisation?
Why has been there so little action on adaptation finance in Australia?

Do you work with state or local government / or / financial services industry on climate change adaptation or adaptation finance in particular?
Do you have suggestions how government could further enable adaptation finance?
Anyone you suggest we should speak to in order to learn more about (innovative) climate change financing?

The interview questions centred on gathering information on the issues, attitudes, barriers and possibilities for financing climate change adaptation initiatives in Australia. Transcripts were coded by three members of the research team. Six interviews were selected randomly and each interview was coded by two researchers independently, using a deductive approach. Codes from all three researchers were collected, compared, resulting in a common code source book which was the basis for coding all of the interviews. The results were analysed and a narrative was developed around ten main themes that emerged from the interviews data, which is reported in this document.

1.4 Scope and limitations

The scope of this study was geographically defined to Australia, although international case studies and good practice examples were included where relevant. This became particularly important because the uptake of such mechanisms in Australia has been very limited. Further, because of NCCARF's larger project of developing a Coastal Climate Risk Management Tool, the CoastAdapt, this research focused on coastal zones. Again, when relevant and transferable, examples from other areas were included in the assessment of adaptation finance mechanisms. Since adaptation finance was ultimately framed as an issue of ‘supply and demand’, economic valuation techniques and the ‘option to abandon’ were not included. Finally, whilst this report focused on adaptation finance it was deemed informative to also include a small number of innovative tools or mechanisms that have been applied in the climate change mitigation area, but could easily be transferred into the adaptation domain. Similarly, disaster risk reduction and resilience projects—because of their close and inherent link with adaptation—were included where appropriate.

This research has several limitations. First, the focus on climate change adaptation finance was very specific and, despite careful selection of key stakeholders and experts, often required considerable discussion in itself. This is testimony to the relatively recent demand and concept of 'finance for adaptation', highlighting the need for this report but also

indicating that collecting tangible information has been challenging at times. Further, because of the relatively recent nature of climate adaptation finance, there are very few historic data, or any form of systematic quantification. As outlined in this report, only recently have major organisations begun to develop frameworks for collecting this type of information.

This research relied to a considerable extent on qualitative information provided by key informants, and the well-known limitations of this type of research apply, including expert selection, respondent bias, and interviewer bias. The coding process is also not without limitations, although inter-coder reliability practices were applied. To address some of the limitations of qualitative research, a wide selection of experts has been involved, and interviews were relatively structured. Also, interview data were triangulated with information extracted from the literature, both academic and professional and within Australia and internationally. Thus, despite some limitations—including a tight timeframe of six months—the researchers feel confident that this report provides a robust assessment of the state of climate change adaptation finance in Australia.

2. Literature review: Climate adaptation finance and the insurance industry

2.1 Current knowledge of adaptation finance flows: an uncertain present

As stated earlier, climate adaptation finance is a subset of climate finance, but it is rarely specifically separated out in global climate finance discussions. Climate finance has two main components, as articulated in the Lima Call for Climate Action (UNFCCC 2014b):

a) mobilization of public and private finance towards mitigation and adaptation measures
b) provisioning public finance from developed to developing countries (also known as the North-South transfer).

Both components include finance for adaptation; however, climate adaptation finance is typically mentioned in the context of the second component referring to public finance routed to developing countries and less so in the context of developed countries (Box 2). Importantly, climate adaptation finance in developing countries is fundamentally different to such finance in developed countries, as developing countries rely heavily on funding from multilateral development banks and mechanisms such as the Special Climate Change Fund or the Least Developed Countries Fund. These mechanisms are not available to Australia, and are not discussed further in this report.

Box. 2. Adaptation finance in relation to the North-South transfer raises important ethical questions, notably those related to climate justice and country alliances, to name a few (see for example Prys and Wojczewski (2015), or Gampfer et al. (2014)). While climate justice is not a key issue for adaptation finance in developed countries, it is recognised that the poorer and disadvantaged segments of Australian society are often more vulnerable to the effects of climate change. Hence, this report also extends to adaptation finance mechanisms that may help vulnerable populations (e.g. subsidised insurance, social impact investing and microfinance).

Estimating climate finance figures is challenging and the scale of finance for adaptation globally is uncertain. The UNFCCC's (2014a) estimated overall climate finance flows in 2014 (which includes adaptation finance) ranging from US$340 to $650 billion illustrates the level of uncertainty surrounding figures.

There are multiple reasons for this lack of certainty in data. The scope of climate finance is wide and involves a range of different sectors, organisations, and government jurisdictions that apply different definitions and methods to record and report figures (Buchner et al. 2014; UNFCCC 2014a). Adding to the uncertainty is the strong likelihood that current climate finance figures underestimate actual contributions, as they do not fully capture finance in all sectors, and also overestimate flows by including the value of entire investments, where only a small proportion of components address climate change (Buchner et al. 2015; UNFCCC 2014b). The good news is that concerted efforts to improve the comparability of data have begun and this is expected to facilitate transparency in the future (UNFCCC 2014a). Rather than focusing on figures alone, analysts have found that climate finance exhibits interesting characteristics (see Table 3).

Table 3. Key trends in global climate finance more broadly that are relevant for adaptation finance

The climate finance market has expanded significantly over the last three to five years through the development and implementation of a myriad of new innovations and more money was invested in climate finance in 2014 than ever before.
Climate finance tends to be domestic: approximately three-quarters of climate finance flows stay in domestic markets.
Strong presence of the private sector in climate finance: private sector contribution exceeds that of the public sector. Private sector finance amounted to US$243 billion, while public sector finance was US$148 billion in 2014.
Most climate finance is provided through debt finance mechanisms, regardless of whether they originate from public or private sources.
Decreased overall figures may not necessarily mean decreased activity: total global climate finance decreased in 2013, partially attributed to the spread of 'cheaper' technologies, such as solar PV.
Finance for renewable energy, particularly solar dominates the climate finance landscape, amounting to 78% of all finance towards mitigation.

Source: Adapted from Buchner et al. (2014; 2015) and CCST (2015).

Table 3 reveals that private sector contribution to climate finance is significant. In 2014, it was estimated at US$243 billion, which represents 62% of all climate finance (the remaining 38% was from the public sector) (Buchner et al. 2015). The private sector refers to individuals, businesses and all forms of non-governmental organisations, including virtual ones, like crowdfunding platforms. While all climate finance exhibits strong preference towards staying in the domestic market, this is especially true for private finance. Over 90% of all private sector finance remained in the country of origin in 2014 (Buchner et al. 2015).

Finance flows for adaptation fall well below all targets. According to UNCTAD (2014), global investment for adaptation is approximately US$20 billion, which translates to an investment gap of US$60-100 billion per annum. Data published by the Climate Finance Institute are slightly more favourable: according to their calculations, adaptation finance to both developed and developing countries amounted to US$25 billion in 2013 and 2014 (Figure 2) (Buchner et al. 2014; 2015).

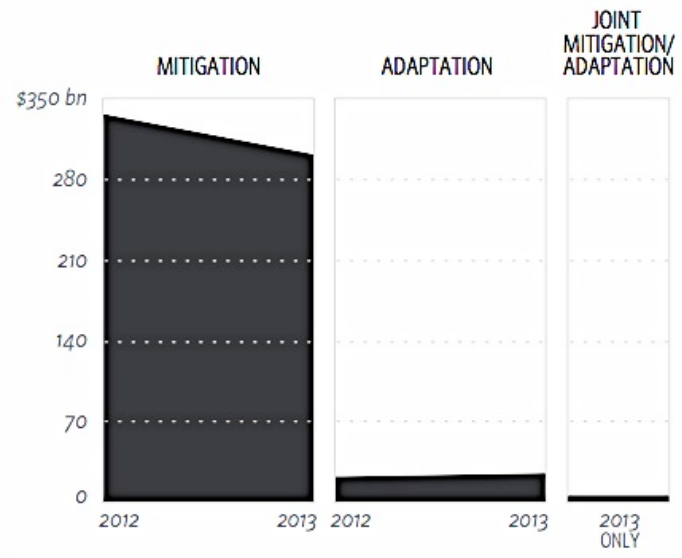

Figure 2. Global estimated finance for mitigation and adaptation in 2013. Source: Buchner et al. 2014.

Figure 2 shows that adaptation finance represents a small proportion of overall climate finance flows, around 7% in 2013, which was a marked 25% increase from the previous year (Buchner et al. 2014). Disproportion of flows between mitigation and adaptation are even more extreme in developed countries. Only 1% of climate finance flows in developed countries could be tracked to adaptation (Buchner et al. 2014). There are also significant differences as to which sectors or adaptation activities receive finance (Figure 3).

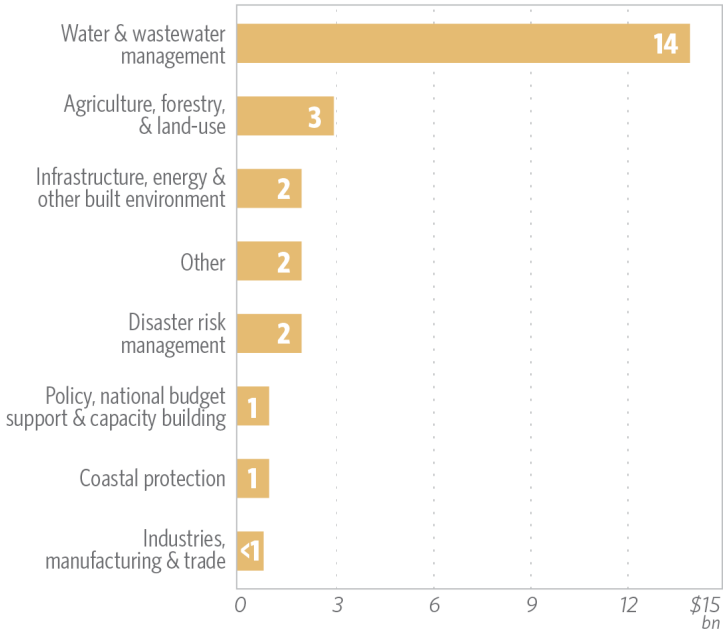

Figure 3. Adaptation finance by sector in 2014 (in USD billion). Source: Buchner et al. 2015.

Adaptation initiatives primarily target the water sector, while nearly equal investments were provided to all other activities such as coastal protection and infrastructure resilience (often linking to tourism development or infrastructure, especially in small island developing states or SIDS), disaster risk management, agriculture, forestry and land use, policy, regulation and capacity-building.

It is important to note that all of the adaptation finance captured in the report and shown in Figure 2 originated from public sources as no data could be obtained from the private sector. For this reason, the actual volume of adaptation finance is likely to be higher. Adaptation and resilience activities, in particular, are often incorporated (mainstreamed) into large-scale climate change initiatives; further underestimating actual flows (Buchner et al 2014; Pauw 2015). The tendency for mainstreaming adaptation projects may well continue. There are regional differences in how adaptation is defined, and hence the type of activities that fall under the adaptation category. And lastly, another difficulty with adaptation finance is the absence of a reliable methodology to assess the effectiveness of adaptation (or resilience) initiatives (UNFCCC, 2014a).

After numerous observers have pointed to the difficulty in obtaining any meaningful and reliable adaptation finance data, efforts are finally being made to remedy the problem. Seven multilateral development banks (African Development Bank (AfDB); the Asian Development

Bank (ADB), the European Bank for Reconstruction and Development (EBRD); the European Investment Bank (EIB); the Inter-American Development Bank (IDB); and the International Finance Corporation (IFC) and World Bank (IDA/IBRD) from the World Bank Group (WBG)) and the International Development Finance Club (IDFC) have recently issued the *Common Principles for Climate Change Adaptation Finance Tracking* (AfDB et al. 2015). The Principles define adaptation activities as stand-alone projects, multiple projects under larger programs, or project components, sub-components or elements, including those financed through financial intermediaries that address current and expected effects of climate change, where such effects are material for the context of those activities. This definition is inherently focused on the project as the basic unit of finance, but it is in-line with our earlier definition of adaptation. The document emphasises the need to obtain data that is specific to adaptation, including disaggregating the adaptation component of projects.

The vast gap between current and target levels for climate finance suggests that a fundamental shift is needed in the economy. Indeed, nearly all commentators reviewed agree that climate finance targets to 2020 and beyond can only be reached through an economic transformation. Meeting the challenge of mobilisation and redirection involves transferring investments away from high-carbon to low-carbon activities, while ensuring overall investment keeps up with planned economic growth (Spencer et al. 2015; Castree and Christophers 2015).

2.2 Insurance and adaptation

The potential for insurance as a mechanism, and insurers as an industry to improve societal resilience to extreme weather events and motivate and enhance climate change adaptation behaviour is well recognised (e.g. see Mills 2005; Kunreuther and Michel-Kerjan 2009b; Mills 2009; McAneney 2014). Insurance as a mechanism operates in a number of ways. The compensatory nature of insurance enhances adaptive capacity as it caps losses and provides the financial means to cope and re-establish subsequent to catastrophic and unexpected events (Arent et al. 2014). Appropriately designed insurance products can also act as "*the point of pressure… to engage in adaptive behaviour*" (Godden et al. 2013, p. 249). The Intergovernmental Panel on Climate Change (IPCC 2012a) and a range of Australian governmental commissions and inquiries (Productivity Commission 2012; Murray et al. 2014; Productivity Commission 2014a, 2014b; Australian Government 2015) also document the industry's potential to significantly influence societal behaviour that could reduce the impacts and risks. Such behavioural changes are seen to benefit the economy at large. Thus, whilst adaptation is far from the insurance industry's responsibility alone

(McAneney et al. 2013), and indeed at times it may conflict with profit imperative (Sturm and Oh 2010; McAneney et al. 2013), the literature echoes a common thread that adaptation measures provided and influenced by the industry may be a prerequisite of affordable insurance, and ultimately provide sustainable market coverage as loss events and risks rise in accordance with climate change predictions (Bagstad et al. 2007; Hecht 2008; Ward et al. 2010; Suarez and Linnerooth-Bayer 2011; Prudential Regulation Authority 2015).

The influence of insurance as an industry is derived from its considerable economic weight in the global economy. In 2014 the insurance industry wrote US$5 trillion in premiums (Aon Benfield 2015) and managed over US$28 trillion in assets (OECD 2015). This made the insurance industry the world's third largest investor, trailing only mutual and pension funds. Total assets under management of the insurance industry are projected to continue to increase and overtake those of pension funds (OECD 2015). As Sturm and Oh (2010 p. 156) write, "whether or not it chooses to actively engage in political decisions, an industry [insurance] this large has no choice but to wield a tremendous amount of power". Thus, whilst the oft-considered compensatory nature of insurance is an important prerequisite for a stable economy and the positive investment environment this enables (Ranger et al. 2011), the potential influence of the mechanism and the industry extend well beyond this.

2.2.1 Insurance concepts

The following section (including figures and boxes) was extracted from a briefing note prepared by one of the authors for the National Climate Change Adaptation Research Facility (NCCARF) in 2015.

At its most basic, insurance provides financial compensation in the event of damages suffered due to unforeseen circumstances or events (ICA 2014). Individuals enter into agreements (policies) with an insurer to forgo small certain payments (premium) spread out across time in return for protection from financial implications of an instantaneous, large uncertain event (Productivity Commission 2012).

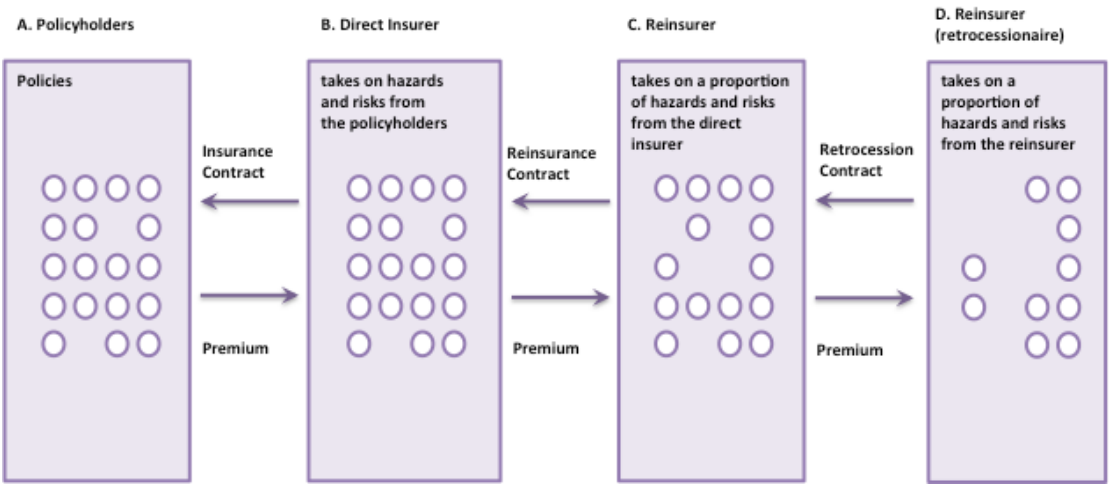

Figure 4. (Re)insurance relationships. Source: customised from Swiss Re (n.d., p. 9).

The insurance landscape facilitates the disbursement of risk across numerous entities, locations and timescales (Figure 4). Although it is continuously evolving (see Alternative Risk Transfer Mechanisms below) the landscape has traditionally comprised two basic direct functionaries: insurers and reinsurers supported by a third: insurance brokers.

Direct insurers (B) provide distinct insurance policies directly to individuals (A - encompassing both distinct natural persons and organisations).
Reinsurers (C) insure primary insurers. In turn reinsurers may subsequently transfer a portion of any assumed risk to another reinsurer (D - retrocessionaire). Reinsurers come in three guises: professional reinsurers who deal only in reinsurance; primary insurer reinsurance departments; and "others" such as government-owned companies and reinsurance syndicates and pools (King 2013). Unlike primary insurers, reinsurers generally exercise more flexibility over their contracts allowing greater customisation of terms and conditions.

Insurance brokers facilitate the spread of risk through the provision of advice and services to insured parties by aiding in risk identification, insurer and product selection and claim process (ICA 2014).

2.2.2 The challenge of insuring natural catastrophes

The insurability (Box 2) of natural catastrophes is significantly more constrained than most other forms of insurance. Because natural disasters can impact large sections of the economy concurrently, insurers must be prepared to make considerable payments during a short period of time. This 'correlation of loss' or 'systemic risk' acts to concentrate risk both in time and place that ultimately leads to potentially unmanageable losses for insurers.

Consequently, insurers often transfer significant proportions of their natural disaster exposure to reinsurers or other external parties, and are bound by regulation to hold greater capital reserves (McAneney et al. 2013). Reinsurance costs can spike significantly subsequent to natural disasters (Hofman and Brukoff 2006). At times increases in these costs may bear no apparent relationship to local conditions. For example, despite not being in a major hurricane corridor, Barbados experienced ten-fold increases in public infrastructure premiums following the significant damage to Florida and the Gulf Coast of the United States from Hurricane Andrew in 1992 (Suarez and Linnerooth-Bayer 2011).

High correlation of loss also inhibits the application of certain actuarial principles, such as the law of large numbers, which reduces the certainty of risk calculation results (Hofman and Brukoff 2006). Costs required to compensate for this additional uncertainty, in addition to holding capital reserves and diversifying risk, can be significant and are invariably passed onto consumers (Hofman and Brukoff, 2006; Kunreuther and Michel-Kerjan 2009b).

Box 2. Insurability Not all risks are insurable. A risk is generally only insurable if an insurer is able to cover its expected losses and risk management and operational costs reliably at a price that is both profitable to the insurer and affordable to the market place (King 2013) (see Figure B1). A risk that is insurable one year may not be insurable the next and vice versa.

Reliable calculation of expected loss is predicated on the ability of an insurer to pool individual, uncorrelated risk. Effective risk management also relies on being able to transfer some proportion of the pooled risk, for example to reinsurance companies.

Figure B1. Components of an insurable policy: all must be covered if a policy is to be viable Source: King (2013)

Pooling involves the aggregation of like, uncorrelated policies with two implications:

1. Sufficient funds are available to meet losses as they occur. As the timing of individual losses are uncorrelated (independent of each other), insurers are better placed to meet claims as they fall due.
2. Expected losses can be calculated with confidence. Insurers are able to leverage the "law of large numbers" which asserts that unpredictability of individual risks reduces and converges closer to a mean with greater aggregation (Hofman and Brukoff 2006).

Management of risk is critical to an insurer's ability to pay losses specific to any given event. An inability to do so effectively has the potential to threaten the solvency of the insurer. Risk transfer

mechanisms such as reinsurance enable an insurer to reduce the amount of risk that it individually assumes. This comes at a cost, which is invariably passed onto consumers.
Affordability is determined by both the willingness of a market to pay and the willingness of an insurer to provide coverage at a particular price. In effect, if a price to cover a risk is higher than consumers are willing to pay, than that risk is uninsurable.

2.2.2 Insurance and 'acts of the sea'

Insurance coverage of climate related events has many challenges and may not be applicable to all types of events. Of particular relevance to Australia's predominantly coastal population, there is limited insurance coverage offered for 'acts of the sea'. An extensive study of over 40 general insurers operating in Australia found that, although some offered partial coverage for erosion and seawater inundation due to storm surge, none offered products that cover loss or damages due to gradual sea-level rise (see Table 9.1 in Bell 2014). Such an absence is not surprising, given that insuring reasonably foreseeable events such as gradual sea-level rise (and as noted by Dobes et al. 2014), increasing temperatures) fundamentally diverge from the principles that currently underlie property cover, i.e. sudden uncertain impacts and losses:

> Sea-level rise bears little similarity to the risks traditionally covered by property insurance, and is arguably more akin to the risk covered by life insurance. Life insurance provides coverage for a risk that is certain to occur (i.e. death), although the timing of when the risk will materialise is uncertain (Bell 2014 p. 228).

Complexities arise however, from the application of a life insurance model to sea- level rise. For example, whilst life insurance provides coverage for a single life, properties may be sold any number of times prior to the materialisation of any risk (Bell 2014). Potentially, the issue of multiple-ownership could be addressed by tying insurance to a property as opposed to an owner. However, such an approach may not be sufficient to motivate the purchase of insurance where potential impacts are perceived to be far into the future. Consistent with financial stability where: "once climate change becomes a defining issue for financial stability, it may already be too late" (Carney 2015, p.4), leaving coverage too close to expected events may render insurance unaffordable.

2.2.3 Insurance as an industry of influence

The scope and scale of the industry is of such significance that it is

> theoretically well positioned to serve as a quasi-regulator of individual and corporate behavior…[and] provide a structure that facilitates both mitigation of atmospheric greenhouse gases and adaptation to climate change's inevitable impacts (Hecht 2008 p. 1614).

Quite simply, insurance acts in a quasi-regulatory fashion through the threat of its withdrawal should certain requirements not be met (Surminski and Oramas-Dorta 2014). Arguably, a salient example of the insurance industry's potential in this regard is insurer refusal to provide coverage to the residents of Roma and Emerald in Queensland subsequent to flooding in 2011. Insurers demanded government construction of flood levies as a prerequisite of coverage, in recognition that the economic cost of mitigation would justify reductions in potential future losses (Wiltshire 2014). Additionally, the coupling of insurance provision with other mechanisms has the potential to counteract weak enforcement of regulatory standards. For example, in Fiji, an alliance has been established between the Fiji Institute of Engineers and the Fiji Insurance Council for a third party certification programme. An approved member of a panel of professional engineers (established by the Insurance Council) must provide structural certification prior to access to cyclone insurance, which in turn is a prerequisite for finance. This approach has effectively institutionalised building standards in the country since developers are forced to comply with them to access bank financing (Mahon et al. 2013). The magnitude of investment controlled by insurers and the nature of their skill set place the industry in a unique position to influence both climate change mitigation and adaptation initiatives (Table 4).

Table 4. Examples of recently implemented insurer initiatives that may be able to influence climate change adaptation action

Initiative	Description	Examples
Selective financing	Provision of financial support to adaptation innovation and low carbon technologies whilst directing funds from climate damaging industries (Herweijer et al. 2009; Mills 2009)	AXA has announced that it will divest €500 million from coal related funds whilst tripling green investment to €3 billion by 2020 due to climate change concerns (Axa 2015).
Information provision	The provision of leading edge information (King et al. 2013; Bell 2014) and sharing of data such as losses and flood maps to planning authorities (Bacani et al. 2015)	In Australia Suncorp Group Ltd has entered into a partnership with the James Cook University Cyclone Testing Station to supply researchers with claims, policy and assessment data in the hope of leading to more resilient buildings and lower insurance premiums (Productivity Commission 2014b). The Property Resilience and Exposure Program initiated by the Insurance Council of Australia provides participating local governments with a 'resilience heat map', which identifies areas where properties are at higher risk and might require mitigation measures (Productivity Commission 2014b). An industry association, Finance Norway has collated and distributed commercial insurance loss data to universities and several universities for use in land planning and disaster resilience (Bacani et al. 2015). The Fiji Insurance Council has partnered with the Fiji Institute of Engineers to provide cyclone certification. The certification is available from a panel of experts and is mandatory for both insurance and finance (Mahon et al. 2013).

Initiative	Description	Examples
	management practice (Herweijer et al. 2009).	
Leading by example	In-house policies applied to reduce environmental footprint and entity resilience. This could include provision of employee incentives to do the same (Herweijer et al. 2009).	In 2011 the Munich Re board to strive for complete group carbon neutrality by 2015 (Munich Re n.d.-a).
Societal awareness building	Educate the public about the risks of climate change and how to reduce them (Herweijer et al. 2009)	In Australia, NRMA Insurance has partnered with the New South Wales government and civil society groups to promote a consumer flood awareness program (Productivity Commission 2015). The Sustainable Governance Forum on Climate Risk launched by insurance broker, Marsh, CERES and Yale University in 2006 educates corporate board members about climate change risk and opportunity (Mills 2009).
Institutional lobbying	Includes advocating for risk-reduction policies and support from government and institutional actors (Mills 2009; Productivity Commission 2015).	International industry associations and initiatives such as the Geneva Association[3] and ClimateWise[4] in addition to the UNEP Finance Initiative's Principles for Sustainable Insurance[5], provide a platform for insurers to advocate for climate change mitigation and adaptation policy. In Australia two leading insurers make up the six member board of the Australian Business Roundtable for Disaster Resilience and Safer Communities, whose vision incorporates collaboration amongst government and the private and civil sectors to "*actively improve the capacity of people and businesses to better withstand future natural disasters*" (The Australian Business Roundtable 2015).

[3] https://www.genevaassociation.org
[4] http://www.climatewise.org.uk
[5] http://www.unepfi.org/psi/

Initiative	Description	Examples
Climate related research	The support of research undertaken by other institutions to enable adaptation to climate change.	The Institute for Business and Home Safety is funded in the US by insurers and develops strategies to improve homeowner and business resilience to extreme weather events (Herweijer et al. 2009).
Finance risk reduction	Direct financing of consumer adaptation measures that improve extreme weather resilience (Herweijer et al. 2009)	In 2015 Suncorp announced, within the context of strata insurance in North Queensland, that it will contribute up to $10 000 towards fittings that improve extreme weather resilience (Australian Government 2015).

Table 4 illustrates the range of ways in which insurers can and have engaged in adaptation initiatives beyond the provision and design of insurance mechanisms. Partnerships between industry and government and other civic actors are apparent, perhaps in recognition of both the broader societal and insurer benefits from such actions (Productivity Commission 2012). Indeed, King et al. (2013) highlight that close cooperation between insurers and other societal actors is key to the provision of information and incentives for bushfire mitigation and adaptation. Kunreuther (2015) asserts that collaboration between industry and governments through public-private partnerships can encourage protective measures that alleviate insurance affordability issues, and the challenges of catastrophic event coverage. Beyond a minor number of examples there appears little evidence in the literature of the effectiveness of insurer initiatives such as those listed in Table 2. For example, an initial assessment of Norway's Finance Norway initiative indicates significant improvement in the planning and knowledge base of municipalities, resulting in stronger land use planning for disaster resilience (Bacani et al. 2015). Whilst a number of insurer data-sharing initiatives have resulted in premium accuracy improvements, the assessment also cautions that further advances have been curtailed by a lack of further information sharing between, and within, public and private entities and the availability of sufficiently granular data (Productivity Commission 2014b). A conspicuous absence of climate change discourse in a number of Australian insurer-publicly related policies and statements is cited as further evidence of a failure to live up to potential (WWF 2015).

2.2.4 Insurance as a mechanism of influence

The role of insurance is often perceived as reactive because it compensates policyholders subsequent to a damaging event (King 2013). McAneney et al. (2013) notes however, that whilst the funds provided by insurance subsequent to a disaster are a critical element of recovery efforts and enhance adaptive capacity, compensatory insurance does not reduce risk but merely transfers it. Beyond the protection that insurance provides from the negative financial impacts of extreme weather events, insurance can also proactively motivate behaviour that reduces vulnerability to those same events (e.g. see Mills 2005; Kunreuther and Michel-Kerjan 2009b; Mills 2009; Godden et al. 2013; McAneney 2014). A driver commonly cited to enable such a function is risk based pricing, which is based on the premise that premiums charged reflective of risk provide a price signal to the market that acts to incentivise the reduction of vulnerability to that risk (e.g. see Kunreuther and Michel-Kerjan 2009b; Productivity Commission 2014b). As Worthington (2015 p. 1) stated, "appropriately priced insurance is a powerful mechanism for discovering and motivating

appropriate risk-taking behaviour". However, accurate pricing is not always attainable, due to constraining elements including price regulation, competition pressures, subsidies, availability of data and government market intrusion (Bagstad et al. 2007; Maynard and Ranger 2012; King 2013; Productivity Commission 2014b; McAneney et al. 2015).

The effect of risk priced insurance has received much attention in the literature, because it may drive premium prices potentially beyond levels that consumers can or will pay, resulting in under- or non-insurance. This particularly affects low-income earners who perversely often also inhabit high-risk areas (e.g. see Phelan 2011; Productivity Commission 2012; King et al. 2013; Productivity Commission 2014b). Lack of insurance access and affordability are often noted as an incentive for government involvement in the insurance markets (Kousky and Cooke 2012; Australian Government 2015; Kunreuther and Michel-Kerjan 2015; Worthington 2015). But government intervention generates a raft of intended and unintended consequences for the public and private sectors alike (see for example McAneney et al. (2015); and Worthington (2015)).

Beyond the complexities of risk-based pricing, a number of other factors can limit the effectiveness of insurance to motivate proactive adaptive behaviour (Table 5).

Table 5. Factors that inhibit insurance effectively motivating climate change adaptation actions

Inhibiting Factor	**Explanation**	**Example**
Outlook	Consumers often maintain a myopic outlook to risk (Ma et al 2013). Standard annual terms of contracts act to support this outlook thus reducing motivation for adaptive capital investment and long term risk management (Jaffee et al. 2008).	A survey of 1100 adults in May 2006 revealed minimal investment in low-cost property loss-reduction measures (17%), hurricane survival kits (32%) and family disaster plans (40%) subsequent to two devastating hurricane seasons along the US's Atlantic and Gulf Coasts in 2004 and 2005 (Goodnough 2006).
Moral hazard	The expectation of coverage in the event of a disaster can act as a disincentive to take proactive action to reduce the potential impacts of that disaster (Kunreuther and Michel-Kerjan 2009b; Bell 2014). This ultimately increases societal risk as current risk reducing	A Queensland property developer located in a particularly flood-prone region stated "that they may not move infrastructure (i.e. air-conditioning units) from basements, because when the next flood came, it would probably be time to replace these; and then the

	activity is curtailed in lieu of expectation of future assistance.	insurers would pay" (Shearer et al. 2013, p. 117).
Adverse selection	In an insurance sense adverse selection is a function of information asymmetry that results in an insurance pool skewing towards more high risk than low risk policies. It can occur where insurers, due to lack of information, are unable to differentiate risk at an individual policy level. Where prices are the same, there will be a natural tendency for individuals with risk greater than prices reflect to take out policies than those with risk below. A pool of greater risk leads to higher claims which results in increasing premiums. As premiums increase the pool skews further and further towards higher risk.(Botzen 2008; Dobes et al 2014).	Improved information and an ability to reflect this in premiums, as well as substantial market coverage through compulsory insurance schemes such as that for flood insurance in France, can reduce adverse selection problems (Botzen 2008).
Lack of information for consumers	Lack of consumer understanding about the details of their insurance policies, risks faced and how these risks impact policy pricing can result in under-insurance and impede risk mitigation activity (McAneney et al. 2015; Productivity Commission 2014b).	In Australia, Suncorp Group asserts that current regulation prevents the provision of personalised advice that could address information asymmetries to consumers (Productivity Commission 2014b.
Maladaptation	Occurs when governments and/or insurers unintentionally promote activity that increases or fails to reduce exposure to climate change (Shearer et al. 2013).	Policies such as full replacement cost coverage replace like with like, forgoing the opportunity to apply more adaptive measures, e.g. rebuilding with more resistant materials (King et al. 2013).

Appropriately designed and implemented insurance mechanisms have the potential to address many of these factors (Table 6). By offsetting increasing losses as climate related events rise, the reduction in risk that these innovations drive may be paramount to insurance that is sustained, affordable, accessible and indicative of risk (Ward et al. 2010).

Table 6. Examples of innovative insurance mechanisms

Mechanism/Tweak	Explanation, Benefits and Barriers	Country: Example
Policy Tweaks that Promote Loss Prevention		
Premium discounts (Kunreuther and Michel-Kerjan 2009b; Ward et al. 2010)	Reduces premiums commensurate to risk reduction through proactive action. Benefits: • motivate risk prevention in exchange for lower premiums • reduce premiums to affordable levels • reduce potential for adverse selection. Barriers: • Insurers may fail to reduce premiums where there is insufficient information to quantify the impact of mitigation action. Information barriers are usually greater for smaller scale measures, e.g. individual properties than large-scale (Productivity Commission 2014b).	Australia: Suncorp programme "Protecting the North" awards discounted premiums for recognised cyclone proofing enhancement by way of a "cyclone resilience benefit" (Suncorp n.d.).
Shared costs (Botzen and van den Bergh 2009; Worthington 2015)	Inclusion of policyholders in meeting losses provides incentive to minimize loss, e.g. policyholder covers first 10% of an insured loss with insurer covering the balance (i.e. deductible or excess). Benefits: • Reduces moral hazard (i.e. the expectation of coverage in the	Mongolia: For a particularly innovative application of this principle see the Mongolian Index-Based Livestock Insurance Project (IBLIP) explained in Box 2

Mechanism/Tweak	Explanation, Benefits and Barriers	Country: Example
Rebuild right (Mills 2009)	Leveraging the insurance claim process to improve building subsequent to losses. Benefits: • infrastructure rebuilt in a more resilient manner to withstand future events • prevents maladaptation.	Australia: Allianz offer $5000 beyond property sum insured towards installation of green features such as water tanks, grey water recycling etc. (Allianz n.d.).
Long-term insurance (Jaffee et al. 2008; Kunreuther 2015)	Increase insurance term beyond one year and couple it to property improvement loan. Benefits: • generates longer-term outlook tied to financial improvements • creates more certainty and assuredness for policyholders, particularly when situated in disaster prone areas (Kunreuther and Michel-Kerjan 2009a). Barriers: • additional cost required to cover uncertainty created regarding cost of capital over time (Kunreuther and Michel-Kerjan 2009a) • Maynard and Ranger (2012) concluded that, in Australia, the additional cost of multi-year contracts, in addition to other factors such as increased risk of insolvency and loss of flexibility deem long term insurance comparatively unattractive.	United States: Three-year structured cover against named windstorms and associated flooding for Miami Dade County Public Schools (Swiss Re 2014).
Directors and Officer Liability	Apply climate preparedness as one factor in determining cost of Director's liability.	Switzerland: In 2008 Zurich Insurance extended Director and Officers Liability

Mechanism/Tweak	Explanation, Benefits and Barriers	Country: Example
	Benefits: • enhanced climate change implication awareness amongst corporate leaders (Mills 2009) • an increased focus on climate change exposure (Ross et al. 2007).	(Mills 2009).
Recognizing and rewarding the "halo effect"	Sustainable practice correlates to low-risk behaviour and is thus rewarded with lower premiums. Benefits: • motivates sustainable practice (Mills 2009).	United States: Workers compensation and environmental insurance premium reductions of up to 5% were offered by Allianz/FFIC to the manufacturing sector displaying sustainable practice and products (Mills 2009).
Innovative Insurance Products and Services		
Energy Insurance (Mills 2009).	Protects energy efficiency and renewable energy practitioners in event that savings/energy generated falls short of expectations. Benefits: • financial protection and confidence of both supplier and customer to engage in low carbon energy activities.	United Kingdom: HSB Engineering Insurance, a UK subsidiary of Munich Re's offers insurance that covers projected savings from energy efficiency projects (Munich Re n.d.-b).
Green Building and Equipment Insurance and Warranties (Mills 2009)	Covers building and certification related risks. Benefits: • financial protection and confidence of both supplier and customer to engage in low carbon energy activities • enhances legitimacy of green buildings.	United States: Fireman's Fund in the US offers several "Greencard" insurance policies which amongst other things covers additional time and cost required for green certified

Mechanism/Tweak	Explanation, Benefits and Barriers	Country: Example
		buildings to maintain certification after loss has occurred (Mills 2009).
Parametric Insurance	Payment made subsequent to a pre-agreed variable or variables reaching or exceeding a pre-agreed threshold within a pre-agreed timeframe, e.g. wind exceeding an agreed speed. Benefits: • promptness of payment and reduced cost through reduction in claims costs (Hofman and Brukoff 2006) • Grove (2012) cautions about potential for political misallocation of compensation funds. Barriers: • parametric insurance involves basis risk from the insured whereby payments may fail to cover all losses incurred.	United States: The State Insurance Fund of Alabama used a parametric product to insure against hurricanes with payout based on wind speed over a specific geographic area (Swiss Re 2014).
Contingent credit (or contingent capital)	Provides a way of not so much reducing risk but spreading it over time (Hartwig and Wilkinson 2007). It operates by providing liquidity to bridge the gap between catastrophic event and post-disaster financing, i.e. when funds are needed the most (King 2013). Hartwig and Wilkinson (2007) compare it to a line of credit that becomes available upon the occurrence of an insured event. Benefits: • speed of payment and lower cost compared to other forms of insurance	Columbia: The Columbian government organised a $US 150 million line of credit with the World Bank that would provide immediate post-disaster liquidity (Cummins and Mahul 2009).

Mechanism/Tweak	Explanation, Benefits and Barriers	Country: Example
Microinsurance	Insurance tailored to the "*protection of low-income people against specific perils in exchange for regular premium payments proportionate to the likelihood and cost of the risk involved*" (Churchill and Matul 2012, p. 8). Benefits: • coupled with risk reducing activity opens up potential of insurance to the developing world and lower income earners.	Australia: Good Shepherd Microfinance has partnered with a number of insurers to provide affordable insurance to low income earners via innovations such as flexible payment options (Good Shepherd Microfinance 2015).
Multi-peril insurance	Multi-peril insurance protects the policyholder against multiple risks (Keogh et al. 2011). Benefits: • reduces volatility, enabling the policyholder to leverage any in-house risk consolidation thus offsetting uncorrelated risks and potentially reducing over-insurance (Hartwig and Wilkinson 2007) • bundling of uncorrelated risks (e.g. fire, flood, earthquake) under one policy reduces accumulated risk of any one event enabling insurer to offer coverage (Worthington 2015).	Australia: In 2014, Latevo International introduced coverage for Western Australian farmers against the effects of frost and drought (Hayes 2014).

Source: Based on a table prepared for an NCCARF briefing note in 2015, typology based on Mills (2009)

Table 6 is a snapshot in time. As apparent from Alternative Risk Transfer Mechanisms below, innovations are continuously evolving to meet consumer demand and societal challenges. The innovations from microinsurance, whilst predominantly targeted at low-income communities in the developing world (see Box 3), are particularly interesting as they have potential application to a broader societal base given the generic nature of challenges faced (in particular cost and education). Further consideration of microfinance as a mechanism in Australia might be worthwhile.

Box 3. Additional examples of Microinsurance Innovation

Ethiopia – Insurance for Work. Cash constrained farmers have the option to pay for insurance premiums either in cash or through disaster risk reduction work, thus building community resilience both in anticipation of and subsequent to drought (Suarez and Linnerooth-Bayer 2011; Greatrex et al. 2015).

Mongolia – Layered Insurance. The Mongolian Index-Based Livestock Insurance Project (IBLIP) is a public-private partnership that adopts a formal layering risk management approach where individual herders absorb the first 6% of herd losses; the next 24% is covered by commercial insurance sold at actuarial rates, with any losses above 30% covered by the Mongolian Government. The scheme provides an example of how insurance can motivate resilient behavior whilst providing financial security. Claims costs are reduced through the utilization of an index of livestock mortality rates measured from January to May (when 80% of losses occur) at a local level. Upcoming innovations under discussion include reducing administration costs further by utilizing trusted banking channels to sell premiums as opposed to distinct insurance agents. In 2014 approximately 15,000 herders were covered by the scheme and as testament to its success an announcement was made that it would transition from a donor-funded project to a private company (Greatrex et al. 2015).

Peru – Forecast Insurance. Peru's ENSO insurance employs a trigger that pays out based on a seasonal forecast (in this case a flood associated El-Nino climatic event) allowing policyholders time to apply payments to flood mitigation measures. Insurance is enhanced with awareness-raising and educational efforts that aid policyholders understand the best measures to reduce flood risk. Whilst it is too early to determine the full impact of the ENSO scheme, one result evidenced to date has been the application of ENSO monies to new efforts by farmers' associations in remote regions of Peru to clear drainage systems in preparation for hazardous events (Surminski and Oramas-Dorta 2014).

Whilst the potential of insurance to reduce risk and aid climate change adaptation receives strong support in the literature and a number of products have begun to emerge, quantification of the degree that innovations have influenced risk reduction behaviour appears to have received little attention to date (Surminski and Oramas-Dorta 2014). Evidence, where it exists, appears more anecdotal than empirical. For example, based on the account of one adaptation expert, Booth and Williams (2012, p. 41) found evidence that

the inclusion in audits of local government by some insurers is influencing bushfire adaptive behaviour in Tasmania. King et al. (2013) and Shearer et al. (2013) note little interest in using insurance to drive climate change adaptation in Australia and, based on a study of homeowner insurance undertaken in Florida, Kunreuther (2015) contends that insurance is failing to motivate consumers to proactively reduce their exposure to disasters. The conclusion of the National Association of Insurance Commissioners' (NAIC) most recent survey of US insurers that the majority of insurers in the US are unprepared for climate change (see Messervy et al. 2014) indicates that provision of climate orientated tweaks and products is in its infancy.

2.2.5 Alternative risk transfer mechanisms: captives, pools and capital market mechanisms

Alternatives to traditional insurance, known as alternative risk transfer mechanisms (ART),have developed since the 1990s and continue to evolve in response to demand and innovation (Hartwig and Wilkinson 2007). Swiss Re (2003) note that ART encompass an element of alternative carrier and product, and that the more innovative forms of ART typically combine some degree of insurance and financial features. Alternative carriers incorporate vehicles of self-insurance such as captives and pools capital markets participants engaged either directly or via securitisation:

- captives are a wholly owned separate legal entity owned by the insured (Salve and Simpson 2011)
- pools enable entities to group (or pool) their disaster risk with other entities with the objective of sharing risk (Hofman and Brukoff 2006)
- capital markets include both the securitisations and distribution of risk amongst multiple capital market participants or the placement of risk with a single designated non-insurer.

Captives and pools are utilised extensively by governments in Australia. With the exception of the Northern Territory, all states and territories and the Australian Federal Government have captive insurers that supply services to government agencies (Productivity Commission 2014b). In Queensland, the Council of the City of Gold Coast arranges insurance via a wholly owned captive insurer (DFD 2012). Many Australian local governments also apply mutual pooling arrangements. For example, in 1994 the Local Government Association of Queensland (LGAQ) established an insurance pool to reduce local government public

liability risk (Jardine Lloyd Thompson 2014). Both the City of Gold Coast and the LGAQ report extensive insurance cost savings due to these arrangements (LGAQ 2013; Council of the City of Gold Coast n.d.).

Captives and pools allow insured entities to exercise greater control over the extent of insurance, its affordability and form, whilst exploiting tax deductions available to premiums which are forgone should taxable income be set aside to build in-house reserves (Salve and Simpson 2011). Entities may also pool their risk to constitute a form of cooperative self-insurance, which has the potential to create a critical mass that enables operational and pricing advantages unavailable to single entities. It also provides a spread and sharing of risk, although this advantage may be severely curtailed where entities share homogenous characteristics and risks are correlated (Hofman and Brukoff 2006). However, a number of pitfalls are associated with captives and pools including:

- a reduction in reserve size due to the build-up of 'unused' reserves which then become a temptation (e.g. political pressure) to utilise them for other governmental purposes
- an early catastrophe or coincident events (e.g. two or more events occurring in quick succession) exposing shortfalls in reserve accumulation
- public insurance funds raised through an increase in taxes may prove overtime politically unpalatable (Michel-Kerjan and Zelenko 2011; Kunreuther and Heal 2012).

Additionally, the set-up and running costs of entities such as captives dictate a minimum critical mass for economic viability whilst the complexity of the operation demands both a supply of relevant expertise and regulatory supervision (Salve and Simpson 2011).

The capital market is the sphere where most ART innovation has occurred. Capital market mechanisms typically involve the hybridization of both insurance and financial features to form insurance linked securities (ILS) (Villegas et al. 2012). The most popular examples of ILS are catastrophe bonds (or cat bonds) and industry loss warrants (ILW) although others currently exist and are continuously evolving (Box 4).

Box 4. Examples of alternative risk transfer mechanisms. Catastrophe bonds (also known as cat bonds) are fixed income securities that enable the transfer of insurance risk from sponsor (insurer, reinsurer, corporate) to investors via the capital markets. Bonds may be placed publicly, i.e. to the capital market or privately (known as catastrophe bond light) via a select group of investors (Ng 2012). Monies are invested in a special purpose vehicle (SPV) from

where they are collateralised (usually in the form of low risk government bond). Collateral interest and regular pre-agreed sponsor payments are combined are paid to the investor in return for which, should a catastrophe strike, monies are forgone in total or in part and paid to the sponsor. Triggers can be indemnity based or occur with respect to a pre-agreed single or multiple of parametric events. Cat bonds are usually written across multiple periods and are generally used to cover high-severity, low-probability risks (Waite 2014).
Collateralised reinsurance enables non-insurance market participants such as hedge funds and pension funds to participate directly in the reinsurance market (McKinsey&Company 2013). Third-party capital providers put up capital to cover in full potential losses that could arise specific to the reinsurance contract.
Weather derivatives are a form of parametric insurance tradeable on a number of the world's stock exchanges, e.g. Chicago Mutual Exchange (Clements 2012).
Industry loss warrants (ILW) are instruments that trigger when expected industry wide losses exceed a pre-agreed amount (Salve and Simpson 2011). As an ILW trigger is based on expectation and not the substantiation of actual lose the payment process and associated cost is generally less significant than other options (King 2013).
Resilience bonds are a conceptual tool that aims to quantify risk reduction created by adaptation infrastructure (e.g. sea walls) and applying this to reduce the cost of catastrophe bonds (Vajjhala and Rhodes 2015). These savings are calculated upfront as the difference between the cost of a catastrophe bond (or any other form of risk transfer including insurance) before and after infrastructure build and can be applied, amongst other things, to further build or infrastructure maintenance (Vajjhala and Rhodes 2015).
Collateralized Risk Obligations (CRO) are derived from pooling and trenching techniques similar to those applied to create Collateralized Debt Obligations (CDO). By aggregating currently unrated and non-investment grade risk into a pool and then dissecting this pool into a spectrum of differing risk, proponents argue that CROs would "increase the availability of investment-grade catastrophe risk and high- yielding catastrophe risk" (Koch 2015 p. 3). They argue this would make ART more attractive and available to larger institutional investors, frequently constrained by risk related policy, subsequently increasing demand and geographical market scope (Koch 2015).

Products such as cat bonds, ILWs and collateralised reinsurance have expanded the scope of risk transfer mechanisms (McAneney et al. 2013), in some circumstances, enabling the transfer of risks that commercial insurers have refused to cover (KPMG 2012). Recent innovations such as resilience bonds and collateralised risk obligations (CROs) have the potential to enhance this scope even further, as CROs briefly entered into the capital

markets in early 2000s, only to disappear at the onset of the global financial crisis (Koch 2015) and resilience bonds are currently at proposal stage (Vajjhala and Rhodes 2015).

The literature details a number of pros and cons of market-based participation relative to traditional insurance and reinsurance. For example, market-based products increase risk transfer capacity and options and provide greater potential for longer dated instruments thus reducing price volatility and time consuming renewal, but also generally incur higher upfront fees, are less committed to a long client-provider relationship and require a greater understanding of capital markets and complex, technical concepts (Michel-Kerjan and Morlaye 2008; Michel-Kerjan and Zelenko 2011; Moody 2012; McKinsey&Company 2013). McKinsey&Company (2013) find that about half of capital market instruments are collateralised, which generally has an advantage of reducing credit risk (the risk that an insurer will default on payment) for insured parties (Kunreuther and Heal 2012). However, the quality of assets used as collateral and how these are immunised from valuation fluctuations is key to their security (Madigan 2010; Carayannopoulos and Perez 2015).

Whilst there is apparent value of ILS in expanding the potential for risk transfer options, there is no indication in the literature of the capacity of ILS to incentivise proactive adaptation and risk mitigation behaviour. *Prima facie* it is arguable in the context of market theory that the incorporation of market participants drives the price of ART products to accurately reflect risk. However the cost of ILS products incorporate transactional costs such as legal, financier and ratings fees (Michel-Kerjan and Zelenko 2011), potentially as distortive as those applied to traditional insurance. In addition, market forces, such as investor appetite and product availability, also influence ILS pricing at the time of issuance (Hofman and Brukoff 2006; McAneney et al. 2013; Braun 2014; Waite 2014).

Demand for capital market mechanisms has been strong. Growth in 2014 was greater than 3% (to $US66 billion), outpacing total reinsurance growth for that year (Artemis 2015). Whilst the insurance industry has historically been the predominant sponsors of insurance-linked securities, there is evidence of non-insurers also utilising these instruments to transfer risk. For example, in 2013 a cat bond was issued by the New York Mass Transit Authority (MTA) to safeguard infrastructure from the impact of storm surges (Artemis 2013a) and in the UK councils have engaged another form of ILS, weather derivatives, to hedge damage to infrastructure such as roads from extreme weather events (Stoneman 2012).

There is also evidence of application of these sorts of instruments in Australia. In 2013 QBE Insurance completed a $250 million indemnity-basis Cat Bond (Australia's first) that utilised a

fully collateralised Bermuda based special purpose vehicle and covered losses from US earthquakes and Australian tropical cyclones (Artemis 2014). In the same year innovative weather transaction was completed for an Australian mining company, Roy Hill Holdings Pty Ltd (Artemis 2013b).

ART have not been used by any Australian government agencies, even though they have been suggested as a means of insuring Australia's vast (and otherwise) uninsurable network of roads (KPMG 2012). KPMG (2012 p.8.) highlight that although the cost of ART has historically exceeded that of traditional insurance, that "high premiums do not necessarily mean that the option is not cost-effective, particularly from the Commonwealth's perspective". The Productivity Commission (2014b) also found an interest amongst some participants in exploring the potential of ART, whilst others were concerned, that beyond the cost, the complexity and difficulty of determining a trigger, particularly for small councils, made ART unviable.

Thus whilst ART, in particular capital market mechanisms, represents an innovation in risk transference with potential and increasing overseas application to government agencies, in Australia they remain a largely untested and novel concept.

3. Local government requirements and capacity for adaptation finance

This chapter combines data from the interviews and the literature to discuss the finance needs of local governments for adaptation to climate change and their ability to meet those needs given current institutional arrangements. In order to understand the potential for development of adaptation finance, it is critical to clearly define the demand side characteristics. Firstly, this study has focused on local government as the entity with the demand for finance. For Australian local governments, adaptation now falls within a rapidly expanding set of responsibilities, which creates significant strain on existing resources and revenues. While revenue and resources are challenges, local governments have solid asset bases, stable revenue and low debt, which are potentially valued customer characteristics for finance providers.

The second aspect of the demand side relates to the application of the finance, which is adaptation to climate change. The diversity in terms of what adaptation encompasses, how it is pursued and may materialise are issues that need to be explored. Adaptation to climate change will require a mixture of approaches, including the transfer of existing technology, development of new technologies, the revision of planning standards and systems and, some may argue, also a change in our mindset and the way we think about adaptation. For local governments, most initiatives will take the form of projects where some will involve engineering design and construction creating tangible assets, and others will change processes or policies with less obvious tangible outputs.

3.1 Local government adaptation roles and responsibilities

There has been a significant degree of attention to the allocation of roles and responsibilities for adaptation to climate change across Australia's three levels of government. The lack of clarity regarding roles and responsibilities has been widely recognised as a barrier to adaptation with attention directed at the federal government to clarify roles across levels. In the absence of this 'top down definition', certain roles and responsibilities are emerging through practice.

The original role of local government was the provision of property services often referred to as 'roads, rates and rubbish'. Today, the roles of local governments differ from state to state, but often include governance, advocacy, land use planning, community development,

regulation, provision of infrastructure, environmental management, parking management, community health, emergency management, and service delivery (e.g. waste, sewerage, potable water). Shifts to increasing involvement in the provision of social services, including health and welfare services, community housing, recreation, sporting facilities and local economic development have been increasingly common. The Productivity Commission (2008) review into the revenue raising capacity of local governments recognised the gradual shift and expansions of roles and responsibilities since their establishment in the late nineteenth century in response to shifting demographic conditions and societal expectations.

In terms of public sector response to climate change, adaptation has primarily been framed as a problem of land use planning and asset management. As a consequence, local government is under significant pressure to incorporate climate change into decision-making or risk being seen as negligent in fulfilling its duties. To date this has placed additional pressures on local government internally—particularly on staff—to update procedures and undertake planning exercises. However this is gradually shifting to increasing the costs for infrastructure provision, creating new pressures on council budgets. The interview participants expressed the responsibilities of local governments for climate change adaptation as follows:

> *There is very broad acceptance of the fact that coastal councils are going to have to prepare for the impact of both sea level rise over the longer term and also more frequent and severe extreme weather events in the shorter to medium term...It's [adaptation finance] a critical issue because, as we see it, coastal council is really at the forefront of dealing with adaptation issues* (Alan Stokes, CEO, Australian Coastal Councils Association).

> *What we haven't ever done is say we are going to fund a bunch of action all around the country. Because really that's seen ... at the federal level, that's seen as a responsibility for local and state decision makers... I think the real challenge there is that there is a broad perception in federal government that adaptation actually needs to be taken at the local level and that at that local level it is either the responsibility of the private sector or it's the responsibility of local government or funded by state government* (Commonwealth Policy Officer).

3.1.2 Relevant legislation

Within the Australian Federation, local government is a responsibility of each state and territory and local governments currently have no constitutional recognition. The roles and responsibilities of local governments stem from state legislation; so while there are similarities there are also variations by state such as the basis for revenue and the capacity to access finance. In addition, the Local Government Act in each state provides the legal and regulatory framework that enables the operations of local government. There are a number of other acts that have implications for local government revenue and access to finance such as planning and development and finance legislation.

For climate adaptation finance, the implication of these legislative arrangements is that they can be interpreted as creating a range of obligations for adaptation. At the same time, they also create restrictions on the capacity of local governments to raise the necessary revenue to fund these obligations as well as accessing finance. This is discussed in more detail below.

3.2 Defining adaptation needs

The roles and responsibilities for local governments—as defined simultaneously by legislation and social expectations— shape the demand side for adaptation finance by determining the needs for adaptation and subsequently the applications (initiatives) to which finance will be applied. A wide range of different initiatives will be needed to enable adaptation to climate change. Most of these initiatives are similar to those required to reduce vulnerability to current extreme events. One way to distinguish between initiatives (projects) that satisfy adaptation needs is based on a climate change adaptation risk assessment approach, suggested by Willows and Connell (2003), which identifies three project types:

- **Climate Adaptation** - a project undertaken explicitly to address issues or risks associated with present or future levels of climate variability, climate extremes and/or future climate change. Many areas of local government operations fall into this category such as (e.g. future coastal flood protection, flood-plain development, nature conservation management).
- **Climate Influenced** - projects undertaken by local governments whose outcomes could be affected directly or indirectly by climate change, but where climate change is one of a number of important factors. The degree of importance of climate change may vary from negligible to moderate, in which case some climate adaptation may be

appropriate. Many long-term business decisions may fall into this class, where, for instance, climate change could indirectly affect supply lines, customer demand or insurance costs.

- **Climate Insensitive** - it is useful to determine the projects (decisions) where climate change risks may be ignored, because they are not materially relevant to outcomes.

While the distinction between these project types is not absolute, the above categorisation is a useful starting point for thinking about local government adaptation needs. While both 'climate adaptation' and 'climate influenced' projects involve adaptation to climate change both the adaptation cost component and the evaluation of adaptation performance will affect the demand characteristics for adaptation finance (Table 7).

Table 7. Characteristics of adaptation projects

Project type	**Adaptation cost component**	**Evaluation of adaptation performance**
Climate Adaptation	100%	Aligned with project success
Climate Influenced	<100% and >0%	Misaligned with project success
Climate Insensitive	0%	N/A

Source: Adapted from Willows and Connell (2003).

The first set of characteristics in the table, the 'adaptation cost component', shapes the demand side by determining if finance is sought for the entire project or a component of the entire project. The component of the project seeking finance is important to understand because it affects the dynamics between the users and providers of finance. In particular, the degree of a control available to the provider is reduced where there are multiple finance providers without the creation of a distinct asset to which the finance can be tied. This then has consequences for the second characteristic, which relates to the potential for evaluation.

Currently, no established metric exists to compare or evaluate the performance of adaptation projects. This absence of such a measure impacts on the potential for adaptation finance because it creates difficulties for evaluating projects both *ex ante* and *ex post* in terms of performance. As such, if an investor is looking to maximise adaptation return there is no clear basis for identifying projects. This situation would favour investment in climate adaptation projects over climate sensitive projects because at least climate adaptation

projects can be evaluated as contributing to adaptation on the basis of completion, whereas completion does not determine the success of the adaptation component of a climate sensitive project.

Increasingly, public infrastructure projects are more likely to be climate sensitive rather than climate adaptive with a trend towards projects that serve multiple objectives simultaneously. An example is the response of New York City to the inundation due to Hurricane Sandy. Many of the planned inundation protection works (levees) are being designed to incorporate environmental and social values to shape the politics and commercial spaces to contribute to the funding. There is also the sentiment that it is easier to finance to cover implementation than the planning stages of 'climate sensitive' projects. The latter is will be predominantly paid for by the public in one way or the other:

> *…by the time you get down to seeking finance to implement adaptation actions, they are, in fact, really well integrated into other processes. It'll be things like financing planning work to integrate climate change adaptation into your planning scheme, or financing your infrastructure plan to implement adaptation activities like say increasing storm water pipes, or retrofitting storm surge gates, and things like that* (Dorean Erhart, Local Government Association of Queensland).

Within local governments, projects are delivered across a project lifecycle similar to that provided in Figure 4 below. This project lifecycle shows how projects develop over time, from their initiation as a planning process into the development of a business case and then onto contracting and construction or implementation. The business case stage of a project is important for identifying funding and financing models and for determining the potential role of the private sector, all of which are interrelated but separate decisions.

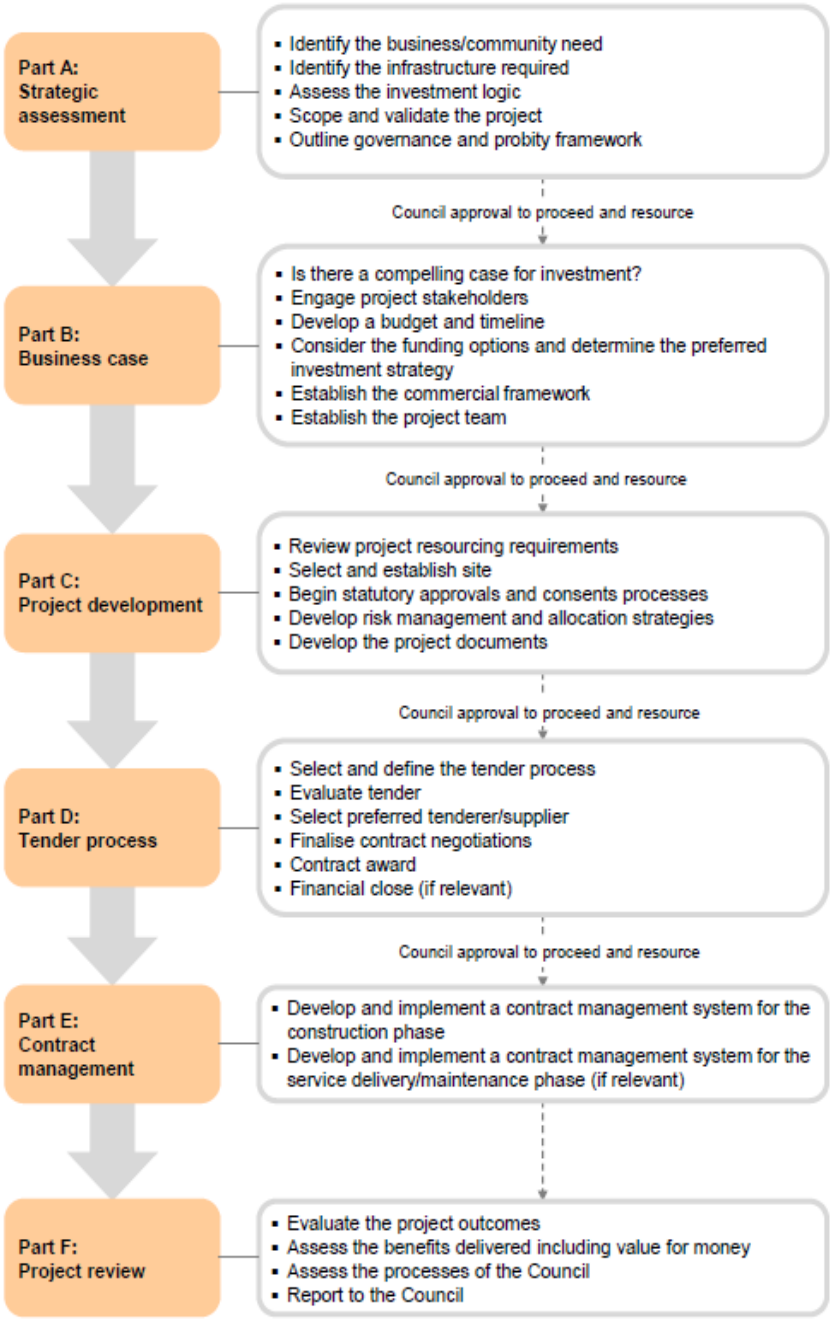

Figure 4. Structure of major projects. Source: Maddocks and Ernst & Young 2014.

Within the project lifecycle, the key decisions related to adaptation finance occur within the 'business case' phase where project cash flows are identified and then considered within the funding constraints or even earlier, during the 'strategic assessment' phase when investment logic is developed. For government projects generally, there are greater cash outflows than inflows and the difference needs to be dealt with through funding; in the case of local government that would be rates, users charges or grants. There is often a difference in the shape of the cash inflows and outflows over the lifespan of a project. Typically, the cash

outflows for a project will be higher initially, which is particularly the case for infrastructure type projects. If this is the case then finance provides a means of realigning the inflow and outflow curves effectively straightening out the outflows and where debt finance is concerned, by borrowing, which can be paid back over time and usually with interest. This alignment of flows is a particular issue for local governments as they rely on user charges to fund projects because it is not possible to charge user fees until a project is delivered making some form of financing a necessity.

In addition to financing, another interrelated aspect is the nature of private sector involvement within the project. Many public sector projects involve the private sector in the form of project delivery, which may be through consulting services, engineering design, construction services or even operation. Many decisions regarding the nature and extent of private sector involvement need to be considered in the business case stage (or earlier). However, any form of private sector involvement within a government project is effectively a form of public private partnership.

Public private partnerships are widely misunderstood as a form of privatisation of public infrastructure. In fact, public private partnerships can be more appropriately understood as a spectrum of private sector involvement in public project delivery, where contracting approaches sit between full government control and delivery and full privatisation. The various approaches along this spectrum are differentiated by the distribution of risk between the public and private sector, but for accepting risk the private sector will seek a return. Under this concept a public private partnership will generally involve both a financing and a funding mechanism:

> *Infrastructure funding is normally related to a project which has some maybe at least a suitable community benefit or financial return within the larger span of the council budget, four year projections. It's a lot more difficult to demonstrate the return or the benefits to be gained in the short term from investment in adaptation* (Alan Stokes, CEO, Australian Coastal Councils Association)

3.3 Determining the cost for adaptation

A further characteristic of the demand side of adaptation finance is the size of the finance required which could be similar to the potential costs of adaptation. Providing finance has a series of transaction costs that are somewhat independent of scale so that the larger the opportunity the lower proportion of transactions cost for the provider. In this context scale is

highly important; in the context of local governments, potential demand for adaptation finance, the capacity (or lack of capacity) to bundle multiple opportunities will affect the extent to which so called 'economies of scale' are available to justify the transaction costs.

Identification of genuine incremental costs specifically for adaptation is a serious challenge for enabling access to adaptation finance mechanisms. This is because adaptation may be just one of many features of a new or upgrade project infrastructure, making the separation of adaptation costs difficult. One approach proposed to estimate the costs of adaptation to climate change is by Parry et al. (2009), where

> Total adaptation cost = cost of explicit adaptation measures + residual impacts of climate change + transaction costs of implementing adaptation measures.

The above calculation focuses only on projects introduced explicitly to deal with climate change and excludes those that are introduced to meet other challenges that incidentally help adaptation to climate change (Parry et al. 2009). This approach also recognises that adaptation will not remove all the consequences of climate change, and there will be residual impacts. This may result from lags in investment or from differences between the projections and experiences of future climate or they may simply be the impacts of events that are greater than our willingness to pay for resilience; for example a flood levee. In Australia it is common to design for the Q100 event and accept that at some point an event will occur that will exceed this and society will accept the losses that result—this will be no different in the future and the capacity to deal with these costs needs to be included within adaptation efforts. Another important cost is the transaction costs associated with making changes to policies and practices in the face of potential climate change. These include: costs for research and development and costs of refining policies or reviewing decisions; importantly these costs will be incurred even if decisions are subsequently made not to adapt to climate change.

For local governments the cost of implementing adaptation initiatives can be broken down further into the following areas: i) the cost of adapting (or if needed replacing) existing operations and infrastructure such as changing building codes or replacing wastewater outfalls to deal with increasing sea levels; ii) the cost of building infrastructure that is needed to adapt to climate change such as seawalls and desalination plants; and iii) the additional costs of climate-proofing new infrastructure investments such as the additional cost to build roads to cope with increased rainfall intensities.

Interview participants indicated that most climate change adaptation funding in Australia covered the transaction costs of implementing adaptation measures. In general these were in the area of funding for climate change adaptation planning exercises and research, while investment in implementation has lagged behind.

3.4 Local government finances

The term 'local government finance' relates to the management of the capital or wealth of local government and in local governments, 'finance' is commonly understood as a functional area within the organisation[6]. Local government functions are controlled by legislation and contribute to the capacity to fund and access financing.

The nature of the legislative controls over local government finance differs by state; however, controls are consistent in addressing available revenue sources and controlling the ability of local government to seek financing. In addition, the legislation also controls expenditure. Balancing revenue with expenditure is a key administrative function for local government. Where revenues exceed expenditure, financing would be readily available, however where expenditure exceeds revenue, access to financing may be limited. Given the need to achieve this balance, there are significant implications for the ongoing sustainability of local government when roles and responsibilities expand fiscal outlay. If this expenditure cannot be balanced by increasing revenues over ongoing budgets then a deficit will emerge. In order to continue to operate and meet its responsibilities, a local government in a deficit situation will need to take on some debt which will require repayment with interest. The repayments of the debt and interest will draw more revenue and unless expenditure can be reduced or incomes increased the problem can rapidly intensify.

The implications of the extension of the roles and responsibilities of local government has been recognised by successive government reviews. The reviews point to the increased expenditure requirements for local governments (House of Representatives SCEFPA 2003; Productivity Commission 2008). The Productivity Commission Report (2008) (see Figure 5) identified that the largest shares of local government expenditure are in the following areas:

- transport and communication (including road construction and maintenance, parking, rail and air transport, community transport and communication technology)
- housing and community amenities (including housing and community development, water supply, household garbage and sanitation, sewerage and street lighting)

[6] To clarify, 'financing' as defined earlier in the report is not the present particle of the infinitive 'finance'.

- general public services (including administrative functions such as executive, legislative and financial affairs and expenditure not classified elsewhere)
- recreation and culture (including public halls, swimming pools, national parks and wildlife, libraries, museums and art galleries).

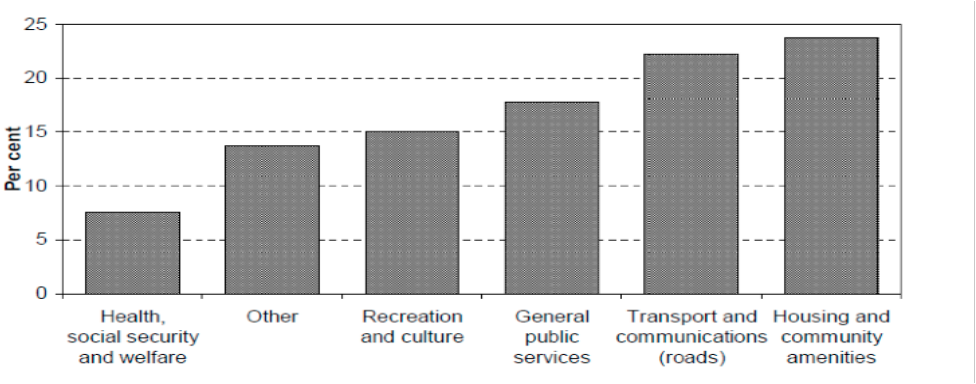

Figure 5. Local government expenditure by function (shares in 2005-2006). Source: Productivity Commission (2008).

Several options are available to local governments to cover the costs associated with planning, building, maintaining, upgrading and extending their assets and services. These include revenues raised through rates and user-charges, interest, fines and developer charges or from external sources such as state or federal grants and philanthropic funds (external sourced funds for adaptation are described in section 5.3). In addition, local governments have the capacity to borrow funds.

Options for generating revenue vary by state. The relative breakdown of revenue sources is provided in Table 8 and shows significant variation by state.

Table 8. Relative contribution sources of local government revenue by state. Source: DIRD 2015.

State	NSW	Vic	Qld	WA	SA	Tas	NT	Total
Rates	34.2	45.7	29.9	41.7	63	46.7	28.4	38.2
Sales of Goods and Services	35.8	18.2	32.9	22.8	18.4	21.6	25.7	28.2
Interest	2.8	1	2.6	2.8	1.1	2.4	2.7	2.2
Other	18.8	27.8	30.7	21.9	10.2	22.6	15.7	24.2

Grants and subsidies	8.4	7.2	3.9	10.7	7.4	6.8	27.8	7.2

The table shows that local governments in Queensland and Northern Territory are the least reliant on rates. Local governments in New South Wales have the highest reliance on sales of goods and services. Local governments in Northern Territory rely most on grants for revenue, while this source is the least available in Queensland.

Rates are the only form of taxation revenue available to local governments. Council rates are taxes collected from landowners on the basis of property value (Productivity Commission 2008). Generally, rates include a minimum charge or fixed charge and a proportion of estimated value component. Rates may consist of general rates and special levies, which may be targeted by location or other variable. Table 9 describes the basis for rates revenue by state.

Table 9. Local government rates legislation

State	Legislation	Rate type	Land valuation method
Victoria	Local Government Act 1989 (Vic)	General rates (s 158) uniform rates (s 160); differential rates where Capital Improved Value (CIV) is used (s 161), or limited differential rates where CIV is not used (s 161A)	Site value, net annual value or CIV (s 157); Valuation of Land Act; 1960 (Vic) (s 13DC)
New South Wales	Local Government Act 1993 (NSW)	Ordinary rates (s 492) or special rates (s 493); wholly ad valorem or base amount plus ad valorem (ss 497- 499); categories of rateable land include farmland (s 515), residential; (s 516), mining (s 517) or business (s 518)	Land value (s 498(2)); Valuation of Land Act 1916 (NSW) (s 6A)
Queensland	Local Government Act 2009 (Qld)	General, separate or special rates (s 94); councils may decide by resolution the categories of land for the purpose of levying differential general rates (s 93)	Site value (non–rural land) and unimproved value (rural land) Land Valuation Act 2010 (Qld) (s 7)
South	Local	General rates (s 152), separate	Valuation of Land Act

State	Legislation	Rate type	Land valuation method
Australia	Government Act 1999 (SA)	rates (s 154), service rates or charges (s 155); all land within council area, subject to exemptions, is rateable (s 147) or land against which rates may be assessed (s 148)	1971 (SA) (s 11)
Western Australia	Local Australia Government Act 1995 (WA)	Differential general rates (s 6.33); 'minimum payments' (s 6.35); specified area rates (s 6.37) or service charges (s 6.38); rateable land (s 6.26)	Either unimproved value (rural use), or gross rental value (non-rural) (s 6.28(2)); Valuation of Land Act 1978 (WA) Part 3 Div 1
Tasmania	Local Government Act 1993 (Tas)	General rates (s 90); service rates (s 93) or service charges (s 94); councils may, by absolute majority, make a separate rate or charge in respect of land or a class thereof in its municipal area (s 100); rateable land and exemptions (s 87)	Values used under the Valuation of Land Act 2001 (Tas) to be used as basis of rates (s 89A); Valuation of Land Act 2001 (Tas) (s 45) – land value, capital value, or assessed annual value
Northern Territory	Local Government Act 2008 (NT)	Fixed charge, valuation-based charge (s 148), general rates (s 155) or special rates (s 156) rateable land (s 141), conditionally rateable land (s 142) or exempt land (s 144)	Unimproved capital value, improved capital value or annual value (s 149) Valuation of Land Act 1963 (NT) Part 4

Source: Maddocks and Ernst & Young (2014).

Local governments have significant control over the amount of revenue that they can collect via rates; however there are also some economic and political limitations that act as powerful incentives to minimise the amount collected via rates. These include both the capacity and willingness of residents to pay for rates, which are influenced by factors such as the income of the local community, demographic and economic aspects of the community.

This issue of the political barriers to increasing revenue through increasing rates is highlighted in the following exchanges between and interviewer and local government representative.

> Interviewer: *They could increase rates, right?*
> Local government representative: *Have you heard of political death?*

The second major source of own source revenue is in the form of user charges or the sales of goods and services. Sales of goods and services includes any revenue derived from the direct provision of goods and services (Productivity Commission 2008). In the context of funding climate change adaptation through user charges, the primary challenges are that i) user charges are misaligned with the project lifecycle costs, and ii) user charges require a service to be delivered, whereas adaptation services will often have large upfront costs.

Table 10. Local government user charges legislation

State	Legislation	User charges
Victoria	Local Government Act 1989 (Vic)	Fees and charges for goods and services (s 113(2)); charges for administrative costs (s 159(1)); service charges (s 162) and special charges (s 163)
New South Wales	Local Government Act 1993 (NSW)	Annual charges for domestic waste management; other annual charges (s 496); charges for water; sewerage; drainage; waste management and other prescribed services (s 501) and approved fees (s 608)
Queensland	Local Government Act 2009 (Qld)	Separate charges, special charges and utility charges (s 94) and fees (Chapter 4, Part 2)
South Australia:	Local Government Act 1999 (SA)	Fees and charges (s 188), power to source funds (s 133) and service rates and service charges (s 155)
Western Australia	Local Government Act 1995 (WA)	Revenue and income (s 6.15) and imposition of fees or charges for goods and services subject to absolute majority (s 6.16)
Tasmania	Local Government Act	Service rates and service charges in relation to nightsoil removal; waste management; stormwater removal; fire

State	Legislation	User charges
	1993	protection (s 93); construction rates and charges (s 97) and separate rates or charges (s 100)
Northern Territory	Local Government Act 2008 (NT)	Imposition of charges in relation to works carried out or services provided (s 157)

Source: Maddocks and Ernst and Young (2014).

3.4.1 Capacity to borrow

External funding through borrowing affects the affordability of a given project by altering the payment profile. When a local government has to rely on internal revenue sources to fund projects, projects with large up-front costs may need to be delayed until sufficient reserves are accumulated. By borrowing, the upfront expenditure (capital cost) component of the project can be transferred across time to allow repayments while the benefits for the project are being received (e.g. revenue is generated). It is important to note that while borrowing creates benefits, any borrowing must be paid for and there are costs such as interest charges associated with borrowing. The relatively high asset bases and stable revenue sources of local governments (Table 11) make them attractive lending prospects for financial services providers.

Table 11. Local government assets and liabilities by State (2014-15)

State	NSW $m	Vic $m	Qld $m	WA $m	SA $m	Tas $m	NT $m	Total $m
Total assets	141 494	77 872	102 033	30 891	22 102	8 858	2 525	385 775
Total liabilities	6 215	2 889	8 558	1 329	1 095	253	108	20 447
Borrowing	3 604	1 132	6 565	622	470	86	9	12 488
Asset to borrowing	2.5%	1.5%	6.4%	2.0%	2.1%	1.0%	0.4%	3.2%

Source: DIRD (2015).

There are two main borrowing options for the council: i) debt sourced from private banks and ii) debt sourced through government treasuries. The capacity for local governments to

borrow, as a source of finance, is generally regulated by the respective state or territory through the Local Government Act (Table 12). Restrictions are typically imposed on one or more of the following:

- amount borrowed
- purpose for which it is used
- source of borrowings.

Table 12. Limitations on local government borrowing in Australia by state

State	Ministerial approval required	Borrowings arranged through central agency	Restricted from access to foreign finance sources	Other comments
Qld	Yes	Yes	N/a	Governments are assessed on their internal capacity to generate income
NSW	Yes	No	Yes	Borrowing rate must be less than indicative rate; no borrowing for less than 30 days; borrowing must not exceed the life of the asset financed by the borrowings
Vic	Yes	No	No	Cannot borrow for 'ordinary purposes' or for the purposes of municipal enterprises unless proposed in a budget, or where the borrowings are used to re-finance existing loans
Tas	Yes	No	No	Restricted from borrowing where the annual repayments exceed 30 per cent of the council's revenue
SA	No	Yes	N/a	
WA	Yes	Yes	N/a	
NT	Yes	No	No	Ministerial approval required for individual leases with a capital value greater than $10 000 or any combination of leases with a total capital value that exceeds $35 000
ACT	Yes	No	No	

Source: Adapted from Productivity Commission (2008).

Traditionally, local governments are considered to be debt adverse (Comrie 2014) and the interviews confirmed this phenomenon:

> *There is a reluctance in local government to raise funds privately or commercially to undertake these sort of works* (Alan Stokes, CEO, Australian Coastal Councils Association).
>
> *Private/public partnerships require careful consideration for local governments, particularly if public funds are being invested. Public benefit needs to be very clearly demonstrated* (Dorean Erhart, Local Government Association of Queensland).

These sentiments, and the subsequent consequences for service provision in particular infrastructure, are reflected in a number of national reports. A 2014 review of the use of debt by Australian local governments, commissioned by the Australian Local Government Centre for Excellence, found that the use of debt by Australian local governments was low when compared to other sectors with similar income stability and asset ownership (Comrie 2014). The national average of local government borrowings was 27% in 2012 (as a percentage of GFS revenue) which translates to a very low rate, on average in all jurisdictions. As Comrie (2014) explains, at the scale of a household this translates to an annual household income of $60 000 and a mortgage of $16 200 with no other debt.

The report also found a systemic aversion to the use of debt by local government attributed to the poor capacity to manage debt, resulting in an experience of sub-optimal interest rate exposure by local governments using debt. According to a review of the prioritisation and financing of local infrastructure funded by DoRALGAS and conducted by Ernst & Young there are only two options to pay for infrastructure; i) governments can either invest in infrastructure from their own revenues, or ii) impose direct charges on the users and beneficiaries of infrastructure (Ernst & Young 2012).

The central issue constraining greater private sector financing of infrastructure in Australia is the lack of available funding, rather than access to capital. Infrastructure must be paid for irrespective of how it gets financed. The report recommended the establishment of a national financing authority for local government to improve local government access to financing (Ernst & Young 2012). The authority would have a mandate to invest directly in local government programs by providing competitive and low-risk finance, and to facilitate inward investment. The authority would have the ability to bundle approved council borrowings into a limited number of bond issues, which could be underwritten by the Australian Government.

A similar review conducted in 2004 by SGS consulting at the instigation of the Department of Transport and Regional Services (DoTaRS) to investigate the extent to which local governments across Australia used private sector financing for the provision of infrastructure (Mcdougall 2004). This report reached a similar conclusion to the 2012 report:

> Of course, where the private sector assumes risk, it must be commensurately compensated. Herein lies the reason why opening up infrastructure assets to the private sector does not solve Councils' funding worries. Although the private sector might bring forward the ability to finance large capital works, as they remove upfront capital costs from the Council's immediate resourcing requirements, the servicing of the private sector's associated borrowings still remain with the local community (McDougall 2004 p.40).

3.5 Implications for adaptation

In reviewing the local government demand characteristics for adaptation financing, there are some findings relevant to the broader local government adaptation agenda.

3.5.1 Revenue *versus* expenditure misalignment

Adaptation to climate change creates a number of additional costs for local governments, which will require funding. However these additional costs come at a time when existing sources of revenue are already stretched by demands from expanding responsibilities of local governments. Plus, on the other side of the equation, there are limited opportunities to generate additional revenues given the political and social equity limits to increasing rates. The following response highlights the cost imposts of climate change adaptation on local government.

> *Local government doesn't have the money, they are facing the most immediate threat and risk, and communities in coastal areas are facing the most immediate risk associated with adaptation* (Alan Stokes, CEO, Australian Coastal Councils Association).

3.5.2 Identifying how to pay for adaptation

Adaptation to climate change will be implemented through a range of different types of projects by local government; some will be solely focused on adaptation while for others, adaptation will be just one of multiple benefits that the project will need to deliver. The

characteristics of the project will contribute to the suitability of different funding approaches. For instance, local governments' own sources revenue will be required to fund climate change adaptation costs associated with routine maintenance or upgrade of infrastructure assets, which do not generate income, to pay fixed costs, wages or superannuation. However the use of debt by local governments to finance would be appropriate where the:

- finance would be used to create or establish a tangible asset such as capital infrastructure
- asset has a long lifespan
- benefits of the project are misaligned with the cost profile
- funding is available to meet the repayment obligations.

3.5.3 Not just a finance department problem

Financing adaptation was described as integral part local governments that affect them on several fronts:

> *Invariably, it [adaptation finance] affects all parts of the organisation because of the potential impact it has on the financial viability and capability of the organisation because many of the projects which may be needed to counter adaptation* (Alan Stokes, CEO, Australian Coastal Councils Association).

> *The impacts of climate change cut across almost every area of councils in some way or another, but the critical areas are infrastructure, asset management, obviously financial services and has the biggest potential impact on overall financial sustainability* (Dorean Erhart, Local Government Association of Queensland).

And while it is clear that adaptation will increase expenditure for local government, dealing with this expenditure will need to extend beyond the finance department. In order to progress adaptation, projects will need to be designed in such a way that they are self-funding to some extent and this will require real innovation both in terms of the design teams and also in the communities where they are deployed.

4. Perspectives of climate adaptation finance and adaptation in the private sector

Climate adaptation finance is a relatively new concept, not just in Australia, but also in the international climate finance space (UNEP 2014), and particularly its iteration in developed countries and the private sector. During the interviews, participants representing the finance category, finance advisory category and the insurance industry voiced various interpretations of adaptation finance, its relevance to their organisations and how it is or may be addressed. This chapter describes the views of the 23 participants from the financier, finance advisory category (sections 4.1 and 4.2) and participants from the insurance industry (section 4.3). Understanding the interpretations of these stakeholders provides the context for the discussion of potential finance mechanisms and ways to move the adaptation finance agenda forward in the following chapters.

4.1 Attitudes toward and understanding of adaptation and adaptation finance in the finance sector

Adaptation finance is not a mainstream concept among financiers in Australia. Interviews indicate that financiers recognise the need to adapt to climate change and the need for financing in this space. Yet adaptation financing has been described as still in its infancy and largely conceptual in nature, especially compared to financing climate mitigation. Climate change adaptation finance was recognised by nearly all participants as relevant to organisations at several levels. For instance, it was recognised as potentially affecting a number of different portfolios or asset classes or in several areas or departments within organisations.

A number of interview participants interpreted climate adaptation finance as a type of 'resilience finance'. One of the climate change specialists from a major consulting firm distinguished between 'resilience finance' and 'adaptation finance' as follows:

> *...resilience financing is very much focused on dealing with any types of shocks and stresses that an organisation may face" such as earthquakes, terrorism or natural disaster, while adaptation is focused on "increases in sea level rise or storm surge, increasing intensity and frequency of extreme weather events, but very much focused on the climatic related responses.*

Adaptation was also explained as the need to adapt to 'the transitions to a low carbon economy', or as a 'betterment' initiative (e.g. Green Cross Australia's 'Build it back better' initiative).

Many of the finance advisors and some financiers had a firm understanding of what adaptation entails and its economic benefits. Adaptation was identified as a benefit to companies over the long-term and providing wider benefit to the economy by reducing volatility in certain sectors in response to the impacts of climate change (also see West and Bianchi 2013). It was also recognised that mitigation and adaptation are often complementary; both are integrated into projects in which adaptation may not be described as a distinct feature.

Some participants in the financier and finance advisor categories expressed a feeling of being left out of the adaptation discussion. For example, adaptation has been described as a topic that is largely dealt in the realm of the environmental field. Too much focus on the impacts of climate change and planning, as opposed to implementation, was also voiced by a climate change specialist in a large consulting firm:

> *There's been no focus on the how, which is how do we actually start to deliver on these adaptation action plans that are sitting in all these councils and businesses and addressing the key barriers, which include financing, in getting these programs up and running.*

4.2 Dealing with adaptation in the finance sector then and now

Climate change adaptation issues are addressed within the scope of a range of different environmental or sustainability initiatives. Institutional investors interpret them in the realm of ESG (which refers to the three main issues of environmental, social, governance that investors consider when measuring, evaluating and disclosing their sustainability and ethical practices) or the United Nations Principles for Responsible Investment, more specifically. Lenders have considered adaptation to climate change as a type of environmental risk, which allowed them to incorporate it in their broader credit risk management or part of their natural capital value management strategy. Because adaptation is perceived as involving building or upgrading considerable amounts of infrastructure, it has been described as a type of infrastructure finance. Adaptation finance has also been interpreted as a type of impact investment as it is similar to social impact investment in some respects, such as being preventative, in need of innovative instruments and requiring a systems thinking approach.

Historically, the financial sector has dealt with social and environmental issues from a risk perspective, initially through screening. If a certain activity is found to pose significant risk to a financial institution, it could result in the complete exclusion from the investment portfolio or credit policy. Projects in certain sectors such as tobacco, weapons or nuclear industry have been completely excluded from the portfolios of some financial institutions in developed countries (Banhalmi-Zakar 2016). Some more progressive institutional investors in Australia are already applying this approach to climate change. Bill Hartnett, Head of Sustainability at Local Government Super pointed out that his institution has already "screened out companies around high-carbon and coal and coal--fired generators" and has "restrictions on investments in those types of companies". Screening investments on the basis of carbon emissions is a fossil fuel divestment strategy that may be considered by some as a corporate social responsibility exercise, or means to enhance an organisation's reputation. However, from a strict financial perspective, it represents responsible business practice and is, in itself, a form of adaptation (of investors) to the impact of climate change, i.e. an ensuing low-carbon economy.

Recognising climate change as a risk is now regarded as the first step in mobilising finance for adaptation. The next step is the need to recognise climate change adaptation as an opportunity that involves developing new financial products or mechanisms:

> *I think traditionally, or for the last few years, adaptation finance has meant integrating adaptation considerations into the investment process from a risk perspective. I think where we're moving to now is the understanding that adaptation finance is about financing the adaptation required to respond to climate change. The nuance is it's gone from being seen as solely a risk mitigation approach within policy, and decision making, to more about actually developing new types of products and financial structures to help facilitate capital flows into adaptation projects. It's sort of like a shift from a risk to opportunity that's happened in the last few years. Today, I would say that adaptation finance is developing the products and services required to actually facilitate investment into adaptation* (Emma Herd, CEO, Investor Group on Climate Change).

Some participants have expressed the desire of their organisations to demonstrate leadership in the area of climate change and stay ahead of the game, while others expressed a need to stay competitive and not fall behind. The former position is supported by a recognition that adaptation is good for business: "from an adaptation point of view,

resilience is a key concept and we know that good management of natural capital, particularly in agribusiness supports a resilient, productive agribusiness" (senior banker). The latter position was fuelled by a sense of responsibility to clients: "to be competitive...and to be providing the best we can to our clients, we need to be on top of these issues" (Arti Prasad, QIC).

While several private sector investors and finance advisors described adaptation as an area of interest from an investment perspective, there is little evidence from the interviews that actual collaboration in adaptation finance is taking place. Only three (out of 13) private sector financiers or finance advisors representatives are currently working with partners in this area. Interview participants representing the finance advisor group indicated that they have formed partnerships with various levels of government and institutional investors, but not with small regional councils, lenders or the insurance industry. In terms of collaboration, the Investors Group on Climate Change has been the most active in establishing partnerships in Australia, particularly with larger councils. The Climate Policy Institute, an international organisation, also works extensively with multiple partners from a variety of sectors, including multilateral development banks, climate investment funds, insurance industry and donor agencies.

Still, some key players in the Australian finance sector have made significant commitments in the area of climate change. While most of these commitments are focused on mitigation (such as increased share of energy use from renewable sources, commitment to carbon price etc.) the reality is that climate change is recognised from a strategic point of view at the highest level of governance among the biggest domestic players in the finance sector. In essence, climate change is being discussed and observed by decision-makers in the boardrooms of major investors and lenders (Johnston et al. 2013).

4.3 Insurers' perception of adaptation and their role in adaptation

There was consensus among participants that in the long-term climate change represents a threat to the viability of the insurance industry and that, partly due to a "social contract between insurers, society, government and consumers" (insurance industry expert), the industry has a role in helping society adapt to climate change. However, participants cautioned against over-emphasising the magnitude of this role and the potential for moral hazard created by such reliance, as illustrated by the following quote:

> *… if we overstate the role of insurance, we actually are more likely to fall into the trap that we've had for many years … then we can remove the impost on those that should be managing that risk, to manage that risk in a better way* (insurance industry expert).

Governmental and societal engagement and advocacy were the predominant approaches taken by insurers to influence societal adaptation behaviour.

There was agreement that whilst insurance can contribute, the key to effective adaptation lies with improving instruments and policy, in other words addressing government failure. Examples provided by participants included improving land and development planning, building codes and financial and tax incentives to better manage risk. A participant from Suncorp explained that a lack of emphasis of current building codes to protect property, forgoes an opportunity to reduce the potential for future property damage from extreme weather events. Another industry expert explained that failures in policy had negative implications for consumers and insurers alike (i.e. higher repair and insurance costs), and justified insurer involvement in policy formation:

> *It's not in insurer's interest just to simply rely on the traditional ways of dealing with high-risk situations, which is to increase premiums, and to no longer underwrite risks. There are additional options. Most of them involve trying to influence policy, particularly policy related to mitigation from these natural disaster events I talked about, these weather events. Things like improving flood defences, improving building standards so that buildings are more resistant to floods and cyclones.*

Engagement occurs at both individual firm (i.e. Munich Re and IAG) and industry levels via associations such as the Insurance Council of Australia and the Australian Business Roundtable for Disaster Resilience and Safer Communities. Active participation in relevant government inquiries via submissions and dialogue is common. Swiss Re advised that they employed a dedicated 'public sector team' to engage government on their own behalf and that of their clients:

> *We engage directly with state and federal government agencies to put forward our own company view of climate risk and the need for adaptation. In that case we provide additional support to our clients who are also engaging with government and by backing up our clients, so to speak, we're able to provide further support in that policy space by engaging directly with government.*

Interview participants form the insurance industry described three recent examples of government engagement with insurers in Australia: the development of flood mitigation solutions in Roma and Grantham (Queensland), the Northern Australian Premiums Taskforce and the Productivity Commission's Inquiry into Natural Funding Arrangements. Other examples of adaptive measures included support for climate-related research internally (e.g. IAG) and collaboration (e.g. Suncorp and the James Cook University Cyclone Testing Station). Insurance companies have also implemented internal carbon footprint policy and provide risk expertise directly or via participation in public and governmental forums, such as advisory panels. The construction of a flood levy to mitigate flood risk for Roma was provided as an example of insurer compulsion to build relevant adaptive infrastructure.

For the domestic insurers, whilst climate change is acknowledged as a risk, at this point climate change is not a significant business priority:

> *Climate change right now, in whatever, or whatever, permutations it comes up to, isn't seen as a current large-scale business issue* (insurance industry expert).

Consistent with the IPCC (2012b) and McAneney et al. (2013) domestic insurers attributed losses to population and development trends as opposed to climate change. A representative from IAG explained that:

> *… when we try and unpack and look at how climate change is impacting our data, and our claims, we actually at this point do not see evidence, which is different to what other people will tell you, that in our claims data, we do not see evidence of climate change. If we normalize our claims data for concentrations of exposure along the coast, so migration if you like, and also for consumer price index changes, or buying power changes, then the patterns in the trends we observe are normal…*[At the same time] *we are of the view that climate change is not a phenomenon to be debated and this evidence will emerge over time*.

An industry expert noted more pressing issues such as the potential advent of the driverless car as a greater concern to the industry due to its more proximate and greater impact on income levels.

Although both Swiss Re and Munich Re noted that climate change implications (in particular mitigation) were influencing investment strategy in their overseas asset management

division, there was no evidence to support such an approach amongst domestic insurers or specific to Australia. Suncorp noted that although there was an ongoing debate amongst direct insurers regarding how to reduce exposure to climate change risk and in a climate friendly manner that in Australia the issue was still in a ‘germination phase’.

5. Mechanisms to finance climate change adaptation

There are limited examples of finance mechanisms applied to climate change adaptation projects as most existing financing mechanisms are not aimed at financing adaptation; a notable exception are resilience bonds, an emerging, potential finance mechanism to enhance community resilience to climate change and other stresses. However, various mechanisms that are currently used to fund mainstream (non-adaptation) projects could also be used to finance adaptation. This is because, when structured as projects, the characteristics of some adaptation initiatives have many similarities to (non-adaptation) projects financed by the private sector. For instance, large adaptation infrastructure projects resemble green infrastructure projects from a financiers' perspective.

5.1 Potential mechanisms to finance adaptation in Australia

No single mechanism exists to finance climate change adaptation initiatives specifically. However, several mechanisms were identified from the interviews and the literature that could potentially be used to finance adaptation initiatives in Australia (Table 13). These mechanisms are selected because they either i) specify adaptation in their mandate (such as green and climate bonds) or ii) have been used to finance adaptation projects in past in Australia or overseas, or iii) are currently used to finance mitigation projects only, but could potentially be easily expanded to also apply to adaptation. Table 13 briefly describes the type of activities that are often subject to financing mechanisms, highlighting the limitations of these instruments. For instance, green bonds/climate bonds or municipal bonds are only suited for large-scale projects (or bundles of projects) over a longer (project and investment) timeframe. A discussion of how they are or could be manipulated to finance adaptation is presented below the table.

Table 13. Overview of potential adaptation finance mechanisms

Finance mechanism	Main features and limitations	Used in Australia	Used elsewhere
Green bonds/Climate bonds	Available only for large-scale investments targeting energy-efficiency projects	Issued by some Australian financial institutions.	Widely used for mitigation only (e.g. renewable energy) including possibly adaptation/resilience

Finance mechanism	Main features and limitations	Used in Australia	Used elsewhere
Municipal bonds	Available for large projects, issued by a municipality or state government to finance capital and operating costs, usually tax exempt	Not as such (only public bonds with no tax free incentive)	Yes, particularly in the US including for 'resilience'
Resilience bonds	Linked to catastrophe (CAT) bonds, but 'proceeds' must be used for resilience	No (not yet?)	No (not yet?)
Corporate bonds	A bond issued by private corporations, which may be 'green/climate bonds'	Yes, for mitigation (renewable energy)	Yes
Green revolving funds	Internal fund of an organisation used for sustainability purposes, can even be used to finance capital works	Yes, but usually not for climate change	Yes
Corporate financing	Balance-sheet based financing (financing based on operating performance of existing entities), the typical mechanism used by local governments to fund developments	Yes, it is likely that adaptation elements of several adaptation initiatives have been financed this way	Yes
Project financing	Cash-flow based financing through an Special Purpose Vehicle (SPV) arrangement, typically used to fund large-scale and complex projects, and common in public-private-partnerships	Yes, it is likely that adaptation elements of several projects have been financed this way	Yes
Impact investment	Applies to preventative initiatives, requires evidence-base that the initiative works, relatively new mechanism used in the social space	Yes, as in social impact investing but not for adaptation	Not known
Environmental upgrade agreements	Finances energy-efficiency upgrades to commercial (privately owned) building, repaid by council (rates) to bank	Yes, but only for mitigation	Not known
Energy efficiency bonus	Reduced interest on loan for specific energy efficiency projects	Yes, but only for mitigation	Not known
Microfinance	Small scale financing provided to those who cannot access mainstream financing from banks and government	Yes, but not for climate change	Yes, including for adaptation
Crowdfunding	Funding/financing by collecting small scale funds via Internet platform	Yes, recently, but not for climate change	Yes, few examples for adaptation
Yieldcos	Separates risky investment from predictable cash flow of operating assets, pays through dividends, frees up assets	No	Yes
Purely theoretical instruments	Examples are asset-contingent loans for	No	No

5.1.1 Bonds: Green bonds, climate bonds, municipal bonds, resilience bonds

Bonds are large-scale debt finance instruments that are used to fund one or several large-scale projects. Bonds represent illiquid assets. Liquidity is the measure that an asset or security can be sold or traded on the market easily. Illiquid assets represent longer term investments because they are more difficult to sell as there are fewer interested buyers, compared to liquid assets. This is important because investors often have limitations (tied to regulations) on the proportion of illiquid assets they can carry in their portfolios. This limits the extent to which investors, such as superannuation funds can invest in bonds.

A range of different types of bonds exist in the market. Green bonds and climate bonds are used to finance projects that have an environmental benefit. Both bonds presently target primarily renewable energy projects. These bonds are often tied to standards (such as Climate Bond Initiative) to assure investors that the projects financed through the bonds will meet expectations. The green bond market in Australia consists of the KfW Kangaroo Green Bond, ANZ Green Bond, NAB Climate Bond and the World Bank Kangaroo Green Bond. The size of this market was estimated at $1200 million in 2015 (CEFC 2015). Bond issuance is evenly split between domestic commercial and international development banks: 72% of investors are domestic, 18% from Asia and US and 10% from Europe. Only 4% ($48 million) of bonds are geared at funding adaptation. NAB's Climate Bond was issued in December 2014 and raised AU$300 million for financing a portfolio of renewable energy assets including wind farms and solar energy generation facilities in Victoria, South Australia, Tasmania, Western Australia, NSW and the ACT (NAB 2016). ANZ's AU$200 million Green Bond is set to support green building projects in Australia and New Zealand, as well as some parts of Asia and renewable energy, largely wind and solar on a 40-60 ratio. There are also examples of Australian companies, other than banks, entering the green bond market. Stockland has issued a EUR300 million green bond over seven years on the Singapore stock exchange. The bonds can be used to fund the development or upgrade of green star rated commercial and residential buildings and retirement living projects (ASX 2014). Hallett Hill, a South Australian wind farm owned by Energy Infrastructure Trust, has issued a $206 million green bond into the United States private placement market (Rose 2015; Infrastructure Capital Group 2015).

Municipal bonds represent another category of bonds, but they are issued by local governments usually to finance infrastructure. Municipal bonds do not exist in Australia, but

they are common in the United States where they are subsidized through tax relief on the income earned, making them a popular investment (CCST 2015) (also see Box 4).

Box 4. Incentives for Municipal Bond (US – not available in Australia)
Interest earned on traditional municipal bonds are exempt from federal taxes, providing 'cheaper' capital for state and local governments and benefiting US taxpayers. *Build America Bonds* are a new type of municipal bond that seeks to widen the investor base. This bond incurs federal taxes, but 35% of the bond interest is reimbursed to either the municipal bond issuer (in cash) or bond holder (as tax credit), although the former is the preferred option.

The possibility of establishing a system that supports sovereign bonds in Australia has already been proposed (see Dollery et al. 2012). Dollery et al. (2012) argued that a Commonwealth guaranteed bond bank, which sold pooled debt in regular issues, thus reaping scale economies, would provide the local government sector with the cheapest long-term credit at the lowest possible transactions cost. After securing state borrowing permission, local councils would apply for bond bank funding for approved infrastructure projects, secured by individual council debt. The problem of financial incapacity would also be overcome as disinterested expert financial advice would be offered by the bond bank to individual local authorities. As a consequence, small local councils, afflicted by a combination of financial stress and financial incapacity, would have an inexpensive and reliable source of financial expertise. In addition, the bond bank could offer assistance to local authorities in asset management practice as a capacity-building service.

5.1.2 Balance sheet based financing and project financing

There are two debt finance mechanisms that have been used to finance adaptation initiatives: balance sheet based financing (also known as corporate financing) and project financing (also known as cash-flow based financing). Banks are the primary provider of debt financing (loans) in Australia. Balance sheet based financing is usually used to finance a single or multiple projects of a company or other (public). To date, it is the predominant form of climate adaptation finance globally, although this is because most of the global data is for public sector financing (Buchner et al. 2014). Balance sheet based financing is the main form of financing used in the public sector, including local governments in Australia. Currently, local governments in Queensland borrow exclusively on the basis of the balance sheet, according to an interview participant from the state treasury. The benefit of this type of financing is that local governments can utilise revenue from another source to repay the loan

(such as rates or environmental levies). The repayment is not tied to the profitability (cash-flow) of the project that is financed.

Project financing is applied to large-scale complex projects (e.g. power plants, dams). The project is usually delivered by a special purpose vehicle (SPV), which is an 'empty' company created specifically to undertake the project. The SPV has limited assets and no financial track record. Loan repayments are paid from the revenue generated by the project (hence it is also called cash flow based financing). To manage the risks associated with the loan, banks take on security (collateral) which, in the case of project financing, is the land the project is built on and/or the future project itself.

Both forms of financing have prospects in adaptation financing and it is highly likely that these schemes are currently used to finance adaptation to a greater extent than thought. For example, adaptation features have been incorporated into projects as a 'fudge factor' to account for the risk:

> *I've been involved in other engineering projects where the engineers have just added in a fudge factor for climate change say …I would have just reduced the frequency of big storms …instead of one in 50 year, reduce it say a one in 10 year, and that would initiate the need for higher sea walls, maybe a higher wharf if you're building a port. It's the engineers who would factor it in, in their analysis rather than doing it at the overall financing area…If you get the engineers to do it at the lower level it becomes embedded in the big cost of the asset as opposed to explicitly accounting for it* (bank executive).

However, the nature of project finance precludes the financing of certain activities, such as those that are unable to generate a (financial) return.

5.1.3 Impact investment

Impact investment is an alternative, innovative potential finance mechanism that targets preventative programs. Preventative programs can create future cost savings, but this requires an evidence-base that demonstrates that the approach works. According to a representative from this industry, once the evidence is present, the task is to find a suitable impact investing model, such as payment by outcome models, shared value, etc. In addition, setting up a social impact investment requires a case-by-case assessment, and an exploration of numerous factors to identify benefits and beneficiaries. Thus the process of structuring social impact investment is of potential interest for adaptation finance.

5.1.4 Revolving funds

Revolving funds are funds that are often used by public sector organisations and in the not-for-profit sector to cover the ongoing maintenance costs of buildings or infrastructure. Interestingly however, some types of revolving funds have a component that is used as a financing mechanism, known as a revolving loan. A revolving loan provides upfront capital for specific projects and an example is Harvard's $12 million Green Revolving Fund, which is available for projects that reduce the organisation's impact on the environment (Harvard 2016). The Massachusetts Clean Water State Revolving Fund (CWSRF) loan program is an example of a state level revolving fund used in the US for adaptation, described in Section 5.3.3.

Revolving Funds could provide the necessary funds to cover the operational and upgrade costs of new local government adaptation infrastructure for instance. Revolving funds in Australia are currently used in a different way. Revolving funds have been established by the Federal government to purchase land for conservation and placing a covenant on it to ensure future maintenance of conservation values.

5.1.5 Specialist bank products: Environmental upgrade agreements and energy-efficient loan schemes

Environmental Upgrade Agreements (EUAs) and energy-efficient loan schemes (EELs) are small scale financing mechanisms primarily targeting small and medium-sized businesses. They are both geared toward enhancing energy-efficiency of assets and/or equipment, but could be extended to cover adaptation and resilience upgrades potentially more readily than other mechanisms in Table 13. Both EUAs and EELs rely on some type of standard or rating scheme to determine eligibility as they provide the guarantee that the new technology or upgrade achieves its objective (in energy reduction for instance).

EUAs are mechanisms that provide long-term financing for energy-efficient upgrading of commercial buildings, repaid through an environmental upgrade charge tied to council (land) rates passed on to the lender directly from local government (CEFC n.d.; Office of Environment and Heritage, NSW 2016). EUAs are available in most States. The benefit of EUAs to owners is that the agreement is tied to the property and not the owner; therefore it does not affect the owner's loan capacity (CEFC n.d.). In New South Wales, eligible upgrades include those that target the implementation of energy and water efficiency, renewable energy or reduction of greenhouse gas emissions, reduce pollution or the use of materials, encourage recovery or recycling, assist with monitoring environmental

performance and encourage alternatives to car travel, such as walking and cycling (Office of Environment and Heritage, NSW 2016). These activities can be extended to include upgrades that enable adaptation of buildings. For example, refurbishments could enhance resilience to the impacts of climate change, such as flooding, increase winds or cyclones, heat waves, etc.

Several major Australian banks have developed products that offer discounted finance rates for energy-efficiency. These are small-scale equipment-finance type schemes that rely on industry and government standards (for pre-approval or eligibility) and support (co-financing) from the Clean Energy Finance Corporation (CEFC). NAB's Energy Efficient Bonus and Commonwealth Bank's Energy Efficient Loans are examples of such schemes, while Westpac's Energy Efficient Scheme launched in 2012 appears to have ended (Westpac 2012). There is potential to extend these initiatives in principle to adaptation technologies. Some possibilities include equipment to monitor building safety during high winds, building upgrades for flood protection, etc. However, given the strong reliance of the scheme on government standards to support eligibility, a suitable guideline for adaptation and climate resilience will need to be developed. Further details of NAB's and the Commonwealth Bank's schemes are provided in Box 5.

Box 5. Energy efficiency support schemes. NAB's Energy Efficient Bonus provides up to $500 000 on a discounted finance rate (0.7% p.a.) for energy efficient upgrades for assets that include low emission cars, irrigation systems, solar PV, building upgrades, lighting upgrades, processing line improvements and refrigeration with the CEFC (NAB 2016). Key features of the program are that no deposit is required, the financing is secured by the equipment itself and that eligible technologies are listed (pre-approved) (NAB 2016. The pre-approval relies on a selection of industry and government standards, such as NABERS for buildings, Federal Government's Green Vehicle Guide, the Registered for Small-Scale Renewable Energy Scheme, registered under the Australian Carbon Credit Units (ACCUs) under the Federal Government's Emissions Reduction Fund, NSW Energy Savings Scheme or the Victorian Energy Efficiency Target (VEET), etc. Commonwealth Bank's Energy Efficient Loan is a minimum of $75 000, over a tenure of three to seven years. Eligibility is tied to CEFC's energy efficient criteria (Commonwealth Bank 2016).

5.1.6 Microfinance

While microfinance is usually associated with developing countries, it does exist in Australia and is accessible to the Australian public. Microfinance can take many forms, including loans, buyer schemes and savings schemes (see Table 14). Microfinance activities are most often delivered by not-for-profit community organisations in partnership with financial institutions, known as Community Development Financial Institutions (CDFI) in Australia

(Department of Social Services 2016). CDFIs use government funding to cover operational costs and government funding in turn has leveraged private sector funds of up to $5 million for loan capital (Department of Social Services 2016).

Table 14. Microfinance mechanisms in Australia

Name	Provider, partners	Features	Loan amount, interest, tenure, eligibility	Location
Microenterprise Loan Program	NAB	Unsecured business loan, offered as a credit card, with a low, subsidised fixed interest rate. Can be used for capital expenses, e.g. to purchase plant, equipment, stock, leases, IT, or marketing. It cannot be used as cashflow or to refinance existing debt.	Up to $20 000 over 3 years. Interest rate was 9.99%. First 90 days interest free, funds must be spent. Recipient cannot access other form of loan, must participate in mentoring program.	Australia-wide
No Interest Loans Scheme (NILS)*	Good Shepherd Microfinance with 220 community partners	Interest free loans to buy essential household items (e.g. washing machines, computers or furniture).	$800 - $1200 and you must have or qualify for a health care or pension card. Repayment within 12 - 18 months	Australia-wide
StepUP	Good Shepherd Microfinance, in partnership with the National Australia Bank and the Australian Government	Low interest loans (at 5.99%) for individuals for essential household items like a fridge, washing machine, bed, TV, clothes dryer, health aids and education costs to help transition into mainstream credit products.	Loans of up to $3000 for Australians with a health care card or pension card. Repayments are arranged individually.	Australia-wide
In-roads (CDFI)	A Community Sector Banking initiative, backed by Bendigo Bank through the Kimberley Employment Service (North West Australia) and Nahri SEQ)	Loans for basic household items, education toward employment, car or car repair to get to work, free financial education included	Loans $500 to $3000 for up to two years. Flexible repayment. Fees and interest charged.	Australia-wide
Many Rivers Microfinance Ltd. (CDFI)	Various partners, most notably Westpac	Unsecured loans for small business. Backed by Westpac business loan to help build credit history.	Unsecured loan of up to $5000 for business with sole owner and $10 000 for business with additional owner. Possible large loans based on track record. Reduced interest rate.	NSW, QLD, WA
Fair Loans	Supported by Federal Government	Application through the internet, for any purpose	Two categories of loans a) $1000 - $2000, with no	

Name	Provider, partners	Features	Loan amount, interest, tenure, eligibility	Location
Foresters Group (formerly Fair Finance Australia)(CDFI)	Partners include NAB, Mecu, Australian government, NGOs, etc. Backed by investors (e.g. ChristianSuper, English Family Foundation, McKinnon Family Foundation)	Various loans for individuals including for car repairs, micro enterprise, NILS, debt consolidation, emergencies, unexpected expenses or other worthwhile purposes.	$500 - $4000 for a two-year term. Interest rates and fees upon contact.	Brisbane and the surrounding areas

While the microfinance market is relatively small in Australia, its impact 'adds-up that it fulfils an important function in the community. NAB has monitored the perf its Microfinance Loan Program: a study commissioned in 2012 shows that the pr provided $13.2 million to organisations over five years, produced a total turnover $44 million and created over 280 full-time equivalent jobs (The Centre for Social 2012). The total direct economic benefit amounted to over $2.5 million and the e savings in Centrelink benefits was approximately $7.3 million (The Centre for So 2012).

Microfinance could be used to finance adaptation in remote, low-income areas. I it may be possible to extend microfinance schemes to include purchases of air c for the elderly in areas prone to heat waves. The good news is that microfinance established in Australia, already reaching many communities in need, who are o most vulnerable to climate change. Private sector partnerships and venues for d contribute are functioning. Microfinance loans and providers are already represe certain communities through offices such as Good Money stores, which were es partnership with NAB and the Australian Government. The fact that microfinance exists could facilitate access to microfinance for adaptation across the country.

5.1.7 Crowdfunding

Crowdfunding is a relatively new type of financing that involves a large number o investing (pledging) relatively small amount of funds for an initiative through an i based 'crowdfunding platform' (Box 5).

Box 5. Crowdfunding can be directly between individuals or through an investment fu may take the form of donations, equity investment, or lending (von Ritter and Black-Ly 2013). Crowdfunding is readily available to any individual with an Internet connection funds, although maximum funding size is limited. Its key feature is that it is accessible individuals and organisations that are often outside of the scope of traditional private s finance such as "more risk-tolerant segment of individual donors/lenders/ investors in C countries" (von Ritter and Black-Lyane 2013 p.4). The volume of the global crowdfundi market in 2015 was estimated at US$34.4 billion (Masssolution 2015). Crowdfunding c expose crowd-lenders to some specific risks, such as foreign exchange risk and borro field partner default (von Ritter and Black-Lyane 2013). Crowdfunding platforms differ i of how they handle risk (among other features) which offers investors some options.

Crowdfunding has been applied to range of projects, programs, and product developments, including climate change initiatives (Table 15).

Table 15. Examples of global crowdfunded climate initiatives

Crowdfunding platform	Partner	Initiative
Kiva	Various	Creation of 'Green Project' category
MicroPlace	Various	Creation of 'Green' category
Kiva	BarefootPower	Individuals raise funds that are loaned to local distributors (micro-entrepreneurs) of solar systems, lanterns and renewable batteries to poor population. Initiative also creates jobs to sell, install and maintain solar systems.
Kiva	BrazAfric Enterprises	Vendor credits are supplied to individuals and cooperatives to bulk purchases energy efficient cooking stoves and solar lanterns.
Sunfunder		Individual fund solar businesses in developing countries. Investors do not earn interest, but instead get 'impact points' which they can reinvest but not withdraw in cash.

Source: Based on Von Ritter and Black-Layne (2013).

Table 15 shows that several schemes are realised through a co-operation between crowdfunding platforms and microfinance institutions, such as the crowdfunding platform for international development, known as Kiva.org. Von Ritter and Black-Layne (2013) believe that crowdfunding holds great potential for adaptation, for example in funding climate resilient upgrades of private homes. They envisage that support from large-scale climate funds can assist crowdfunding contributions to the climate finance agenda in a meaningful way by; i) supporting investors through risk-reducing measures (such as first loss guarantees), or ii) reducing the cost of green technologies (for instance through concessional funding), or iii) backing green climate investment bonds to finance small- and medium-sized clean energy solutions (such as mini grids) (von Ritter and Black-Lyane 2013).Compared to many developed nations, crowdfunding is in its infancy in Australia, as it is only recently that it has been legalised.

5.1.8 Yieldcos

The suggestion of Yieldco-type mechanisms for adaptation is purely conceptual. Yieldcos are new, yield-based investment vehicles formed to own operating assets with predictable cash flows. In terms of their setup, Yieldcos are similar to master limited partnerships (that

exist in the US mainly to transport oil and gas) and real estate investment trusts (REITs) (which exist in Australia). They are publicly traded, often paying out earning through dividends. Yieldcos allow the separation of predictable cash-flow generating operations from more volatile cash-flow generating operations and thereby offer numerous benefits to investors and project sponsors (Ernest & Young 2015). In the US, these benefits include regular and predictable cash distributions, acting as a tax shield to investors (through incentives associated with this structure) and can attract foreign investment (due to tax breaks) (Ernst & Young 2015). Yieldcos are predominantly used in the renewable energy sector, where they can offset the risks associated with regulatory uncertainty. The potential of Yieldcos for adaptation is that it demonstrates a new way to structure (restructure) corporations and the ability to separate companies on the basis of risks associated with cash flows.

5.1.9 Mortgage contingent loan for coastal retreat options

Various options to fund retreat from coastal areas threatened by the impacts of climate change have been proposed by Dobes and Chapman (2011), including private insurance, group insurance, catastrophe bonds and reverse mortgage for adaptation and a new instrument they call ‘mortgage contingent loans’. Mortgage contingent loans resemble income-contingent loans (such as student loan schemes like the Higher Education Contribution Scheme), but would be based on the value of property (rather than income) and would only be available to those in need. Basic elements of the scheme include: government acting as the guarantor for the commercial loan of a new home for eligible home owners; loans would be capped at the market price of a home not at risk; government could sell the property upon the owners death or retain the net benefit from the sale of the property if the owner sells (Dobes and Chapman 2011). Owners of coastal properties at risk of inundation without the means to buy a new home would be eligible for the loan and the scheme appears to be able to avoid negative public perception of being a government provision for the wealthy (Dobes and Chapman 2011).

5.2 Insurance mechanisms for adaptation

Participants indicated that the design of insurance products to proactively motivate increased resilience to extreme weather events in Australia is a very recent development. Two domestic insurers have recently released products designed to reduce extreme weather risk and thus maintain insurability of domestic residences (Table 16).

Table 16. Australian extreme weather resilience insurance products

Provider	Programme /Product	Synopsis
Suncorp	Protecting the North	Awards discounted premiums for recognised cyclone proofing enhancement by way of a “cyclone resilience benefit” to eligible cyclone prone properties located north of the Tropic of Capricorn within 100kms of the coastline. Discounts are determined by consumer self-disclosure over the phone. Provision of up to $10 000 towards resilience orientated enhancements subsequent to damage from an insured event, e.g. high winds from a tropical cyclone, bushfire.
IAG	Insurelite	Insured home replaced with accredited design where property severely damaged. Damages must exceed a “small stuff” threshold beyond which entire cost is covered. Main residence is covered only, thus excluding garages, sheds, pools, fences etc.

Source: IAG (n.d.) and Suncorp Insurance (n.d.).

Consistent with the literature, minimising moral hazard through mechanisms such as excesses and the provision of accurate risk-based pricing arose as key prerequisites to effective product design—features that appear to have been incorporated into the design of the above two products. The Suncorp participant advised that collaboration with James Cook University Cyclone Testing Station provided the groundwork that enabled the *Protecting the North* programme. The Testing Station analysed and provided information on the capacity of varying building features to deal with cyclonic conditions. This information and the application of a consumer self-assessment process enabled Suncorp to determine the extent such enhancements are incorporated in building structures and price discounts accordingly. It is arguable that such enhancements not only enable a greater reflection of consumer behaviour in premium pricing but also reduce information asymmetries thus safeguarding insurers from the potential for adverse selection.

The recent introduction of a micro-insurance product designed by Suncorp in partnership with micro-financiers, Good Shepherd and reinsured by Swiss Re, whilst not specific to extreme weather events, was also offered as a signal of an industry looking to ensure sustained insurance affordability. Risk-based pricing was identified as critical to proactive risk reduction by all interviewees with the Suncorp representative explaining that the potential of price signal to drive change applies at various societal levels (e.g. with respect to recent governmental focus on insurance affordability in Northern Australia):

> *In a way, I think we're already seeing the price signal having an effect… That is what encouraged the Productivity Commission to get involved, and the*

Australian government, and everyone else to look at it. I think what we're seeing now is a path developing to a place where adaptation or mitigation, or whichever one you want to call it, becomes the way forward and that has largely been driven by the price signal.

The IAG participant stated that the company was actively considering how to ensure that insured assets "are appropriately built such that they are resistant to any current and future effects of natural perilous events" but at this stage uncertainty precluded climate change pricing within policies.

The difficulty of developing products specifically targeting extreme weather and climate change adaptation emerged as a common theme amongst participants. Both domestic insurers advised that current policy pricing and incentives are based on historical climate variance as opposed to future expectations of climate change. Munich Re representatives explained that product design challenges formed part of the reason that they had invested so heavily in research and government advocacy as a pathway to adaptation.

There was little mention of ART during the interviews, perhaps as a reflection of their lack of utilisation in Australia. The IAG participant noted:

We are well aware of CAT Bonds and other ART options but, at this point the structure of the products and the maturity of the rating mechanisms in Australia (e.g. indexes etc.) mean the products do not respond in a way we can rely on to form part of our capital base. We have recently become the 10th shareholder in PERILS[7] in order to progress the introduction of reliable products into this market.

A Swiss Re representative explained that recently there had been increased interest in products such as Cat Bonds in Australia, particularly related to tropical cyclones in the North. The Swiss Re participant noted that the greatest barrier to uptake of ART was simply awareness that such products existed and an understanding of what they could and could not offer.

5.3 Funding for adaptation

In addition to the traditional funding mechanisms of local government for adaptation (i.e. rates etc. as described earlier) and the schemes provided through the Commonwealth's

[7] PERILS AG is a company that provides data on natural catastrophes (windstorm, flood and earthquakes in select countries, and not for Australia) that can be accessed through annual subscription (PERILS AG 2016)

Natural Disaster Relief and Recovery Assistance (NDRRA) there are other sources or types of funds that can cover the costs of adaptation to climate change. Table 17 identifies some of the funds and funding mechanisms that are or have been used in Australia for adaptation. The Table also includes two examples from the US.

Table 17. Funds and grants that are or have been used (wholly or partly) to fund adaptation to climate change.

Name	Type	Overview
State-level		
Coastal Hazard Adaptation Strategy (QLD)	Adaptation specific fund	The scheme will provide $12 million to coastal local governments over the next three years (2016-2018). Administered by the Local Government Association of Queensland.
Building Resilience to Climate Change program (NSW)	Adaptation specific fund	The fund has provided $875 000 to local governments to implement (rather than assess) adaptation projects. Administered by the Local Government Association of NSW.
Western Australian Coastal Adaptation and Protection Grants	Adaptation specific fund	Approximately $1 million is provided per year since 2009/10. Grants of $10 000 - $300 000 are available to meet up to 50% of total project costs. Administered by the Western Australian Department of Transport.
Queensland's Betterment program	One-off fund, linked to disaster recovery program	A $20 million fund with equal contribution by the State and the Federal Government for local governments activated for NDRAA assistance due to tropical cyclone Marcia. Funding is for essential public assets which are non-state owned to 'build back better' for areas affected by Tropical Cyclone Marcia. Betterment costs are the difference between the cost of restoring or replacing an essential public asset to its pre-disaster standard, and the cost of restoring or replacing the asset to a more disaster-resilient standard. Administered by the Queensland Reconstruction Authority.
Sustainability Fund (VIC)	Environmental levy	The fund aims to lower the State's impact on the environment through reducing impacts from waste, limiting greenhouse gas emissions, helping communities and natural environments adapt to climate change and building a more sustainable future. More than $240 million of revenues from landfill levies have supported hundreds of projects ($67 000-$200 000) across Victoria since 2005.
Federal level		
The Reef Trust Fund	Fund also linked to financing with environmental/ sustainability focus	$140 million commitment to invest in meeting the objectives of the Reef 2050 Plan. A number of different mechanisms are used to provide funding and foster engagement through partnerships, competitive tenders, training and mentoring programs in business and farm management. The Fund is

Name	Type	Overview
		joint partnership between the federal and Queensland government and the Great Barrier Reef Marine Park Authority.
Local government-level		
Climate Change Response Fund - City of Onkaparinga (WA)	Environmental (but climate change specific) levy	Established in 2008 to implement the Council's Climate Change Strategy. It included a one-off 1% increase in general rates for capital costs, with 0.15% for operational and ongoing costs. Total expenditure was $3 572 742, while an additional $554 100 was provided by funding partners in the Adaptation category.
Environment Levy - Sunshine Coast Council (Qld)	Environmental levy	Annual levy ($60 per property) funds the purchase of environmentally significant land and a range of other projects including adaptation activities such as coastal dune rehabilitation and shoreline erosion management, community engagement and education. Small grants ($5000) to community organisations for conservation, adaptation programs are also available.
Philanthropic grants		
100 Resilient Cities - Rockefeller foundation	Broader environmental/ sustainability focus	Sydney and Melbourne have received $2 million over a two year period, used in part to fund a Chief Resilience Officer employed by the councils to plan and undertake a range of resilience programs.
Sidney Myer Fund and The Myer Foundation	Broader environmental/ sustainability focus	Grants in the broad area of urban greening and resilience are offered to local governments in the range of $3000 to $100 000.
International examples		
Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program (US)	Adaptation specific, triggered by disaster	Consists of three programs: Pre-Disaster Mitigation (PDM), Flood Disaster Mitigation (FDM) Hazard Mitigation Grant Program (HMGP). Eligible local governments may apply on the behalf of individual homeowners and business owners. Program may provide up to 75% of the cost of a project, with the state or grantee contributing 25%.
State Revolving Funds (US)		Two types of funds: the Clean Water State Revolving Fund (CWSRF) and Drinking Water State Revolving Fund (DWSRF). It has been proposed that they adopt additional requirements to ensure water efficiency, flood mitigation and green infrastructure and built in to the projects being funded, in order to build climate resilience.

Table 17 is not an exhaustive list of all funds that may be available. The focus was to identify the different options available and to draw out differences in how these funds may be used for different adaptation needs and their limitations.

5.3.1 State, local government and federal level funds

Table 17 shows, that the predominant source of adaptation funding has been state level agencies and levies. State government funds are usually available for specific range of actions (e.g. coastal protection, buildings, etc.) or in specific instances (such as response after an extreme weather event), which limits their area of applicability. State funding is also often limited in terms of size and is highly competitive. Some funds are open to a range of stakeholders beyond local governments. The Building Resilience to Climate Change Program in NSW provided grants from $19 000-$80 000, while the Western Australian Coastal Adaptation and Protection Grants ranged between $10 000 and $300 000. Environmental levies, whether collected by the state or local government, are also used to fund adaptation. Given that the use of the proceeds is dictated by the government's own mandate, levies appear to offer more autonomy and flexibility in terms of where and how monies are spent compared to state funds. While regulations determine under what circumstances levies can be charged and how they can be spent, levies are still more within the realm of local government than state funds.

The Reef Trust Fund is an example where a range of sponsorship and investment opportunities for industry, financial institutions, community, corporate and philanthropic organisations are sought to support and deliver projects in partnership with the private sector for a specific purpose, namely to implement the Reef 2050 Plan. While the Reef 2050 Plan has a wide scope, it extends to adaptation to climate change within its jurisdiction. *Partnerships for the Reef* is a new program that explores alternative funding mechanisms alongside traditional disbursement methods (such as grants) to maximise results for each dollar invested. The partnership involves developing further options for the use of conservation financing products or vehicles for investment through or in collaboration between the Reef Trust and experts from the philanthropic and investment sectors. Its new Innovative Financial Mechanisms Panel will provide a forum for experts from leading financial and philanthropic organisations to discuss a range of conservation financing mechanisms (such as green bonds, impact investment and private equity investments) that could be piloted for the Great Barrier Reef. This stakeholder panel is chaired by the Department of the Environment; voluntary members include representatives from Credit Suisse, Zurich, Commonwealth Bank, National Australia Bank, ANZ, the Great Barrier Reef

Foundation and Philanthropy Australia. Observers on the panel include representatives from the Queensland Department of Environment and Heritage Protection, the Australian Government Department of the Treasury and the Clean Energy Finance Corporation.

5.3.2 Philanthropic grants

While most philanthropic funding for climate adaptation is directed to developing countries, there are examples of funding for adaptation in the wider scope of sustainability and resilience. Two such philanthropic funds are: the 100 Resilient Cities fund and the Sidney Myer Fund/Myer Foundation's Sustainability and Environment Grants. Philanthropic grants do not necessarily require additional financial contribution but require a commitment and periodic reports.

The 100 Resilient Cities (100RC) project is managed and sponsored by Rockefeller Philanthropy Advisors. Melbourne and Sydney are its current participants; each received $2 million over two years. The amount of financial support varies from city to city and is at the discretion of the organisation. Cities selected in the program receive:

1. Financial and other support for appointing a new Chief Resilience Officer
2. Support for development of a robust resilience strategy
3. Management of a peer-to-peer network of member cities who can learn from and help each other
4. Connections to solutions, service providers, and other partners who can help cities implement resilience strategies.

Although the program is not specifically about climate adaptation, but resilience in a broader sense, both Australian cities have identified issues of urban resilience and environmental issues as a result of climate change along other physical, financial and social stresses and shocks. Selected cities must be willing to work in partnership with the organisation and undertake a program of tasks to develop a citywide resilience strategy.

The Sidney Myer Fund and the Myer Foundation's Sustainability and Environment Grants support a range of programs including a Sustainability and Environment stream. The current focus of this stream is green infrastructure in urban areas, including urban greening and conservation of natural environments in urban areas such as creeks, wetlands, grasslands and bush, biodiversity, water sensitive urban design, green roofs, walls, urban and community farming. Unsolicited applications to the large grants program are not accepted. There is also a capacity building stream offering grants of between $30 000 and $100 000.

5.3.3 International examples

Two international examples are described to provide potential ideas for funding climate adaptation in Australia: the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program (US) and Revolving Funds.

Funds under FEMA are geared toward projects that will reduce or eliminate the losses from future disasters. Projects must provide a long-term solution to a problem, for example, elevation of a home to reduce the risk of flood damages as opposed to buying sandbags and pumps to fight the flood. In addition, a project's potential savings must be more than the cost of implementing the project. Funds may be used to protect either public or private property or to purchase property that has been subjected to, or is in danger of, repetitive damage. Examples of projects include, but are not limited to:

- acquisition of real property for willing sellers and demolition or relocation of buildings to convert the property to open space use
- retrofitting structures and facilities to minimize damages from high winds, earthquake, flood, wildfire, or other natural hazards
- elevation of flood prone structures
- development and initial implementation of vegetative management programs
- minor flood control that do not duplicate the flood prevention activities of other federal agencies
- localized flood control projects, such as certain ring levees and floodwall systems, that are designed specifically to protect critical facilities
- post-disaster building code related activities that support building code officials during the reconstruction process.

FEMA is generally 15% of the total amount of Federal assistance provided to a State or Territory, authorized under a Presidential major disaster declaration. The Pre-Disaster Mitigation budget for 2015 was US$30 million; US$250 000 each for each state, with the balance distributed on a competitive basis. FEMA exhibits many similarities to the state funding schemes, such as co-contribution requirements, eligibility of specific actions and natural disaster triggers. However, the share of contributions between local government and state and federal government should be noted, as the wider scope of activities included in the program.

State Revolving Funds have been proposed as means to fund disaster resilience in the United States. The two State Revolving Funds that currently exist in the US were initially funded by Federal and State governments but are now self-sufficient (through bonds).

Revolving funds are often used to cover the operational costs of governmental and not-for-profit organisations and remain open as long as they are needed and are continually replenished.

6. Moving adaptation finance forward in Australia

Previous chapters have highlighted the problem of a lack of funding for climate adaptation initiatives in Australia. It is highly likely that adaptation needs cannot be met through state or federal funding alone and alternate mechanisms are needed to close the adaptation funding gap. A range of different potential finance and funding mechanisms were described in the previous chapter that local governments may be able to leverage to meet their adaptation needs. A key question is; how does one decide which mechanism is most appropriate for a given adaptation project or initiative? Selecting the most appropriate mechanism to fund or finance adaptation is not easy. It takes considerable time and should involve prospective financiers or investors ideally during the early phase of project planning.

6.1 Adaptation finance decision support matrix

Interview participants identified a range of barriers and enablers of adaptation finance. When collected and analysed, these barriers and enablers pointed to eleven features of adaptation initiatives that are important from the perspective of financiers and can impact the finance and/or funding options available for individual initiatives. Table 18 lists these features not in the order of importance, but following a logic of project-related features first (1-5), followed by features related to financing (6-11). Three alternatives (categories) are given along a spectrum for each feature. By identifying which alternatives apply or most accurately reflect a proposed initiative, it is possible to get an idea as to which finance mechanism(s) may be appropriate. In this way, Table 18 can act as an adaptation finance decision support tool.

Table 18. Features of adaptation initiatives that impact finance/funding options

Feature	**Spectrum**		
Size/capital requirement	Small (<$25 million)	Medium ($25-$50 million)	Large ($50+ million)
Lifespan of project/initiative	Short-term (now to 2030)	Medium-term (2030-2070)	Long-term (beyond 2070)
Physicality	Soft measure/initiative (e.g. plan, community capacity building, etc.)	Scheme (e.g. partnership)	Engineered structure
Discreteness	Part of new structure	Upgrading existing structure	New stand-alone investment
Ownership	Local government	Public-private-partnership	Private

Feature	Spectrum		
Scalability	Not scalable	Scalable to some extent	Scalable to a large extent
Beneficiaries	Single/few company/individuals	Some (countable)	Many/wider community
Financial return	Unable to generate	Able to generate, unable to distinguish/quantify	Calculable and demonstrable
Return on investment timescale	Short-term (>2 years)	Medium-term (2-7 years)	Long-term (7+ years)
Risk reduction	Difficult to demonstrate risk reduction	Small-scale risk reduction compared to overall project/business	Demonstrated ability to reduce substantial risk
Insurability	Uninsurable	Partly insurable	Insurable

Of course, it may not be possible to pinpoint all the features that are listed in Table 18, particularly if planning is at an early stage (which is arguably the best time to approach potential financiers). However, the more features that can be identified, the more accurately one can identify the range of possible finance/funding mechanisms.

The time and resource limitations of this study meant there was no opportunity to test the matrix, therefore it remains purely conceptual at this stage, although it is entirely grounded in empirical research. At the very least, the matrix provides a starting point and impetus for local government to think about adaptation initiatives also from a financing/funding perspective.

An important prerequisite to advance adaptation finance is the need to develop measurable performance indicators.

> *I don't really buy the argument that adaptation is harder to measure than mitigation, because when they were first designed in green bonds everybody said, carbon emissions were impossible to measure. We worked out how to do that...You just have to prove that you're investing additional capital in an activity that would not have otherwise been undertaken. That's the same principle as with mitigation bonds as well. I think that's entirely possible, we just haven't done it yet* (Emma Herd, CEO, Investors Group on Climate Change).

Ideally, adaptation indicators should be able to identify part of the project that has the adaptation element, show how effective an adaptation initiative is (in increasing resilience for instance) and what reflect the benefits (costs savings or revenues) it can achieve. It appears that adaptation finance cannot materialise as a legitimate private sector financial mechanisms without overcoming this hurdle.

At the same time, it is evident that funding will continue to play a key role in driving the implementation of adaptation in Australia. State-level funds that provide co-contribution for adaptation of new or existing projects/initiatives could lay the foundations for effective public-private-partnerships. For instance, Queensland's Betterment Fund was earmarked to cover the additional costs associated with investment required to increase resilience of assets. Interview participants from the private sector (both the investment and lending-side) identified the need for government to fund the adaptation components of projects to engage private sector in adaptation finance. The reason is that the private sector currently struggles to cost the impacts of climate change as risk or quantify the benefit of adaptation as a return on investment. According to a senior climate specialist from a major consulting firm "…maybe that's just simply the role of government, that it steps in at that point, represents the broader collective societal benefit, and manages that on behalf of the society". The way in which this could be viable for a public-private-partnership (PPP) model was explained as follows:

> *The adaptation risk, the risk of not adapting, would have to be taken on by some other entity like a government or …community organisation…Adaptation is the classic need for a PPP, a public private partnership. There is that need where the private sector comes to the table with its cost of funds and says, "We think the project is this level of risk, X, X level of risk and we'll finance that component" and then the state government should then also come to the table and say, "We'll pay for the adaptation premium on top of that, which is 0.1 of X" and we'll add those two together and that would be the cost of financing the asset. Taking the port example again, if it was a public port, the private sector could come to the table with $800 million. The government comes with its $200 million, adds the two together and says, "We want an outcome based on those two contributions" knowing full well that the port will be operational for 99% of the year now instead of 93% of the year* (bank executive).

While some individuals may possess the business acumen to adapt to climate change without government assistance and self-fund adaptation initiatives, individual initiatives will not be able to address adaptation in Australia at the scale needed. As Dobes (2012 p.2) points out "…it is possible to adapt to major environmental shocks such as climate change

through creativity and strategic flexibility, especially in the absence of government intervention". However, as long as the onus for adaptation rests with local governments, government role and state or federal funding will remain an important part of the solution. Furthermore it is possible that some adaptation initiatives may not be suitable for financing at all, leaving funding as the only option.

Progressing the agenda of adaptation finance, it is necessary to consider, the ability of financial considerations to facilitate adaptation decision-making. In comparing the expediency of cost-effectiveness, multi-criteria analysis and cost-benefit analysis for adaptation in the literature, Dobes et al. (2014) found that none adequately address the issues of uncertainty, adverse selection, and moral hazard with an acceptable degree of robustness. They recommend improved cost-benefit analyses and the use of real options analysis (Dobes et al. 2014). Real options analysis allows the comparison of the (financial) costs and benefits of different options under uncertainty linked to the extent and timing of the impacts of climate change and the uncertain value of coastal assets in the future. Real options analysis has been applied to climate change adaptation at least conceptually. Nordvik and Liso (2004) used it to understand how climate change will impact buildings and the behaviour of owners. Within the Australian context, Hertzler (2007) sought to assist farmers, catchment authorities and community leaders adapt to and share risks associated with climate change by developing a new type of decision diagram based on real options. Linquiti and Vonortas (2012) compared inflexible and flexible ('real options') strategies in different locations and under different climatic scenarios to determine which option would provide the most benefit. Inflexible strategies included; i) building a sea wall once and ii) building a sea wall initially and raising its height by a set amount over a set period of time, while real options strategies involved iii) decision to raise the wall every 20 years, and iv) in any year (Linquiti and Vonortas 2012). Employing net benefit maximization (as opposed to cost minimisation), Linquiti and Vonortas (2012) found great variation among net benefits of different strategies and conclude that no single option (real option or inflexible) is appropriate for adaptation typically, but rather location-specific analysis is need. They further highlight the complications of applying real options strategies under current development funding practices that have short timeframes.

6.2 Barriers to adaptation finance in Australia

Participants identified a range of different barriers to adaptation finance, which were grouped into eight categories (Table 19).

Table 19. Main barriers and specific issue cited by interview participants

Category	Specific barrier issues
Barriers related to adaptation initiatives	In many circumstances it is difficult to pinpoint who the beneficiary is.
	From the above, it follows it is difficult to identify who will pay back the loan/return on investment? Who owns the debt?
	Adaptation finance has not been a priority; the focus has not been on implementation.
	Adaptation projects are high capital cost and low operational cost; this makes it unattractive to the private sector (i.e. 'a difficult sell').
	Focus has been on post-disaster recovery, as opposed to pre-disaster resilience.
	Adaptation is often not distinct and it is difficult to identify it from other projects/initiatives.
	Adaptation is not mandatory.
Barriers related to climate change policy	Uncertainty of government policy on climate change and adaptation.
	Policy has been negative.
	Political expediency with too much focus on post-disaster recovery and not enough on prevention/adaptation.
Climate adaptation finance is a new area	General lack of understanding of what adaptation finance is.
	Industry conservatism and risk aversion within the industry (including the consultants that advise investors) means adaptation initiatives are not promoted (inertia in the system).
	Specific variables/risks that institutions can calculate with have not been identified.
	Lack of demand.
Scalability of adaptation initiatives is problematic	Due diligence work is expensive, therefore new investments need to achieve considerable scale to justify cost of due diligence.
Barriers related to government policy and politics (not related to climate change specifically)	Aggravating vertical fiscal imbalance.
Finance-industry related	Short-term focus.
	Lack of leadership in the finance sector, including failure of consultants to

Category	Specific barrier issues
	raise the issue to government.
	Current accounting rules require ‘adaptation components’ to be written off in the first year, while benefits are realised over time.
	Regulatory requirements in terms of liquidity and capital.
Climate change science-related	Science is not commercially applicable yet (too complex and probabilistic).
Barriers specific to insurance	Short-term focus.
	Premium discounts for adaptation is minor compared to costs.
	Access to appropriate information.

The capacity to identify a return on investment for adaptation initiatives was undoubtedly one of the most critical barriers identified by participants representing the private and public sectors, which was articulated by a participant as follows:

> *If we set aside the actual existence of investment opportunities out there, and we set aside how local governments go about looking for funding, probably the biggest barrier to financing adaptation activities at the moment is the lack of knowledge of how to incorporate revenue return, or how you may incorporate revenue return opportunities into your adaptation activities* (representative from the public sector).

The problem of return on investment is intimately connected to the difficulty of pinpointing the beneficiaries of adaptation initiatives. Many climate change adaptation projects that will be initiated by local governments will have the characteristics of delivering public good (non-rival and non-excludable) which may not be able to generate a return on investment as economic theory suggests.

Another major financial barrier was the upfront capital cost of many adaptation measures, in particular when the benefits of any additional expenditure are uncertain. In the insurance industry, this materialised as the problem of relatively minor size of premium discount compared to capital outlay. Concerns of short-term focus of both the finance sector and insurance industry were also raised frequently. These were fuelled by shareholder financial return expectations for companies listed on the Australian stock exchange. Short-term focus presented additional challenges for insurers, as the IAG participant explained:

> *The challenge that you have is that the way that you determine pricing in insurance is often predicated on external inputs to your price, so the cost of capital, the cost of reinsurance, and various other things that go to form your original rate… those things are calibrated annually, often and they're highly reactive to large events. So if there was an earthquake in New Zealand or something like that, then our initial rates would need to be able to respond rapidly, to be able to recoup the amount of money that we would subsequently have to pay up to third party capital providers.*

A key concept of climate change adaptation is the need to 'embed' adaptation within existing processes such that when a decision is made, 'by default' it factors in adaptation or resilience to future climate. An example of this would be designing a road to be able to adapt to the impacts of climate change such as storm tide inundation, rather than building a new road that over time will require the construction of a levee to protect it. Under this approach the adaptation cost is incorporated within a larger project and cannot be separated as an isolated financing need, although as mentioned earlier, efforts are being made to develop a consistent mode to demonstrate the adaptation components of projects.

Climate change policy and uncertainty was cited more often as a hindrance than negative policy was a prime barrier to progress on adaptation and adaptation finance. For instance, refusal to engage in meaningful dialogue about climate change due to ideological position was mentioned. A number of interview participants noted that they had adjusted their dialogue to suit the political environment. For example, the participant from Munich Re drew attention to the fact that they purposely avoided using the term 'climate change' in two initial reports by the Insurance Council of Australia and the Australian Business Roundtable for Disaster Resilience and Safer Communities.

In multilevel governance systems such as that of Australia, the principle of allocating the capacity to generate income in a manner that is proportionate to the distribution of responsibilities is important. The term 'vertical fiscal imbalance' is used to describe the situation where this does not occur and grants and transfers are required between levels of government to deal with this problem. From the perspective of local government participants, there was a consistent message that the cost of climate change adaptation added to an already a significant vertical fiscal imbalance between the different levels of Australian governments:

> *…what doesn't work in Australia is the federal, state and local government each trying to manage their patch, and there is no one holistic approach. The fact*

> *that government wants to sort out problems in a political way by throwing money at it, rather than taking a long term view and investing in adaptation to get the right behaviour and the right incentives, so that you don't create pools that are financially not sustainable and lead to lack of incentivisation* (insurance industry participant).

> *As it stands, really, there is not a great appetite from the point of view of the federal government to get involved in coastal policy or implementation of coastal works because those areas of policy and activity are seen as principally the responsibility of the states* (Alan Stokes, CEO, Australian Coastal Councils Association).

Political expediency was raised as another significant barrier to effective adaptation and extreme weather efforts in Australia as reflected by an interview participant:

> *One of the problems is that if you're a politician spending money on building defences, which no one then ever sees what you're saving them from, isn't exactly vote winning. If there is a disaster and you step in and throw millions of dollars around, then that is hugely vote-winning. There's actually a political disincentive to do adaption.*

The problem of debt aversion relates not just to adaptation finance, but any other prospect of private sector engagement through financing. Over recent decades there has been significant investment in cultural change initiatives within all levels of Australian government to ensure that principles of good governance were understood and implemented by government officers. A number of the critical messages have been instilled within government professionals to avoid any perceptions of undue influence from private sector interests and to ensure high levels of transparency and avoid favour. These tendencies and perceptions create a difficult environment for enhancing private sector participation in adaptation finance:

> *There is a reluctance in local government to raise funds privately or commercially to undertake these sort of works* (Alan Stokes, CEO, Australian Coastal Councils Association).

> *Private/public partnerships require careful consideration for local governments, particularly if public funds are being invested. Public benefit needs to be very clearly demonstrated* (Dorean Erhart, Local Government Association of Queensland).

6.3 Maladaptive practices

The study had identified some maladaptive practices among stakeholders that either i) hinder the ability of the effectiveness of adaptation initiatives funded/financed, or ii) impede private sector participation in adaptation. An example of the first maladaptive practice is in the focus of current funding on post-disaster recovery, in which funding is not paired with a requirement to rebuild assets in a way that could withstand the future impacts of climate change. Considering the barrier associated with accounting for costs to ensure long-term resilience of infrastructure the need to fund resilience is even greater. One example of a disaster recovery fund which specifically covered extra costs associated with building back infrastructure that was more resilient was Queensland's Betterment initiative.

The second maladaptive practice was identified in relation to how local government charge rates. Current practices involve charging rates on the basis of the value of the property (partly or wholly). Risks, such as those related to climate change, like flooding or bushfires, can impact the value of a property and the rates that councils charge. High-value properties are often located in areas that are susceptible to the impacts of climate change (e.g. along the coast, canals or river banks in low lying areas or on ridge tops with panoramic views). Councils could potentially lose substantial revenue if such properties are devalued because they are deemed to be at increased risk of erosion, inundation or bushfire from climate change.

7. Conclusions and recommendations

This study reviewed financing mechanisms for climate change adaptation, including consideration of insurance mechanisms, and identified potential innovative financial instruments. The study also provided insight into the prospects of adaptation finance in Australia. Given that local governments are largely responsible for implementing climate change adaptation in Australia, the focus was on the issues that impact the ability of local governments to access funds from other levels or government and the private sector. Various regulations have implications for the way that local governments can generate revenue and access finance. Legislative restrictions on borrowing and the 'debt aversion' phenomenon appear to be key barriers to enhancing private sector engagement in adaptation finance. However, since adaptation to climate change places significant and additional pressure on the budgets of local governments, innovative funding practices, including involving the private sector appears to be a viable and necessary solution over the long-term.

From the perspective of the private sector, adaptation finance is not a mainstream concept in Australia. Although financiers recognise the need to adapt to climate change and the need for financing in this space, adaptation finance as a distinct method of financing is largely conceptual in nature (especially compared to financing climate mitigation). The proportion of finance for adaptation is not specifically identified as distinct from overall investments or loan transactions therefore the extent of actual adaptation finance in Australia is unknown. This problem is not restricted to Australia, both developed and developing countries are struggling to overcome this issue. Currently several organisations are involved in developing a framework to facilitate the identification of the adaptation portion of projects, which will also help isolate associated costs.

The result indicated that climate change represents a threat to the viability of the insurance industry on the long-term and that the industry also has a role in helping society adapt to climate change. However, the nature of the industry (such as its ability to insure against sea level rise for example) and moral hazard is perceived to limit this role. Currently the insurance industry engages with governmental organisations (to influence policy) as well as the community, to generate awareness or risks and advocates for action on pre-disaster resilience.

Green bonds, climate bonds and resilience bonds were identified as possible mechanisms to fund large scale adaptation projects. This would require extending climate standards for bonds to capture adaptation features (i.e. creating an adaptation asset class). The benefit of financing adaptation through bonds is that the private sector is already experienced with this mechanism and that bonds are particularly targeted at large-scale projects (or group of projects). A limitation of bonds is that they requires sizable projects (i.e. costs over $25 million) to be feasible, therefore it can only apply to adaptation projects that are scalable. The potential of resilience bonds was highlighted, as a mechanism that attempts to quantify and monetise adaptation (resilience) benefits. While resilience bonds do not exist at this stage, various Australian and overseas organisations (including cities) are currently working on their implementation.

On a smaller scale, specialised bank products that are currently geared toward financing energy-efficiency upgrades of buildings (EUAs) or equipment or purchase of new equipment (EELs) were also identified as favourable candidates for adaptation financing. Again, it is possible in theory to extend eligibility conditions of projects to include adaptive or resilience features, but there is a need to develop standards to assess the appropriateness of technologies.

The potential of the insurance industry and insurance as a mechanism to aid societal adaption to climate change is well documented. This potential is apparent in a continuously expanding range of innovative insurance products designed to motivate societal risk mitigation behaviour and overcome the challenges of insurability. The innovation of ART, in particular insurance linked securities, has increased the scope and scale of this potential even further. Yet the extent of innovation witnessed abroad is yet to materialise in Australia. The short-term outlook of insurers (e.g. the annual premium and regulation cycle) and other stakeholders (e.g. political cycles and consumer attention) is the predominant barrier to the incorporation of climate change factors into products and strategy. Whilst Australian insurers have started to roll out products aimed at enhancing resilience to extreme weather events this trend is very much in its infancy, and at this point products are designed to future proof current climatic conditions, not those that may ensue from climate change. Risk reduction is a pre-requisite of sustainable, affordable insurance and insurers consider government as the predominant driver of risk reduction behaviour.

Of the twelve different funding schemes for adaptation discussed, the Betterment Fund (Qld) provides a potentially viable model to facilitate thinking about how public private partnerships for adaptation can materialise. The fund was designed to cover additional costs associated

with increasing resilience of assets damaged in an extreme weather event. Funding the adaptation component of otherwise financially sound projects will help alleviate the major problem of the inability to demonstrate a return on investment for adaptation. Coupling government funding of adaptation components of initiatives with private sector financing could lay the foundations for effective public-private-partnerships for adaptation and in a way stretch available funds to implement more initiatives on the ground. A similar approach to investigate financing through public-private-partnerships through the Federal government's Partnership for the Reef program (via the Reef Trust Fund) has already begun.

An adaptation finance decision support matrix was developed to help frame adaptation initiatives as investments. The matrix consists of those features of adaptation initiatives that can impact the finance or funding options available for individual initiatives. The features include: size of capital requirement, lifespan of the project, physicality, discreetness and ownership, scalability, beneficiaries, financial return, return on investment, risk reduction and insurability.

The study provided novel insight into the current status and prospects of adaptation finance in Australia, filling an important gap in knowledge that is believed to have applications that extend beyond the Australian context and apply to developed countries in general. Ultimately new financing instruments similar to those for renewable energy will need to be explored for adaptation. Most local governments will seek, and require assistance to meet the additional costs imposed by the need to adapt to climate change. These additional costs will include new technologies as well as more application of existing technology such as seawalls, beach nourishment, water efficiency, desalination and higher standards in building design. At the same time, it is evident that funding will continue to play a key role in driving the implementation of adaptation in Australia, as it is likely that many adaptation initiatives may not be suitable for private sector financing at all. In many cases, government funding will be required to cover the costs of the adaptation component of new or existing projects/initiatives. Even if adaptation is financed, it will still need to be repaid and given that adaptation is the responsibility of local government, this means that the community will ultimately have to pay.

The following recommendations are made.

- Identify, together with stakeholders, which mechanisms hold the most relevance and immediate potential and the pre-requisites for their piloting/implementation.

- To assist progress and innovation, develop a rating tool for adaptation. This will likely be easier for some sectors where standards and guidelines exist and used, such as buildings and infrastructure than others.
- Work with government to create the right framework for financial innovation and effective incentives for adaptation finance including.
- Legislative changes: increase the capacity of local governments (in some jurisdictions) to charge rates and use the income for adaptation purposes (e.g. this could enable resilience bonds).
- Focus governmental efforts and funding pre-disaster resilience as opposed to post-disaster recovery.
- Support disclosure of climate change risk exposure and management of Australian insurers (such as the Financial Stability Board's Taskforce on Climate-Related Financial Disclosure and Australia's Senate Inquiry on Carbon Risk Disclosure).
- Fund further study to pilot potential mechanisms to finance adaptation and innovative insurance products.

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Appendix

List of organisations engaged in the project:

Griffith University

The University of Queensland

The University of New South Wales/ Australian Adaptation Network for Settlements and Infrastructure

Climate Planning

Investors Group on Climate Change

Climate Policy Institute

Department of Environment

Local Government Super

Baker and McKenzie Law firm

Queensland Treasury

Parramatta City Council

Social Outcomes

Suncorp Bank

IAG

Qantas

AECOM

Swiss Re

Australian Actuarial

KPMG

Munich Re

Australian Coastal Councils Association

Local Government Association of Queensland

Sydney Coastal Council Group

City of Victor Harbor, SA

Berkshire Hathaway