



Australian Government
Productivity Commission

Barriers to Effective Climate Change Adaptation

Productivity Commission
Inquiry Report

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19 September 2012

The Hon David Bradbury MP
Assistant Treasurer
Parliament House
CANBERRA ACT 2600

Dear Assistant Treasurer

In accordance with Section 11 of the *Productivity Commission Act 1998*, we have pleasure in submitting to you the Commission's final report into *Barriers to Effective Climate Change Adaptation*.

Yours sincerely

Wendy Craik
Presiding Commissioner

Jonathan Coppel
Commissioner

Neil Byron
Associate Commissioner

Terms of reference

Productivity Commission Inquiry into Regulatory and Policy Barriers to Effective Climate Change Adaptation

I, Bill Shorten, Assistant Treasurer and Minister for Financial Services and Superannuation, pursuant to Parts 2 and 3 of the *Productivity Commission Act 1998* hereby request that the Productivity Commission undertake an inquiry into regulatory and policy barriers to effective climate change adaptation. The Commission will report within 12 months of receipt of this reference and will hold hearings for the purpose of this inquiry.

Background

Climate change adaptation is action by households, firms, other organisations and governments to respond to the impacts of climate change that cannot be avoided through climate change mitigation efforts. An effective national adaptation response will require all levels of government, the private sector and intermediary markets to contribute to that response.

This inquiry will assist COAG to advance climate change adaptation reforms in Australia by examining the policy frameworks required to facilitate effective adaptation, and the costs and benefits of various adaptation options so as to identify the highest priority reforms. In undertaking this review the Commission will also assess the effectiveness and efficiency of market based approaches in facilitating adaptation.

Scope of the Inquiry

The Commission is requested to assess the regulatory and policy barriers to effective adaptation. In undertaking the review, the Commission should identify any specific barriers that may act to inhibit effective adaptation to unavoidable climate change.

The Commission should identify high priority reform options to address any identified barriers to effective adaptation. The Commission should also:

- examine the costs and benefits of the options to address those barriers where it is feasible to do so, including a 'no change' (maintaining the status quo) option; and

-
- assess the role of markets (including insurance markets) and non-market mechanisms in facilitating adaptation, and the appropriateness of government intervention.

In undertaking its inquiry, the Commission should take into account the relevant policies of all levels of government and the work on adaptation undertaken under the auspices of COAG. The Commission should consult with relevant Australian Government, state and territory and local government agencies, and other key stakeholders.

The Commission is to provide both a draft and a final report, and the reports will be published. The Government will consider the Commission's recommendations, and its response will be announced as soon as possible after the receipt of the Commission's report.

BILL SHORTEN
20 September 2011

Contents

Abbreviations	xi
Overview	1
Recommendations	27
1 Introduction	33
1.1 The scope of the inquiry	36
1.2 The Commission’s approach to identifying reforms	39
1.3 Conduct of the inquiry	40
2 The challenges of climate change	41
2.1 Australia’s variable and changing climate	42
2.2 Projected climate change for Australia	42
2.3 The impacts of climate change	48
2.4 Climate change uncertainty	53
3 Adapting to a changing climate	57
3.1 Adapting to climate change	58
3.2 Managing climate risks	60
3.3 Measuring and evaluating adaptation activity	62
3.4 Building adaptive capacity	65
3.5 Assigning roles and responsibilities for adaptation	66
4 Defining barriers to effective adaptation	73
4.1 What is a barrier to effective adaptation?	74
4.2 A classification of barriers to effective adaptation	74
4.3 How should we respond to barriers?	83

5	Assessing reform options and identifying priority reforms	85
5.1	Assessing reform options to increase wellbeing	86
5.2	Assessing reform options under uncertainty	91
5.3	Identifying priority reforms	100
6	‘No regrets’ policies	103
6.1	Economic reform and adaptation	103
6.2	Taxation	105
6.3	Government transfers	108
6.4	Regulation	110
7	Information provision	117
7.1	Information for adaptation	118
7.2	Barriers to information provision	121
7.3	Barriers to information use	137
8	Local government	147
8.1	Adaptation at the local government level	148
8.2	Roles and responsibilities for adaptation	153
8.3	Inadequate local government capacity	156
8.4	Legal liability as a barrier to adaptation	166
9	Land-use planning	171
9.1	Planning regulation incorporates climate change risks to varying extents	173
9.2	Incorporating climate change adaptation in land-use planning	177
10	Building regulation	191
10.1	Building regulation in Australia	192
10.2	Climate change and building regulation	194
10.3	Potential barriers to considering climate change in building regulation	199
10.4	Interactions between land-use planning and building regulation	203

11	Existing settlements	205
11.1	Protect, accommodate or retreat	206
11.2	Cross-cutting issues	211
11.3	An independent public inquiry into managing climate change risks to existing settlements	218
12	Provision and regulation of infrastructure	221
12.1	How is infrastructure provided?	222
12.2	Potential barriers to climate change adaptation	226
12.3	Can investment and regulatory practices be improved?	234
13	Emergency management	241
13.1	Current arrangements	242
13.2	Inadequate governance and institutional arrangements	245
13.3	Recent reforms	250
13.4	Disaster mitigation	252
13.5	Disaster recovery: the Natural Disaster Relief and Recovery Arrangements	263
13.6	Getting the balance right	268
14	Environmental management	275
14.1	Climate change and the environment	275
14.2	Barriers to effective adaptation	277
14.3	Supporting adaptive capacity	279
15	The health system	291
15.1	Effective adaptation in the health system	293
16	The role of insurance	297
16.1	Insurance in a changing climate	298
16.2	Factors affecting insurance costs and provision	305
16.3	Reforms to insurance regulations	314

17 Reform priorities	323
17.1 Two groups of reforms	324
17.2 Who should implement adaptation reforms?	324
17.3 Reform options that should not be pursued	330
A Public consultation	333
References	343

The following appendixes are not included in this report. They are available on the Commission's website (www.pc.gov.au/projects/inquiry/climate-change-adaptation)

- B Australian approaches
- C International approaches
- D Economic modelling and adaptation to climate change

Abbreviations

ABARE	Australian Bureau of Agricultural and Resource Economics
ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABCB	Australian Building Codes Board
AER	Australian Energy Regulator
BCA	Building Code of Australia
BOM	Bureau of Meteorology
CAPP	Coastal Adaptation Decision Pathways Program
CIPMA	Critical Infrastructure Program for Modelling and Analysis
CGE	Computable General Equilibrium
COAG	Council of Australian Governments
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCCEE	Department of Climate Change and Energy Efficiency
GDP	Gross Domestic Product
GIAM	Global Integrated Assessment Model
GTAP	Global Trade Analysis Project
GTEM	Global Trade and Environment Model
IAM	Integrated Assessment Models
ICES	Inter-temporal Computable Equilibrium System
IPCC	Intergovernmental Panel on Climate Change
LAPP	Local Adaptation Pathways Program
LRP	Legislative Review Program
MMRF	Monash Multi-Region Forecasting
NCC	National Construction Code
NCCARF	National Climate Change Adaptation Research Facility

NDRRA	Natural Disaster Relief and Recovery Arrangements
NPA-NDR	National Partnership Agreement on Natural Disaster Resilience
OECD	Organisation for Economic Co-operation and Development
PC	Productivity Commission
PE	Partial Equilibrium
RIS	Regulation Impact Statement
SCCC	Select Council on Climate Change
TISN	Trusted Information Sharing Network
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change

OVERVIEW

Key points

- Australia's climate is changing and will continue to do so for the foreseeable future.
- Changes in the frequency, intensity, location and timing of extreme weather events are likely to be how most Australians experience climate change.
- Adaptation to these changes, and the effects of more gradual climate change, will occur over time as households, businesses, governments and communities respond to incentives to manage the climate (and other) risks they face.
- However, a number of policy and regulatory barriers may inhibit adaptation responses, suggesting the potential for government action to improve outcomes for the community.
- Governments at all levels should:
 - embed consideration of climate change in their risk management practices
 - ensure there is sufficient flexibility in regulatory and policy settings to allow households, businesses and communities to manage the risks of climate change.
- A range of policy reforms would help households, businesses and governments deal with *current climate* variability and extreme weather events. These reforms would also build adaptive capacity to respond to *future climate* impacts. Examples include:
 - reducing perverse incentives in tax, transfer and regulatory arrangements that impede the mobility of labour and capital
 - increasing the quality and availability of natural hazard mapping
 - clarifying the roles, responsibilities and legal liability of local governments, and improving their capacity to manage climate risks
 - reviewing emergency management arrangements in a public and consultative manner, to better prepare for natural disasters and limit resultant losses
 - reducing tax and regulatory distortions in insurance markets.
- Further actions are required to reduce barriers to adaptation to *future climate* trends and to strengthen the climate change adaptation policy framework. These include:
 - designing more flexible land-use planning regulation
 - aligning land-use planning with building regulation
 - developing a work program to consider climate change in the building code
 - conducting a public review, sponsored by the Council of Australian Governments, to develop appropriate adaptive responses for existing settlements that face significant climate change risks.
- Some measures should not be implemented, as the costs would exceed the benefits.
 - Household insurance subsidies, or insurance regulations that impose net costs.
 - Systematically reviewing all regulation to identify impediments to adaptation.
 - Mandatory reporting of adaptation actions.
- Some individuals and communities are likely to face greater challenges in adapting than others, implying a role for the tax and transfer system.

Overview

Australia's climate is changing and the weight of scientific evidence suggests it will continue to change over coming decades and centuries. Average temperatures and sea levels will gradually rise and rainfall patterns will change. As a consequence of these changes, projections indicate that the location, frequency and intensity of extreme weather events (such as bushfires, heatwaves and hailstorms) will also change.

However, the timing and magnitude of future changes to the climate are uncertain. Some climate change is inevitable regardless of global efforts to reduce greenhouse gas emissions (box 1). Limits to scientific understanding of the climate system and the uncertain trajectory of global greenhouse gas emissions means that projections of average temperatures and other aspects of the climate — such as precipitation and extreme weather events — are subject to wide ranges, particularly at regional and local levels. However, there is confidence about the direction of most changes.

Climate change will affect life in Australia in numerous and diverse ways, imposing significant economic, social and environmental costs. For example, more frequent droughts could affect the viability of some farming businesses, a combination of higher sea levels and storm surge could make some areas of existing settlement uninhabitable and some communities could face increased bushfire risk. Climate change could increase pressures on endangered species, leading to extinction in some cases. While climate change could also present opportunities, it is anticipated that the net effect for Australia will be negative.

Actions to respond and adjust to changes in the climate are collectively referred to as climate change adaptation. These actions can be taken in direct response to climate change as it occurs, or in anticipation of climate change. Households, businesses and governments can act to manage associated risks. Importantly, and unlike greenhouse gas mitigation which requires a global response, these actions can be undertaken independently at the local level.

Adaptation is facilitated by the normal actions of markets with price signals (such as changes in insurance premiums) giving households and businesses incentives to change their behaviour. However, where prices do not fully reflect the risks faced or costs borne, the responses of consumers and households will not deliver the greatest possible level of community wellbeing. Government intervention in the form of

regulation or the funding of public goods and services has the potential to facilitate more effective adaptation to climate change and hence better community outcomes.

Box 1 The relationship between mitigation and adaptation

The community can respond to climate change in two broad ways.

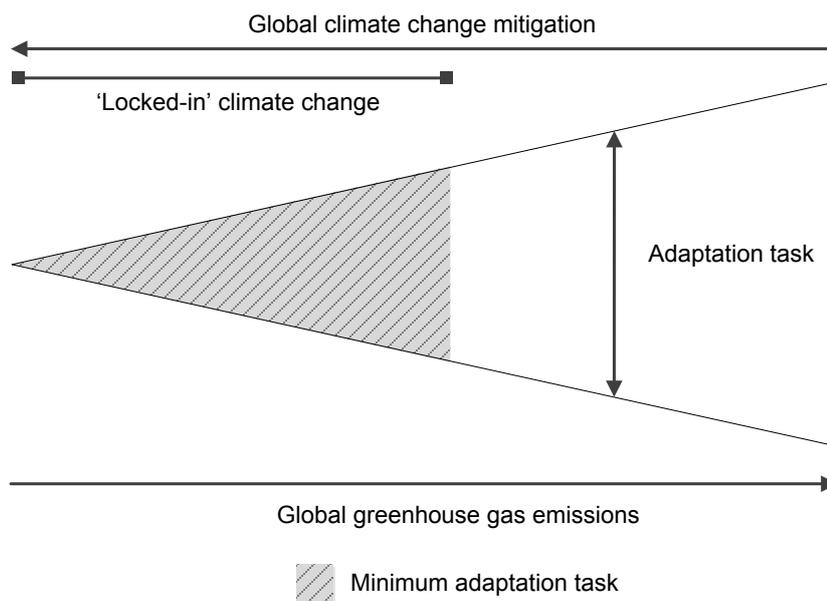
Climate change mitigation refers to actions to reduce emissions of greenhouse gases from human activities that contribute to the warming of the atmosphere. The carbon price in Australia and the EU Emissions Trading Scheme are examples of greenhouse gas mitigation policies.

Climate change adaptation refers to actions to respond and adjust to changes in the climate. The inquiry's terms of reference define adaptation as:

... action by households, firms, other organisations and governments to respond to the impacts of climate change that cannot be avoided through climate change mitigation efforts.

Climate change mitigation involves taking steps to reduce or avoid changes in the climate, whereas adaptation involves adjusting to the climate as it changes by anticipating or responding to climate impacts. For example, building infrastructure that can cope with higher temperatures or bushfire or changing agricultural practices in response to more frequent droughts.

To be effective, mitigation needs to be pursued on a global scale. By contrast, adaptation can deliver benefits when pursued independently at the local or national level. And adaptation can reduce the effects on community wellbeing of climate change that is 'locked in' due to past greenhouse gas emissions and inertia in the climate system. This does not mean that climate change adaptation and mitigation are unrelated; the adaptation task will be reduced by effective global climate change mitigation efforts.



The Productivity Commission has been asked by the Australian Government to identify regulatory and policy barriers to effective climate change adaptation and identify high-priority reforms to address these barriers. In doing so, the Commission has been asked to examine the benefits and costs of a range of market and non-market policy options (including maintaining the status quo), and to take into account the relevant policies of all levels of government and the work on climate change adaptation undertaken through the Council of Australian Governments (COAG).

The Commission's approach

Defining 'effective' climate change adaptation

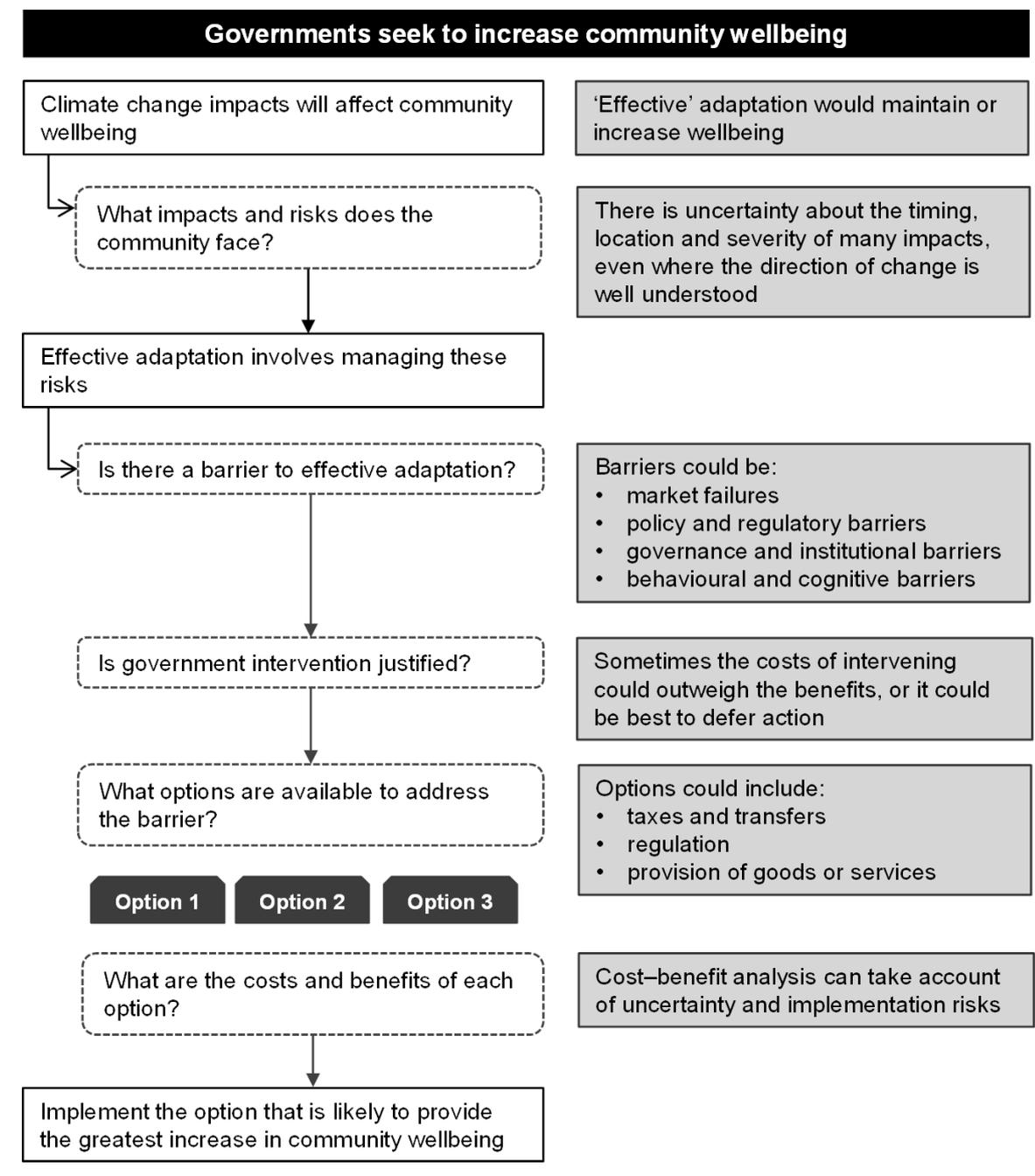
'Effective' climate change adaptation means adaptation actions that enhance community wellbeing. Wellbeing is defined broadly and is derived from market factors (such as income, wealth and consumption) and non-market goods and services (such as good health, environmental amenity, leisure, community participation, and political rights and freedoms). Wellbeing is also influenced by equity considerations and takes account of long- and short-term effects. Actions to increase wellbeing can include those that benefit the community as a whole, or actions that benefit a specific region or group.

One challenge arising from this, or any other, definition of effective climate change adaptation is that it is not possible to measure how much adaptation to climate change is actually occurring and whether it is 'too much' or 'not enough'. While it may be possible to directly monitor some adaptation activity by households and organisations, it is difficult to distinguish actions that are motivated by climate change from those motivated by other, unrelated forces. It is also likely that adaptation is occurring without being formally identified as 'adaptation'. As a result, it is preferable to identify barriers to effective adaptation directly, rather than infer their presence from some measure of inadequate adaptation planning or actions.

Adaptation and community wellbeing

The Commission's approach to identifying priority reforms to address barriers to effective adaptation is framed within an over-arching policy goal of seeking to increase community wellbeing (figure 1). Climate change impacts and resultant damages could pose risks to community wellbeing (and present opportunities to increase wellbeing). Risk management could mitigate some of those risks.

Figure 1 The Commission's approach



What is a barrier?

A 'barrier' to effective climate change adaptation restricts people's ability to identify, evaluate or manage risks in a way that delivers the highest level of community wellbeing. In some cases, the characteristics of markets, regulatory systems, institutions and the way people process information and make decisions could prevent households, businesses and governments from identifying and

managing the climate risks they face (box 2). For example, poor quality or inconsistent information on natural hazards, such as floods and bushfires, can prevent households and businesses from effectively managing extreme weather events. Improving the quality and consistency of natural hazard information could assist adaptation.

Box 2 Barriers to effective adaptation

Barriers to effective climate change adaptation may result from one or more of the following.

- *market failures* — conditions that prevent markets from allocating resources to the uses or areas where they are most highly valued. For example, a barrier could arise where there is insufficient or inadequate information on climate change impacts for households, businesses, other organisations and governments to make well-informed adaptation decisions. Information can be underprovided by private markets when the same piece of information can be used by more than one person and it is difficult to exclude others from using that information (for example, weather forecasts). This results in markets providing less information than society prefers.
- *policy and regulatory barriers* — regulation (or an absence of regulation) that inhibits effective adaptation. For example, a lack of integration of building and planning regulation could create a barrier to adaptation where neither system appropriately manages a particular risk to property (such as flooding).
- *governance and institutional barriers* — poor governance arrangements impede coordination between governments and agencies, reduce accountability or lead to authorities being allocated responsibilities that they do not have sufficient capacity to carry out effectively. For example, the current legal liability of councils is uncertain when they make land-use planning decisions relating to land that is subject to future climate change risks. In some cases, there is a risk that councils may defer decisions as they are uncertain about the legal implications of their decisions.
- *behavioural and cognitive barriers* — the way people process information and make decisions could act as a barrier to effective adaptation. For example, individuals may have trouble weighing up the costs and benefits of adaptation actions where climate change impacts and potential resultant damages are uncertain and occur over long timeframes. As a result, they might procrastinate or defer actions that would be in their own best interest now.

A focus on cross-sectoral barriers

The pervasive nature of climate change and its likely impacts means that the greatest benefits are likely to come from initiatives that cut across sectors. This includes identifying reforms that can build the community's adaptive capacity. Examples include better provision of information and infrastructure, and getting better alignment between land-use planning and building regulation. Specific examples from individual sectors (such as agriculture or water) are identified throughout the report.

The Commission also considered whether there were policy or regulatory barriers to effective adaptation in other areas such as defence and migration. However, research and consultation with experts failed to uncover specific barriers in these areas.

What is the role for households and businesses?

Some adaptation to climate change is already occurring. Households and businesses are responding to incentives to exploit the opportunities and manage the risks of climate change. By managing climate change risks they are capturing the benefits of avoiding real or potential damages. For example, some people living in bushfire-prone areas are managing the increased risk of bushfires by removing vegetation in close proximity to their homes and taking out insurance, infrastructure owners are modifying their investments to manage climate-related risks and farmers are adjusting crop types and planting times as weather patterns change (box 3).

Box 3 Businesses are already adapting

Infrastructure

Infrastructure owners are already considering the risks of climate change. For example, Brisbane Airport Corporation is factoring in expected climate change impacts in its New Parallel Runway Development. The runway site is potentially subject to inundation. In order to mitigate these risks, the Corporation is raising the site for the development above the projected 1-in-100-year flood level and building a new seawall and tidal channels.

Agriculture

Farmers have responded to changing weather patterns by modifying crop planting times, crop types (including opportunistic planting of summer or winter crops), and the choice of fungicides and fertilisers. For example, in parts of Queensland, wheat is now planted three to four weeks earlier than previously.

What is the role for government?

Governments' role in securing effective adaptation to climate change might include:

- managing climate change risks effectively in their own activities
- ensuring regulatory and policy frameworks do not impede private risk management
- correcting market failures (for example, by providing information and disaster-mitigation infrastructure) where the benefits to the community exceed the costs
- managing the distributional consequences of climate change for disadvantaged and vulnerable groups (box 4).

Where governments do not adequately fulfil these roles, adaptation may be less effective than it could be.

Box 4 Managing the distributional impacts of climate change

Some people have less capacity than others to adapt to the impacts of climate change. Disadvantaged groups may find it more difficult to identify the risks they face, and may have less capacity to manage those risks. In some cases, the impacts and resultant damages of climate change could exacerbate disadvantage.

The impacts of climate change are just one among an array of challenges likely to be faced by disadvantaged individuals and communities in the future. Structural adjustment associated with climate change will occur in the context of ongoing economic, social, political and technological change. Measures to alleviate disadvantage and manage distributional impacts should reflect the range of influences on disadvantage, rather than focusing on climate change adaptation alone.

This report proposes a range of reforms that are intended to improve the adaptive capacity of the community as a whole, including those people and groups with less capacity than others to adapt to climate change. For example, improving emergency management arrangements would lead to improved preparation for, response to, and recovery from extreme weather events, with benefits for many in the community.

In the main, the social security and tax systems — along with other standard adjustment measures (such as job search, placement and training services) — will be the most appropriate means of assisting the adjustment process and moderating adverse distributional effects. In the event of extreme climatic events, more targeted, temporary support measures would likely be important to complement the social safety net. However, care must be taken to avoid measures that diminish incentives for individuals and households to manage risk.

Climate change could pose risks to numerous government activities and agencies. To manage these risks effectively, governments need to ‘embed’ a consideration of climate change within their own agencies’ risk management frameworks (box 5). Climate change risks should be considered alongside other risks that government activities face, and managed in a way that is proportionate to the threats they pose (and the opportunities they present). For example, government-provided health services could come under increased pressure due to climate change. The best response is likely to be maintaining an appropriately-resourced, ‘fit-for-purpose’ health system, while monitoring and evaluating outcomes to ensure that health objectives are being met.

Box 5 Some local governments are already adapting

Local governments have an important role to play in managing the risks of climate change in local communities. In fulfilling this role, local governments face difficult decisions regarding selecting and implementing adaptation policies, funding policy responses and dealing with situations where policy responses have negative impacts on the broader community.

Some local governments have undertaken climate change risk and vulnerability assessments and developed adaptation action plans. A number of them have started to implement their plans. For example, Redland City Council (Queensland) developed an adaptation plan covering the period 2010–15 after an analysis of the climate change risks facing its local area. Specific actions include further analysis of risks, updating bushfire mapping and management plans, and investigating options to manage risks, including ‘planned retreat’. Local governments have generally consulted the community to form adaptation responses. For example, Clarence City Council (Tasmania) incorporated a community consultation process in its evaluation of climate change impacts on Clarence Council coastal areas, including public meetings and mail outs to all council-area households.

A number of local governments have commenced implementation of adaptation policies. These range from information provision to the construction of protective works such as seawalls to planned retreat policies. In some cases this has created considerable controversy within communities due to differing attitudes and values as to how local governments should manage sea-level rise, storm surge and coastal erosion. The Commission received a number of submissions from individuals and community groups angered by approaches taken by their local governments. In particular, in New South Wales local government areas there have been public protests where sea-level rise information has been placed on property contracts. Local governments have also faced legal action from property owners, for example, in Byron Bay where residents have challenged the council’s policy of planned retreat.

The experience of local government responses to climate change thus far illustrates the community sensitivities and challenges in developing effective climate change adaptation policies.

Governments also need to examine existing policy settings to determine whether they provide the right incentives for households, businesses and other organisations to manage climate change risks. This will involve assessing whether policies and regulations distort risk management decisions and whether a government response could improve the wellbeing of the community. For example, while individual property owners have an incentive to protect their buildings from natural hazards (such as floods, bushfires and coastal erosion), in some cases governments could improve outcomes by funding larger-scale disaster-mitigation infrastructure.

More broadly, adaptation to climate change is a form of structural change. The key lesson from past structural changes — such as from trade liberalisation, innovations in information technology and shifts in the terms of trade — is that a well-functioning, flexible economy is crucial to swift adjustment and ongoing prosperity in the face of change. Ensuring that there is sufficient flexibility in regulatory and policy settings will help build the capacity of households, businesses and communities to manage many of the impacts of climate change.

The existence of a barrier to effective adaptation only indicates that there is *potential* for governments to improve outcomes by removing or reducing the adverse effects of that barrier. In some cases, there may be little that governments can do to address identified barriers. In other cases, government policy may impose higher costs than the barrier itself.

Assessing reform options

Potential barriers to climate change adaptation have been identified, as have a number of policy options to address them. The challenge for policy makers is to identify the reforms that could reasonably be expected to increase the wellbeing of the community. These are the reforms that should be pursued as a matter of priority.

Options for addressing barriers to effective adaptation could include single actions or a range of measures. In all cases, options need to be considered on a case-by-case basis. This should include thorough cost–benefit analysis, with due consideration of equity and distributional effects, and the risks to the effective implementation of reform options. For each barrier, the reform option that is likely to deliver the greatest improvement in community wellbeing should be pursued. In some cases, the preferred option could be to make no change to existing arrangements.

Identifying options that will increase community wellbeing is complicated by a range of uncertainties. Uncertainty about the nature, timing, location and magnitude of many climate change impacts can make it difficult to quantify the benefits of a reform. More broadly, uncertainty about the state of the world in 50 or 100 years

further complicates the task of identifying reforms that will increase community wellbeing over time. Some changes (for example, demographic shifts) could exacerbate the impacts of climate change, while others could moderate them (for example, technological innovations).

However, uncertainty should not lead to inaction. This is reflected in the ‘precautionary principle’, which states that where there is a threat of serious or irreversible damage, a lack of certainty should not be used to justify postponing cost-effective measures to prevent damage. Nor does uncertainty obviate the need to clearly identify and quantify the benefits and costs of addressing barriers to effective adaptation on a case-by-case basis. Instead, the presence of uncertainty is one factor that should be considered when assessing whether reforms could reasonably be expected to increase community wellbeing.

Uncertainty can be incorporated into the assessment of reform options through ‘sensitivity analysis’ or ‘scenario planning’. These approaches involve making changes to key assumptions to examine how reform options would perform under a range of climate change scenarios. This is particularly applicable to adaptation, as some climate change impacts could emerge in a non-linear way, or be subject to ‘thresholds’ and ‘tipping points’.

The value of flexible options

Where the impacts of climate change are uncertain, flexible policy responses can be preferable to more rigid options. One way to assess the benefits and costs of various policy options and to help policy makers identify the best approach is ‘real options’ analysis. A real option is a decision taken today that makes it possible for policy makers to take a particular action in the future. For example, setting aside suitable land on the coast creates the option for a local government to build a seawall in the future, if rising sea levels make it necessary.

Where real options analysis has been applied in climate change adaptation, it has shown that there can be value in flexibility, although it is not always the case that a more flexible option will be a better choice. For example, it could be advantageous to delay implementing a policy until better information about the future is available. However, in other cases, less flexible (but more certain) options might deliver greater net benefits. Real options analysis also encourages decision makers to consider the benefits of reducing the level of uncertainty about climate change impacts (through research, or waiting to observe impacts over time).

Implementing reforms

As part of identifying reform priorities, it is important to consider whether there are risks that would affect the implementation and operation of reform options. The process of climate change adaptation will evolve over decades. As a consequence, reforms to address barriers to adaptation will need to be sustained if they are to achieve their objectives. Reforms that require ongoing commitment by governments and other parties could be vulnerable, particularly if they led to people eventually losing access to a benefit that they currently enjoy. Reforms that change long-standing policies, or affect existing rights and privileges, may require extensive preliminary work, a phasing-in period or both to ensure their acceptance and success.

Decision makers should consider whether reforms being contemplated might invoke ‘path dependency’ — a situation where a choice made today influences the range of choices that can be made in the future, potentially leading to a sub-optimal outcome. The potential for a reform option to lead to a given path of future decisions does not imply that it should be rejected. However, decision makers should be mindful of the potential long-term effects of their decisions, and how these are likely to influence community wellbeing over time.

Reform priorities

Reform priorities can be broadly categorised into two groups reflecting the nature of the risks to which they are responding — those related to the current climate and those related to the future climate. Reforms of both types that could reasonably be expected to deliver an improvement in community wellbeing have been identified in a range of policy areas, and across all levels of government.

The first group of reforms would improve the management of risks that arise from climate variability and extreme weather events that can have adverse effects today. Such reforms are likely to yield benefits in the short term, regardless of uncertainty about the future climate and assets at risk and their value. In addition, they are likely to build capacity to adapt to future climate change.

The second group of reforms would address barriers to adaptation to climate change impacts that are not causing significant damage today, but could lead to damage in the future (such as sea-level rise). In many cases, the timing and/or magnitude of these impacts are uncertain, and hence the benefits of reforms to address them are also uncertain. In these cases, it would be preferable to focus the reform effort on preparatory action, including research and community consultation. Where there are low-cost, reversible actions that can be taken to prepare for future climate change

— or low-cost ‘real options’ that allow scope for further action in the future — these should be considered. Case-by-case assessment of reform options should guide the decision-making process.

Economic reform to build the adaptive capacity of the community

Economic reform that responds to market failures or the unintended consequences of current policies could improve people’s capacity to manage climate risks. This includes reforms to taxes, transfers and regulations that affect the capacity of the community to respond to both the current climate and future climate change.

Taxes can impede effective climate change adaptation if they distort or delay adaptation decisions. Examples include taxes on property transfers (stamp duties) that can inhibit the movement of labour and capital and the efficient use of land, and state and territory insurance taxes and levies that can distort the ways in which households and businesses manage the risks they face. Replacing these inefficient taxes with less distortionary taxes, such as broadly-based land taxes, could enhance economic performance, as well as the community’s ability to respond to a changing climate.

Government transfers, in some instances, can reduce incentives for people to manage their own risks by taking adaptation actions. For example, inappropriate government support during drought reduces incentives for agricultural businesses to be self-reliant and impedes economic and social adjustment to changing circumstances. Implementation of the reforms recommended in the Commission’s 2009 inquiry into government drought support would enhance incentives for agricultural businesses to adapt to both the current and future climate.

Inappropriate regulation can increase the cost of adaptation, impede the mobility of workers and businesses, and limit the efficiency of markets. For instance, retail electricity price caps and restrictions on time-of-use pricing distort the price signals faced by consumers and affect adaptation decisions. Examples of the latter would include decisions to purchase and use air-conditioners, install insulation or double-glazed windows.

Improving the quality and coordination of information on natural hazards

Good information is essential for households, businesses and governments to identify, prepare for and manage the risks posed by a changing climate. In many cases, climate change will amplify existing risks, including natural hazards such as floods, cyclones and bushfires. Governments play a key role in producing, acquiring

and disseminating information on these hazards, both to undertake their own functions and to inform the broader community. For example, local governments require information on natural hazards to make effective land-use planning decisions, and households and businesses need this information to decide where to locate or how to protect their properties.

There is scope to significantly improve how information on natural hazards is provided. The Australian Government is currently developing guidelines for future flood mapping and is establishing a web-based portal (hosted by Geoscience Australia) through which flood maps held by all levels of government will be made publicly available. While this initiative is likely to benefit the community by making flood information more accessible, it should be expanded over time and regularly updated to cover other natural hazards. Where feasible, the guidelines should take into account the expected impacts of climate change. Regular consultation between providers and users of the information will be important to ensure that hazard maps are used effectively.

Continued government provision and funding of climate information

Governments already provide a range of information on climate change risks to the public. However, the extent of scientific knowledge and the costs of providing information mean there are limits to the amount of information that governments can acquire or provide. Public funding decisions for adaptation information and research will need to be made on a case-by-case basis and informed by the best available evidence.

Disseminating the information that governments have collected and used themselves will inform the public policy debate, as well as give individual non-government entities substantial platforms for making informed adaptation decisions. However, governments' involvement is only justified where there is a clear benefit for the wider community, including the use of information to support government functions (for example, natural hazard maps or local-area climate projections to inform local government decisions). In cases where there would be significant private benefits for individual households or businesses, they have an incentive to pay for the information.

Improving the effectiveness of local government management of climate risk

Local governments have an important role to play in managing the risks of climate change in local communities. They have responsibility for a broad range of local functions, and are likely to face significant exposure to risk as a result of climate

change. The Commission has identified several barriers to effective service delivery by local governments in the current climate.

- *The roles and responsibilities of local government are not always clear.* These include responsibilities for managing the risks of climate change, especially in the areas of emergency management and existing areas of settlement at risk from climate change, but also extend to many areas beyond adaptation. As a first step to clarifying these roles and responsibilities, state and territory governments should compile, publish and maintain a comprehensive and up-to-date list of laws that impose responsibilities on local governments.
- *Local governments have capacity constraints.* Shortages of professional and technical expertise, and financial constraints, are preventing some councils from planning for climate change and implementing effective adaptation actions. There is also inadequate information and guidance to support local government decision making. It is the responsibility of state and territory governments to ensure that councils have the capacity to fulfil their regulatory functions, including those that relate to climate change adaptation.
- *Legal liability concerns are hindering adaptation for many local governments.* For instance, some councils are reluctant to release information on the vulnerability of properties to climatic events because they are concerned that this could negatively impact property values or lead to legal disputes. In other cases, it may be the perception of legal liability that is hindering effective adaptation, rather than the underlying legal arrangements themselves. State and territory governments should clarify where legal liability for adaptation lies and the appropriate processes for councils to manage their liability.

Encouraging flexible land-use planning regulation

Land-use planning regulation in Australia has, until recently, been based on an assumption of a static climate with variable weather patterns. In recent years, as information has become more reliable, governments and regulators have begun to consider projected climate change impacts and potential related losses. However, the extent to which land-use planning frameworks incorporate expected climate change varies considerably by jurisdiction and type of hazard.

Where planning systems are modified to take climate change into account, regulations should:

- facilitate a risk management approach
- incorporate community consultation processes and take into account the community's acceptable levels of risk for different types of land use

-
- consider the costs and benefits of land use from a community-wide perspective.

A risk management approach to land-use planning would promote land-use planning policies and decisions that are robust across a range of climate change outcomes and are responsive to new information. This could include the use of real options, the regular monitoring of risks, and incorporating these risks into decision making by all levels of government. Such an approach needs to be integrated throughout the planning framework and supported through legislation, strategic planning documents, and local government schemes.

Provisions for a range of planning instruments to manage risks may also be necessary, including some potentially novel approaches for development approvals. For example, some local governments are trialling ‘time-bound’ or ‘trigger-bound’ tools (where approval for development can be given for a specified time period only, or until an identified event occurs — a ‘trigger’) so that land-use planning decisions better reflect climate change risk as it develops. For such tools to be implemented effectively at the local level, community consultation and appropriate support from state and territory governments is necessary.

While many state and territory planning frameworks advocate a risk management approach, by and large existing frameworks do not appear to explicitly or clearly support a range of flexible planning tools. Land-use planning systems are regularly reviewed and several state and territory governments are currently undertaking reviews of land-use planning settings. These review processes provide an opportunity to ensure that planning regulation is sufficiently flexible to respond to the impacts of climate change.

Developing approaches to managing climate risks to existing settlements

Climate change has the potential to expose many areas of existing human settlement to greater or unaccustomed risk. Examples include coastal areas subject to storm surge, riverine areas vulnerable to flood, or other areas facing significant bushfire risk. While most areas of existing human settlement will experience climate change impacts, the focus in this context is on areas that face significant risks or where the value of potentially affected assets is high.

Responding to these risks requires consideration of whether, how and when governments should ‘protect’ cities or towns, utilise measures that accommodate climate change impacts in existing settlements, or relocate communities from high-risk areas (box 6). Implementing a chosen mix of adaptation strategies is likely to cut across several areas of policy and raise issues of significance for all levels of government. Further, coordination across different levels of government will be

required to ensure that actions by governments or private individuals to manage climate change risks do not result in adverse impacts on other members of the community, or beyond a given community.

Box 6 Examples of local government ‘protect’, ‘accommodate’ and ‘retreat’ strategies in response to flood

‘Protect’ in Roma

The town of Roma suffered significant flooding in 2010, 2011 and 2012 with the resultant damage estimated at \$58.8 million. Roma was not protected by a flood levee during that time. Insurance company Suncorp has announced that it will not offer new policies to residents of Roma, and that premiums may rise for existing policy holders, until improved flood mitigation measures are implemented. Maranoa Regional Council is undertaking a *Flood Study and Mitigation Project* to consider options for protecting the town against future flood events, including constructing a levee (at an estimated cost of approximately \$9 million).

‘Accommodate’ in Lake Macquarie

Lake Macquarie City Council is currently updating its *Flood Risk Management Plan* in response to recent flood events and the risks of climate change. The Council has identified three categories of flood risk. Where development is proposed to be sited in an area at risk of flood, restrictions intended to ‘accommodate’ this risk will apply, including requirements for floor heights and setbacks from the lake. A consultation process undertaken by the council as part of developing the *Flood Risk Management Plan* indicated that 94 per cent of the 690 residents surveyed supported imposing such development conditions in areas at risk of flood.

‘Retreat’ in Grantham

In response to devastating floods in 2010 and 2011, the Lockyer Valley Regional Council introduced a ‘relocation policy’ in 2011. This policy allows eligible property owners to voluntarily swap their land for a new parcel of land located in a development area owned by the council (above the 2011 flood peak). The relocation policy is staged, with the initial stage open to members of the community from families that lost family members in the floods and those that experienced property loss. This program is scheduled for completion in June 2013, or once all land lots are allocated.

There is currently no well-established or coordinated policy approach to managing climate change risks to existing settlements. In particular, local governments lack a framework — developed at a state, territory or Australian Government level — within which they can formulate and implement locally-appropriate responses. While local governments will be responsible for implementing the majority of adaptation measures, they often lack the capacity to independently develop policy responses. Therefore, the development of a policy framework to manage climate

change risks to existing settlements will need to be supported by the Australian, state and territory governments, with extensive involvement by local governments.

As community attitudes to risk will inform the choice of adaptation responses, any policy approach needs to reflect the community's acceptable levels of risk. Further, it is likely that different levels of risk would be considered acceptable for private or public assets or for assets in different locations, and that these levels of risk will change over time, not least in response to community experience of climate change impacts.

Establishing community attitudes to managing climate risks is beyond the scope of this inquiry. The Commission considers that a further dedicated inquiry emphasising widespread community consultation is required to examine options for managing climate change risks to existing settlements, to consider the costs and benefits of each option, and to start to build consensus on preferred options. This inquiry should be commissioned by COAG and jointly sponsored by state and territory governments, with Australian Government support and extensive consultation with local governments and communities in a variety of locations. The inquiry should canvass the full range of community attitudes to risk for both private and public assets. The inquiry should then seek to identify the range of options to manage climate change risks to existing settlements, and establish clear roles and responsibilities for implementing adaptation policy for each level of government.

Drawing on the outputs of the COAG inquiry, each state and territory government should manage risks to their own assets and produce clear guidance for local governments in their jurisdictions on managing the risks faced by existing settlements. This reflects the important role of local governments in any response, and their need for appropriate support given the capacity constraints they face.

Incorporating climate change projections into the National Construction Code

Building regulation in Australia has traditionally been based solely on historical climate information. However, as the climate changes, the location, intensity and frequency of environmental hazards faced by buildings in Australia is expected to change. This may impact on the ability of building regulation to achieve its objectives — primarily relating to human safety, and the amenity and sustainability of buildings.

The Australian Building Codes Board has recently undertaken some work that considers the implications of climate change for building regulation. A more formal process for incorporating adaptation to climate change in the annual work program for the Board would provide a framework for monitoring projections of climate

change risks to buildings, and for incorporating these projections in the National Construction Code where this would result in a net benefit to the community. Such an approach should be transparent and formalised by the Building Ministers' Forum.

Aligning building and planning regulation

The vulnerability of people and buildings to climate change impacts will depend on how well building standards (which generally control how to build) and land-use planning regulations (which generally control where to build) are aligned in managing environmental hazards. In some cases, the distinction between building and planning regulation is blurred. For example, where local governments impose building regulation through local planning instruments, this can create duplication and overlap in regulation. In other cases, only one or neither system addresses a particular hazard (such as storm surge). A further problem can arise where both planning and building frameworks address a common environmental hazard (such as bushfire), but do not use the best available information to determine the location and level of risk. This can lead to gaps in the regulatory framework.

The importance of the interaction between land-use planning and building regulation is recognised in the National Strategy for Disaster Resilience. A range of work is underway under this strategy to examine how current planning and building frameworks interact to manage environmental hazards. Further, there have been moves towards delineating planning and building frameworks through 'gateway models'. Efforts to better align these regulatory systems would lead to benefits in both the current and future climate.

Improving emergency management arrangements

Improving the management of emergencies in the current climate will enhance the management of future risks as the intensity, frequency, duration or location of extreme weather events change. While the whole community has a role to play in managing emergencies, governments have a specific role of providing 'public goods' relating to emergency management. These include early-warning systems, disaster-mitigation infrastructure, and funding for emergency-response services.

There is considerable scope to improve both weather forecasting and flash flood warning systems in Australia. A recent review of the Bureau of Meteorology (the Munro review) has noted that a significant investment in computing capacity would enable the Bureau to provide more accurate forecasts of extreme weather events at a finer scale than is possible with existing computing resources. At the same time, the

existing system of providing warnings of flash flooding requires reform. The Munro review provides some possible responses to the issue of increased computer capacity and improved flash flood warning systems. Subjecting these proposals to appropriate cost–benefit analysis would be a useful next step in identifying preferred options.

Better coordination and clarification of the roles and responsibilities of emergency service providers would improve the effectiveness of emergency-response services. Reviews after recent natural disasters (including the Victorian bushfires and Queensland floods) have shown that roles and responsibilities are sometimes unclear or overlap, or there are gaps in coverage. While some state governments have commenced reform in this area, further work is required.

Effective emergency management also requires striking the right balance between preventing and preparing for disasters on the one hand, and responding to and recovering from them on the other. Over the past six years, Australian Government funding for disaster recovery was around \$6.7 billion. This figure, which does not include expenditures by local and state governments or households and businesses, is far greater than expenditure on the main federal programs funding disaster mitigation of around \$180 million. The contrast would be much larger if all recovery expenditure was included. For example, adding insurance losses and Queensland Government recovery expenditure to that of the Australian Government for Cyclone Yasi in 2011 and the 2010–11 Queensland floods alone gives a total in excess of \$10 billion. These may well be appropriate expenditure levels, but the discrepancy appears on the face of it to suggest current arrangements may not be achieving the right balance between these activities.

- *Disaster mitigation* — following recent natural disasters, concerns have been raised that both private and government prevention and preparedness actions have been inadequate, imposing significant costs on the community after a disaster has occurred.
- *Disaster recovery* — Australian Government funding of states' and territories' costs to rebuild infrastructure following a natural disaster — the Natural Disaster Relief and Recovery Arrangements — may be distorting the incentives that state and territory governments have to reduce their risks through disaster-mitigation measures. This could occur where states do not face the full cost of rebuilding infrastructure and thus may have reduced incentives to ensure that infrastructure is resilient to extreme weather events. This could be affecting the balance between disaster prevention, preparedness, response and recovery.

Improving the balance will require better coordination of how disaster-mitigation infrastructure is planned and funded, along with detailed planning that assesses all

options for managing emergencies, within a cost–benefit framework. The Australian Government should commission an independent public review of prevention and recovery arrangements, including the Natural Disaster Relief and Recovery Arrangements, along with funding mechanisms for disaster mitigation (including infrastructure), particularly through the National Partnership Agreement on Natural Disaster Resilience. The review should consult extensively with the community and all levels of government.

Managing the impacts of climate change on the environment

Climate change poses significant challenges for environmental management. Changes in temperature, rainfall patterns and carbon dioxide concentrations would likely alter or harm many ecosystems, habitats and species. In turn, this could affect the services provided by the environment, such as crop pollination and soil nutrient cycles. Some adaptation will occur naturally. However, there is a risk of irreversible damage to some ecosystems and the services they provide — such as the Great Barrier Reef and alpine environments — especially if ecological ‘tipping points’ are reached.

Managing these environmental impacts will be a key challenge for governments (in conjunction with landowners, Indigenous groups and others). Climate change is likely to alter the benefits and costs of the range of policies and strategies that governments typically use to manage the environment on behalf of the wider community.

There are a number of actions that governments can take to facilitate adaptation by natural environments. For example, reducing the range of pressures that ecosystems and species already face can improve their adaptive capacity. Similarly, reviewing the mix of strategies used to conserve biodiversity — such as natural reserves, wildlife corridors and agreements with landowners — can help to ensure that resources are allocated where the environmental protection payoffs are greatest.

While the best approaches will vary on a case-by-case basis, principles of good environmental management can guide governments’ decisions. In general, governments can facilitate adaptation by adopting clear governance arrangements, improving environmental knowledge, reviewing policy objectives to ensure they remain appropriate, and taking account of how the community values different environmental outcomes when making decisions. Flexible approaches that allow strategies to be adjusted when circumstances change will also offer value.

Minimising distortions to insurance markets

Insurance helps people to manage many of the climatic (and other) risks they face. By pricing risks, insurance also gives households, businesses and governments an incentive to reduce these risks. However, government intervention in insurance markets may mean that insurance premiums do not appropriately reflect the underlying level of risk. For example, state and territory taxes and levies on insurance distort the price signals that premiums provide. These taxes and levies should be phased out and replaced with other less distortionary taxes.

Other regulations may also distort the cost and availability of insurance, or impose costs on the community as a whole. The Australian Government should not proceed with its proposal to require insurers to offer flood cover to all households (while potentially allowing consumers to ‘opt out’) unless it can demonstrate that the benefits to the wider community would exceed the costs. Governments should also avoid subsidising insurance (for example, in flood-prone areas) as this would impose costs on taxpayers without reducing physical exposure to risks. Governments can best support the functioning of insurance markets by removing barriers in other areas, such as land-use planning (for example, only allowing development in areas that are well-documented as flood prone when appropriate disaster-mitigation infrastructure and/or strategies are in place) and the provision of natural hazard maps and disaster-mitigation infrastructure.

Who should implement adaptation reforms?

Implementing the reforms the Commission has identified will require action by all levels of government, and coordination across levels of government (table 1).

For the Australian Government, reform will require actions with several dimensions. The Government should seek to embed consideration of climate risks in the risk management practices of its own agencies. This could require facilitation by a single agency with relevant expertise, such as the existing Department of Climate Change and Energy Efficiency. However, it is important that agencies take a proportionate approach to managing climate change risks, drawing on other government resources. The Commission anticipates that this would be unlikely to require significant additional program funding.

In addition, the Australian Government will need to implement reforms that fall within the portfolio responsibilities of its agencies. For example, Geoscience Australia, the Bureau of Meteorology, the CSIRO and the Climate Commission would all have a role in improving the quality and availability of information about

the impacts of climate change and developing tools to assist the community to adapt.

Table 1 **Priority reforms by level of government**

	<i>Current climate risks</i>	<i>Future climate risks</i>
Characteristics	<i>Reasonably well understood</i>	<i>Uncertainty about timing, nature and/or magnitude of climate impacts and the assets at risk and their value</i>
Effective adaptation	<i>Take action today to improve risk management and build adaptive capacity</i>	<i>Begin taking preparatory actions</i>
Reform priorities		
All levels of government	<ul style="list-style-type: none"> • Embed consideration of current climate risks and future climate change in agencies' risk management practices • Pursue ongoing reforms to enhance flexibility and adaptive capacity, including to: <ul style="list-style-type: none"> – taxes that act as barriers to adaptation – regulations that inhibit adaptation – transfer payments that reduce incentives for businesses and households to adapt 	<ul style="list-style-type: none"> • The COAG Building Ministers' Forum should develop a work program to consider climate change projections in the National Construction Code • COAG should commission a separate inquiry to develop an appropriate response to managing climate change risks to existing settlements
Australian Government	<ul style="list-style-type: none"> • Review natural disaster prevention and recovery arrangements • Improve hazard mapping • Improve weather forecasting and flash flood warning systems • Reform transfers that impede adaptation (such as drought support) 	
State and territory governments	<ul style="list-style-type: none"> • Clarify the roles, responsibilities and legal liability of local governments • Better align building and planning regulation • Replace inefficient taxes (such as taxes on insurance and property transfers) with less distortionary taxes 	<ul style="list-style-type: none"> • Ensure land-use planning frameworks facilitate a risk management approach to responding to climate change impacts • Establish guidelines to support local governments to manage risks to existing settlements
Local governments	<ul style="list-style-type: none"> • Improve communication of hazard information to residents 	<ul style="list-style-type: none"> • Consider new planning instruments to flexibly manage climate change risks

As well as managing the risks of climate change in its own operations, the Australian Government should support the efforts of local, state and territory governments by addressing barriers to effective adaptation that are national in scale, or where a national or regional approach can be delivered more efficiently. This includes reforms to improve natural hazard mapping and the forecasting of extreme weather events.

An important role for state and territory governments is to ensure that local governments — which are created under state and territory legislation — have appropriate support and adequate resources to fulfil their functions. This includes providing clear state-level policy frameworks, clarifying the roles, responsibilities and legal liability of local governments, and ensuring that they have access to sufficient funding and technical skills to fulfil these roles and responsibilities.

Local governments will need to improve the communication of climate change information to local communities, particularly with respect to climate risks, and incorporate new land-use planning instruments into planning systems.

Some of the Commission's proposed reforms cut across portfolio responsibilities and levels of government. In these cases, effective reform will require coordination and agreement between levels of government, including in difficult and contentious areas of policy — such as managing risks to existing settlements — that require strong political leadership. The COAG Select Council on Climate Change and any successor should seek to progress action in these areas, with support provided by the Australian Government.

Recommendations

Assessing reform options and identifying priority reforms

RECOMMENDATION 5.1

Reforms to address barriers to effective climate change adaptation should be assessed on a case-by-case basis to determine whether they are likely to deliver net benefits to the community. This should include consideration of any risks to their implementation.

If there is a high degree of confidence that reforms will deliver net benefits, they should be implemented without delay.

If there is uncertainty about the net benefits of reform options, there could be a case for delaying implementation or adopting a flexible approach until decision makers have better information on the factors that affect their decisions, particularly if the up-front costs are large and the benefits are likely to be distant.

'No regrets' policies

RECOMMENDATION 6.1

Australian governments should implement policies that help the community deal with the current climate by improving the flexibility of the economy. This would also build adaptive capacity to deal with future climate change. This includes reforms to:

- *taxes that influence the way resources are used, such as land tax exemptions and conveyancing duty, which could inhibit the mobility of labour or capital*
- *government transfers that reduce incentives to adjust to changing circumstances, such as reforms to drought support as outlined in the Productivity Commission's 2009 inquiry*
- *regulations that impose unnecessary costs or inhibit competition or flexibility and could impede climate change adaptation by reducing the ability of businesses, households or other entities to respond to changing circumstances, such as restrictions to water trading.*

Information provision

RECOMMENDATION 7.1

The Australian Government initiative to improve the coordination and dissemination of flood-risk information should proceed in the most cost-effective way, be regularly updated and be expanded over time to encompass other natural hazards. Guidelines to improve the quality and consistency of risk information should also be regularly updated and take climate change into account where feasible.

Local government

RECOMMENDATION 8.1

To help clarify roles and responsibilities of local government for climate change adaptation, the state and Northern Territory governments should publish and maintain a comprehensive list of laws that delegate regulatory roles to local governments. This would assist both state and local governments to assess whether local governments have the capacity to discharge their roles effectively.

RECOMMENDATION 8.2

Local governments' uncertainty about their legal liability is a barrier to effective climate change adaptation. State governments should clarify the legal liability of councils with respect to climate change adaptation matters and the processes required to manage that liability.

Land-use planning

RECOMMENDATION 9.1

As a priority, state and territory governments should ensure that land-use planning systems are sufficiently flexible to enable a risk management approach to incorporating climate change risks into planning decisions at the state, territory, regional and local government levels. Consideration should be given to:

- *transparent and rigorous community consultation processes that enable an understanding of the community's acceptable levels of risk for different types of land use*
- *the timeframe of risks and the expected lifetime of proposed land use*
- *the costs and benefits of land use.*

State and territory governments should provide appropriate guidance to local governments to implement these provisions in local government schemes.

Building regulation

RECOMMENDATION 10.1

The Council of Australian Governments' Building Ministers' Forum should provide formal direction to the Australian Building Codes Board to:

- *monitor projections of climate change risks to buildings*
- *revise the standards in the National Construction Code to take into account these projections where this delivers a net benefit to the community.*

This body of work should be transparently and formally incorporated in the Australian Building Codes Board's annual work program.

Existing settlements

RECOMMENDATION 11.1

The Council of Australian Governments should commission an independent public inquiry to develop an appropriate response to managing the risks of climate change to existing settlements. The inquiry should:

- *explore, via extensive consultation with all levels of government and the community, in a variety of locations, the community's acceptable levels of risk for public and private assets*
- *identify the options available to manage climate change risks to these assets*
- *assess the benefits and costs of each option*
- *establish policy frameworks that can be applied by state, territory and local governments.*

State and territory governments should draw on the findings of the inquiry to:

- *manage risks to their own assets*
- *clarify roles and responsibilities for managing climate change risks for each level of government and the community*
- *provide appropriate support to local governments that face capacity constraints.*

Emergency management

RECOMMENDATION 13.1

The Australian Government should commission an independent public review of disaster prevention and recovery arrangements. This should be broader than the review currently being conducted by the Attorney-General's Department. The review should cover the Natural Disaster Relief and Recovery Arrangements, as well as the funding mechanisms for disaster mitigation, including the National Partnership Agreement on Natural Disaster Resilience. This review should:

- consider whether arrangements lead to inadequate disaster-mitigation infrastructure investments or insurance decisions, or reduce the incentives of state and territory governments to appropriately manage their risks*
- clearly outline the process for the identification of disaster-mitigation infrastructure needs, the provision and appropriate funding of this infrastructure, and the allocation of operational responsibilities*
- evaluate the adequacy of current arrangements for the provision of post-disaster assistance, including guidelines and processes for project evaluation and the criteria for approving and funding the betterment of essential public assets*
- consider the balance of resources devoted to prevention and preparedness relative to response and recovery through a cost–benefit analysis of reform options*
- involve extensive consultation with the community and all levels of government.*

The role of insurance

RECOMMENDATION 16.1

State and territory taxes and levies on general insurance constitute a barrier to effective adaptation to climate change. State and territory governments should phase out these taxes and replace them with less distortionary taxes.

RECOMMENDATION 16.2

The Australian Government should only proceed with reforms that require all household insurers to offer flood cover if it can be demonstrated that the benefits to the wider community would exceed the costs.

RECOMMENDATION 16.3

Governments should not subsidise household or business property insurance, whether directly or by underwriting risks.

1 Introduction

Australia's climate is changing and the weight of scientific evidence suggests that it will continue to change for the foreseeable future, notwithstanding global climate change mitigation action. Projections suggest that average temperatures will be higher, sea levels will rise, rainfall patterns will change and many extreme weather events will become more intense and/or more frequent. There is uncertainty about the timing, size and location of many climate change impacts, but it is clear that people will need to adapt to changing conditions.

Australia faces a significant task in adapting to the impacts of climate change. Adaptation will involve a diverse range of actions by households, businesses, governments, community groups and other organisations. Numerous adaptation actions will appear relatively modest (such as installing insulation in response to higher temperatures). Many will be undertaken autonomously and without the need for government intervention as people respond to the risks they perceive.

However, in some cases, the characteristics of markets, institutional and governance arrangements, government policies and the way people make decisions create 'barriers' to effective adaptation. Where this is the case, government intervention and policy reform have the potential to facilitate more effective adaptation by households, businesses or other organisations.

The Commission's task is to determine whether material barriers exist that are preventing effective adaptation, to identify high-priority reform options to address the barriers, and to examine the policy frameworks required to facilitate effective adaptation.

Australian and overseas adaptation policy frameworks

The Australian adaptation policy framework is a work in progress. Governments at all levels have roles and responsibilities in adaptation, and many have begun work on integrating climate change and adaptation into their existing risk management practices. To guide these efforts, governments have sought to develop high-level principles for climate change adaptation, identify priority areas for action and establish the roles and responsibilities of households, businesses, other organisations and each level of government (box 1.1). The Australian Government

has allocated significant resources to climate change adaptation, including \$126 million over five years from 2007-08 to 2011-12 to implement the *National Climate Change Adaptation Framework*.

It is difficult to assess whether the frameworks have led to more effective adaptation, and whether the significant resources devoted to adaptation have been well spent. For example, under the *National Climate Change Adaptation Framework*, an implementation plan was to be developed in 2007, with biennial reports on implementation and a full review in the fourth year. Neither the biennial reports nor the fourth-year review were undertaken. More recently, the Australian Government's 2010 position paper on adaptation, without an assessment of its effectiveness, appears to have been superseded by the Council of Australian Governments' (COAG) Select Council on Climate Change.

Box 1.1 Australian adaptation policy frameworks

In 2007, acting through the Council of Australian Governments (COAG), the Australian, state and territory governments agreed on a *National Climate Change Adaptation Framework*. The Framework was intended to guide action by jurisdictions over the following five to seven years. It identified two priority areas for potential action: building understanding and adaptive capacity, and reducing vulnerability in key sectors and regions.

In 2010, the Australian Government published a position paper *Adapting to Climate Change in Australia*. The paper 'sets out the Australian Government's vision for adapting to the impacts of climate change and proposes practical steps to realise this vision' (DCCEE 2010a, p. 1). The 'vision' for adaptation is based on a risk management framework, and includes discussion of the roles and responsibilities of households, businesses and governments.

In May 2012, the COAG Select Council on Climate Change held its first meeting. It released a number of documents, including a discussion paper setting out the principles for allocating climate-change risks and the roles and responsibilities of private parties and governments in adaptation (chapter 3). The Select Council on Climate Change has identified seven national priorities for adaptation action: water resources, coasts, infrastructure, natural ecosystems, agriculture, emergency management and vulnerable communities. The Select Council is due to provide a final report to COAG by 31 March 2013.

However, climate change adaptation has been incorporated into a number of Australian Government policy areas, including water, agriculture and emergency management. Some state and territory governments have enacted climate change legislation which includes provisions for adaptation, while others have adopted dedicated adaptation strategies (appendix B).

Governments of other countries have begun to address the challenge of climate change adaptation by enacting diverse policy frameworks and strategies (box 1.2). There are some recurrent themes, including risk management and a focus on providing information to facilitate adaptation. At an international level, the Cancun Adaptation Framework, to which the Australian Government is party, commits signatories to implement adaptation measures (appendix C).

Box 1.2 Selected countries' adaptation policy frameworks

United Kingdom

The UK Government has adopted an explicit legislative framework to support adaptation. Under the Climate Change Act 2008, the Government must assess climate change risks and implement strategies to manage these. Each central government department has published an adaptation plan that explains its proposed actions to deal with a changing climate. The UK Climate Impacts Programme disseminates a range of information and guidance, and large utilities and their regulators are required to report on how they are addressing climate change risks. Further, an Adaptation Sub-Committee has been established to advise the UK Government on adaptation policy.

United States

At the federal level, the US Government provides climate-related research and information, and requires federal government agencies to implement strategies to manage climate change risks. In addition, some state and local governments have adopted adaptation policy frameworks and strategies, which often set out how climate change will be considered in infrastructure, planning and environmental decisions.

New Zealand

The New Zealand Government provides information to facilitate adaptation, including some guidance for local governments. At the national level, there is no formal legislative or policy framework for climate change adaptation, although environmental legislation does require local governments to have particular regard to the effects of climate change.

Source: Appendix C.

1.1 The scope of the inquiry

The focus of this inquiry is on reforms to policy frameworks that address barriers to effective adaptation. The scope of the inquiry is broad. The Commission considered:

- both the long-term impacts arising from gradual climate change (such as changes in rainfall patterns) and the impacts of extreme weather events (such as storms, bushfires and floods)
- adaptation by people (individually and collectively) to the impacts of climate change and reforms that could support the adaptive capacity of ecosystems
- the effects of reforms on people in different areas (reforms that benefit people in one area could have negative effects on people in other areas)
- the effects of reforms on people with different levels of income and wealth
- the effects of reforms over time (because the impacts of climate change will take place over an extended period, the benefits and costs of reforms could accrue to future generations).

As specified in the terms of reference, the inquiry took into account relevant policies at all levels of government in Australia, as well as intergovernmental approaches (such as through COAG).

Defining ‘effective’ climate change adaptation

The terms of reference asked the Commission to ‘assess regulatory and policy barriers to effective adaptation’, but left the meaning of ‘effective adaptation’ open to interpretation. Adaptation to climate change refers to actions taken by households, businesses, other organisations, governments and communities in response to the impacts of climate change. It can include actions taken pre-emptively to reduce the risks of climate change impacts, or in response to impacts as they happen. Definitions of adaptation include adaptation by ecosystems as well as human societies, and some definitions emphasise that adaptation will involve taking advantage of opportunities, as well as responding to threats (IPCC 2007a; UNDP 2004).

In general, ‘effective’ refers to producing the desired result, suggesting that the definition of ‘effective adaptation’ depends on the objective of adaptation. The *Productivity Commission Act 1998* (Cwlth) directs the Commission to have regard to the need to achieve ‘higher living standards for all members of the Australian community’. Taking this as indicative of the overall objective of public policy, the

Commission has interpreted ‘effective adaptation’ to mean action taken in response to the potential or actual impacts of climate change that increases the wellbeing of the community, relative to what it would have been in the absence of adaptation. Wellbeing takes into account all of the positive and negative impacts of adaptation, the distributional impacts and the timing of the impacts. This definition of ‘effective adaptation’ can be contrasted with the concept of ‘maladaptation’, which refers to adaptation actions that ultimately leave the community worse off.

Inquiry participants expressed a range of views on the meaning of ‘effective’ adaptation. Some participants broadly agreed with the Commission’s definition, but emphasised that the effects of adaptation on the community and the environment, and the timing of adaptation, are important elements of effective adaptation (for example, Tasmanian Government, sub. 51). Several participants recommended that the definition of ‘effective adaptation’ should take into account the effects of adaptation actions on disadvantaged groups. For example, the Victorian Local Governance Association (sub. 3, p. 4) stated:

... interventions and strategies that disproportionately benefit those individuals or groups with the least capacity for taking action on their own will bring a higher overall net benefit to the community as a whole.

The Brotherhood of St Laurence (sub. 74) also emphasised the importance of considering marginalised groups, as did the Australian Institute of Aboriginal and Torres Strait Islander Studies (sub. 62), Good Shepherd Australia New Zealand (sub. 20), the NCCARF Adaptation College (sub. 21) and other participants.

Describing what an ‘effectively adapted’ Australia would look like

Some inquiry participants suggested that the Commission should try to describe a set of measures that might constitute ‘effective adaptation’. For example, Adaptive Futures (sub. DR95, p. 2) suggested that the Commission should convert the high-level objective of increasing community wellbeing into ‘a set of tangible objectives and potentially national adaptation Key Performance Indicators’. The Department of Climate Change and Energy Efficiency (sub. DR163, p. 1) suggested that the Commission should seek to identify a set of measures that ‘might look like’ effective adaptation to climate change. The Torres Strait Regional Authority (sub. DR152, p. 1) suggested that the Commission should develop principles for ‘adaptation indicators’ to evaluate whether measures are leading to effective adaptation.

The way the Commission has interpreted the term ‘effective adaptation’ recognises that, in principle, there is an ‘optimal’ level of adaptation. However, the Commission has not sought to describe what this optimal set of adaptation actions might look like in practice, for two reasons.

First, the task is not realistically achievable. Effective adaptation will come about through millions of actions undertaken by households, businesses, governments and other organisations responding to the impacts of climate change in ways that are suited to their individual circumstances. Varying degrees of uncertainty about the nature, timing, location and magnitude of climate change impacts makes it virtually impossible to identify the actions that will be required to effectively adapt (as well as when and where they should be taken) (chapter 2). Further, it is likely that the set of measures that might be considered ‘effective adaptation’ by one person would not be viewed that way by another.

Second, a vision of what an ‘effectively-adapted’ Australia ‘might look like’ is not necessary to achieve effective adaptation. Provided there are no systemic barriers preventing households, businesses and other organisations from managing the risks they face, they should be able to take effective adaptation action. Whether or not these actions align with a particular ‘vision’ of effective adaptation does not determine whether or not they constitute effective adaptation in practice.

Matters outside the scope of the inquiry

Some issues that were raised by participants are outside the terms of reference. In particular, most domestic greenhouse gas emissions-reduction policies are unlikely to constitute a barrier to adaptation to the impacts of climate change, and as such fall outside the scope of the inquiry. For example, the issue of how households will ‘adapt’ to higher electricity prices arising from a carbon price is beyond the inquiry’s scope.

On some mitigation issues, the boundary is less clear cut. For example, the global climate change mitigation effort will be relevant for adaptation in the sense that it could influence the degree and nature of the climate change to which people will have to adapt. Moreover, some actions will have dual benefits if they reduce emissions and contribute to effective adaptation. For example, measures to improve the health of ecosystems could lead to increased carbon sequestration and greater resilience to climate change impacts.

1.2 The Commission’s approach to identifying reforms

The overriding objective of the inquiry is to identify reforms that are likely to increase community wellbeing by addressing barriers to effective climate change adaptation. The Commission’s approach to identifying reform options followed a number of steps.

- Identifying the types of risks (and opportunities) that climate change could pose to community wellbeing (chapter 2).
- Setting out a general approach to managing climate change risks to wellbeing (chapter 3).
 - The process of risk management is well-established. Effective management of climate change risks (adaptation) would increase wellbeing compared to a situation where the community did not adapt.
- Considering whether there are cases where people will not be able to effectively manage the risks they face (chapter 4).
 - Households, businesses and other organisations will be able to manage many of the risks of climate change. However, in some cases the characteristics of markets, regulatory settings, governance and institutional arrangements and how people make decisions could act as ‘barriers’ that prevent people from effectively managing risks.
- Assessing the case for government intervention to address barriers.
- Identifying reform options that could address the barriers.
- Evaluating reform options to consider whether they are likely to deliver benefits that are larger than their costs (chapter 5).

A number of barriers and reform options have been identified across a range of policy areas. Some of the reforms that have been identified would have broad effects, would deliver benefits even if the climate does not change, and could enhance the community’s ability to deal with the impacts of climate change (such as tax reform and water policy reform) (chapter 6). Addressing barriers to the availability of relevant information would facilitate effective adaptation (chapter 7). Other chapters focus on particular sectors and policy areas, including local government (chapter 8), land-use planning (chapter 9), building regulation (chapter 10), existing settlements (chapter 11), the provision and regulation of infrastructure (chapter 12), emergency management (chapter 13), environmental management (chapter 14), the health system (chapter 15), and insurance (chapter 16).

The final chapter (17) summarises reform priorities, which can be broadly categorised into two groups.

- Reforms that remove barriers to effective risk management in the current climate, and constitute a good base on which to develop further adaptation responses as the climate changes in the future.
- Reforms to address climate change impacts that will arise gradually over time, such as sea-level rise. Where effective adaptation will require actions with long lead times, there is a case for commencing low-cost preparatory action today.

The report is supported by appendixes that describe Australian and overseas approaches to adaptation (appendixes B and C respectively), and the use of modelling tools in climate change and adaptation policy analysis (appendix D).

1.3 Conduct of the inquiry

The terms of reference for the inquiry were received from the Assistant Treasurer on 20 September 2011.

The inquiry was advertised in national newspapers, and promoted on the Commission's website. The Commission has consulted widely with stakeholders, drawing on input from participants through visits, roundtable discussions and written submissions (appendix A). The Commission released an issues paper in October 2011, and received 79 submissions prior to the release of a draft report on 27 April 2012.

Following the release of the draft report, the Commission received 89 additional submissions, and conducted further consultation with stakeholders. This included public hearings in Sydney, Melbourne, Adelaide and Canberra in July 2012.

The Commission is grateful to all inquiry participants for meeting with Commissioners and staff, participating in roundtables and hearings, making written submissions and providing other information to the Commission.

2 The challenges of climate change

Key points

- Australia has a long history of climate variability, but observations show that the climate itself is changing.
- Climate change is projected to lead to higher average temperatures, rises in sea levels and changes in rainfall patterns.
- Climate change is also expected to alter the frequency and intensity of extreme weather events such as heatwaves.
 - For many people, changes to extremes may be the most noticeable effects of climate change.
- The direction of these changes is often well established, but the magnitude, timing and geographic location of climate changes are subject to varying levels of uncertainty.
 - Key sources of uncertainty relate to scientific understanding of some of the complexities of the climate system and the future trajectory of greenhouse gas emissions.
- Changes to the climate are expected to have far reaching, diverse and complex impacts on industries, communities and the natural environment.
 - Modelling suggests unmitigated climate change will have a significant negative impact on the Australian economy, with agriculture and mining among the most heavily affected sectors.

Australia's climate is projected to change significantly over the next century. Average temperatures and sea levels are expected to rise and rainfall patterns to change. Extreme weather events such as heatwaves and droughts could also alter in intensity, frequency, location and duration.

These changes could have far reaching, diverse and complex economic, social and environmental consequences. While the direction of many of these changes is well understood, to varying degrees the magnitude, geographic location and timing of changes is less certain.

2.1 Australia's variable and changing climate

Eulogised by Dorothea Mackellar (2010, p. 3) as a land 'of droughts and flooding rains', Australia has a long history of dealing with climate variability and weather extremes. For example, the historical variability of Australia's rainfall significantly exceeds that of comparable locations around the world (Nicholls, Drosowsky and Lavery 1997). Farmers recognise drought as a normal feature of their operating environment, and many native plants and animals have evolved to cope with extended periods of low rainfall (BOM 2010; Botterill and Fisher 2003).

However, in addition to this high degree of natural variability, Australia's climate is changing over time. The CSIRO and the Bureau of Meteorology (BOM) (2007) note a warming trend since 1950 of 0.16°C per decade, an increase in the frequency of extremely hot days and nights, and a decrease in extremely cold days and nights.

Australian observations underscore global trends. Since the second half of the nineteenth century, global average surface temperatures have risen by approximately 0.8°C (IPCC 2007c). Researchers have also observed increases in ocean temperatures, widespread declines in ice caps and glaciers, and a net loss of mass from the Greenland and West Antarctic ice sheets (Climate Commission 2011c; IPCC 2007c). Reflecting these changes, global average sea levels are estimated to have risen by about 17 cm over the twentieth century (IPCC 2007c).

Scientists have identified strong links between these warming trends and greenhouse gas emissions from man-made sources. According to the Intergovernmental Panel on Climate Change (IPCC) (2007c), it is very likely that most of the increase in global average temperatures since the mid-twentieth century is due to increases in greenhouse gas emissions caused by human activities. As atmospheric concentrations of greenhouse gases continue to increase, the pace of climate change is projected to accelerate in the future.

2.2 Projected climate change for Australia

Projections of future climate change for Australia involve changes to a range of climate variables including average temperatures, precipitation and sea level.¹ As a

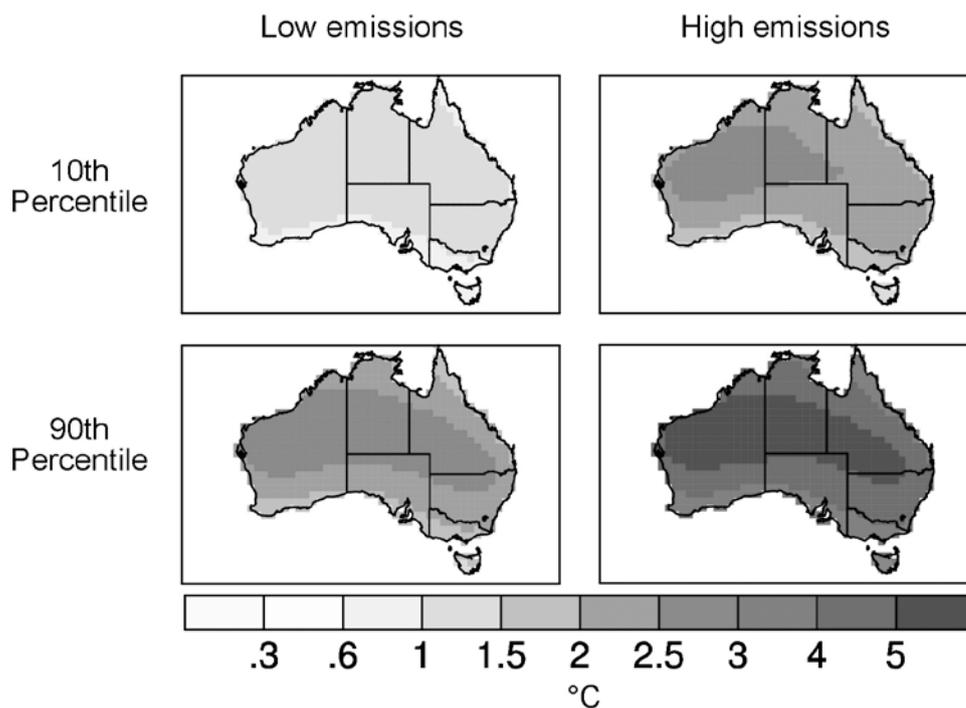
¹ Most climate change projections discussed in this section are drawn from the CSIRO and BOM's 2007 technical report *Climate Change in Australia*, which incorporates findings from the IPCC's Fourth Assessment Report. Projections for average temperatures, precipitation and sea level are presented for both 'strong mitigation' and 'no mitigation' scenarios. The former reflects the IPCC's 'B1' scenario based on an economically integrated world successfully pursuing a global

consequence of these changes, projections also indicate that the frequency and intensity of extreme weather events (such as heatwaves and hailstorms) will change.

Temperature

Average annual temperatures are projected to increase across Australia over coming decades. By 2070, the average temperature increase for Australia as a whole is projected to be between 1.0°C and 2.5°C under a ‘strong mitigation’ scenario, and between 2.2°C and 5.0°C under a ‘no mitigation’ scenario relative to 1990 (CSIRO and BOM 2007). The size of the temperature increase varies by location with inland areas generally projected to experience larger increases than coastal areas (figure 2.1).

Figure 2.1 **Projected temperature increase to 2070^a**
Annual average temperature increase relative to 1990



^a 'Low emissions' refers to the IPCC/CSIRO B1 scenario. 'High emissions' refers to the IPCC/CSIRO A1FI scenario. The 10th and 90th percentile refer to the lowest 10 per cent and highest 10 per cent of the spread of model results.

Source: CSIRO and BOM (2012).

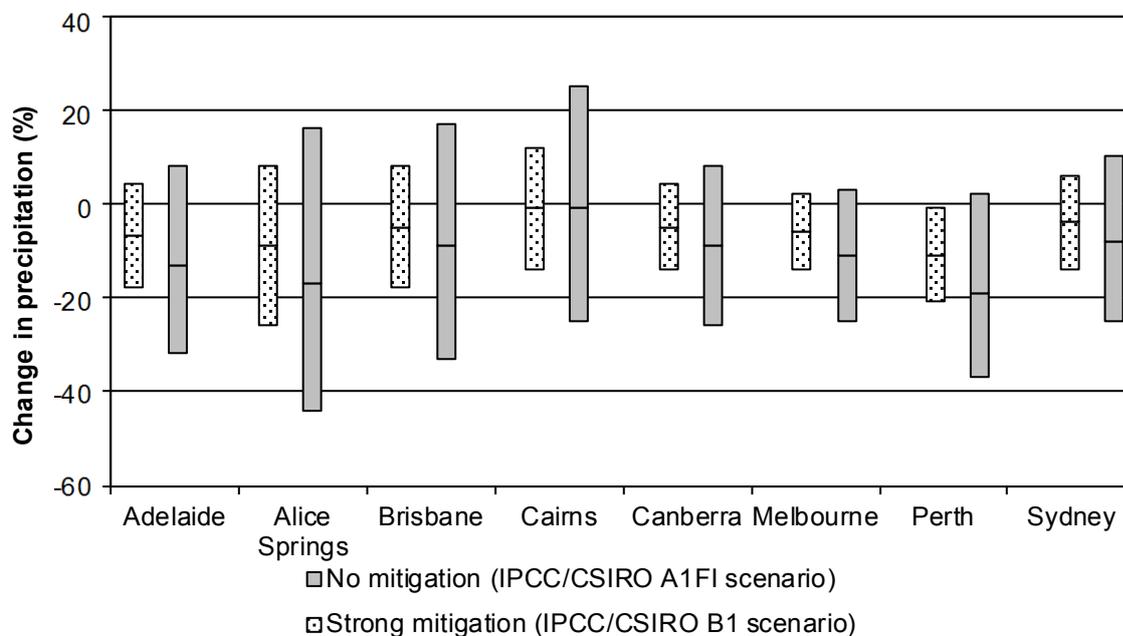
agreement to reduce greenhouse gas emissions. The latter reflects the IPCC's 'A1FI' scenario based on a world categorised by rapid and fossil-fuels intensive economic growth.

Precipitation

Precipitation is affected by factors such as wind patterns and retention of water vapour in the atmosphere, both of which are altered by rising atmospheric temperatures (CSIRO and BOM 2007). Changes in precipitation are less certain than changes in temperature as the relationship between greenhouse gas emissions and precipitation is less direct and more difficult to model.

Projected changes in average annual precipitation vary widely across Australia. In general, best estimates suggest little change in precipitation in the far north and decreases in precipitation across the rest of the country over the coming decades. The largest decreases in precipitation are projected for central and southern Australia regardless of the emissions scenario (figure 2.2). However, the range of estimates under each scenario is relatively wide, and it is not possible to rule out an increase in precipitation due to climate change in many locations. For example, the CSIRO and BOM (2007) project that the impact of climate change on precipitation in Cairns could range from an increase of 25 per cent to a decrease of 25 per cent by 2070 under a no-mitigation scenario.

Figure 2.2 **Projected change in precipitation to 2070^a**
Change in average annual precipitation relative to 1990 in selected cities



^a Each band represents the projected likely range of precipitation change for the given location and scenario. The midpoint of each band represents the best estimate of change in precipitation.

Source: CSIRO and BOM (2007).

Sea levels

Sea levels are projected to rise significantly over the twenty-first century. In the IPCC's Fourth Assessment Report (2007c), average global sea-level rise over the period from 1990 to 2100 was projected to be between 18 and 38 cm under a strong-mitigation scenario and between 26 and 59 cm under a no-mitigation scenario. Sea-level rise around Australia's coastline is expected to be in line with global average projections, though the rise along Australia's east coast may be higher (CSIRO and BOM 2007).

However, the contribution of melting ice sheets to future global sea-level rise is uncertain. The IPCC (2007c) noted that accelerated ice flow in Greenland and the West Antarctic could significantly increase the contribution of ice sheets to sea-level rise, increasing the upper bounds of the scenario ranges given above by between 10 and 20 cm. Several studies conducted after the release of the Fourth Assessment Report have also suggested significantly higher upper values for sea-level rise when a larger contribution from ice sheets is considered (CAWCR 2011). For example, Katsman et al. (2011) estimated that under a no-mitigation scenario, global average sea-level rise could be between 55 and 115 cm by 2100.²

Extreme weather events

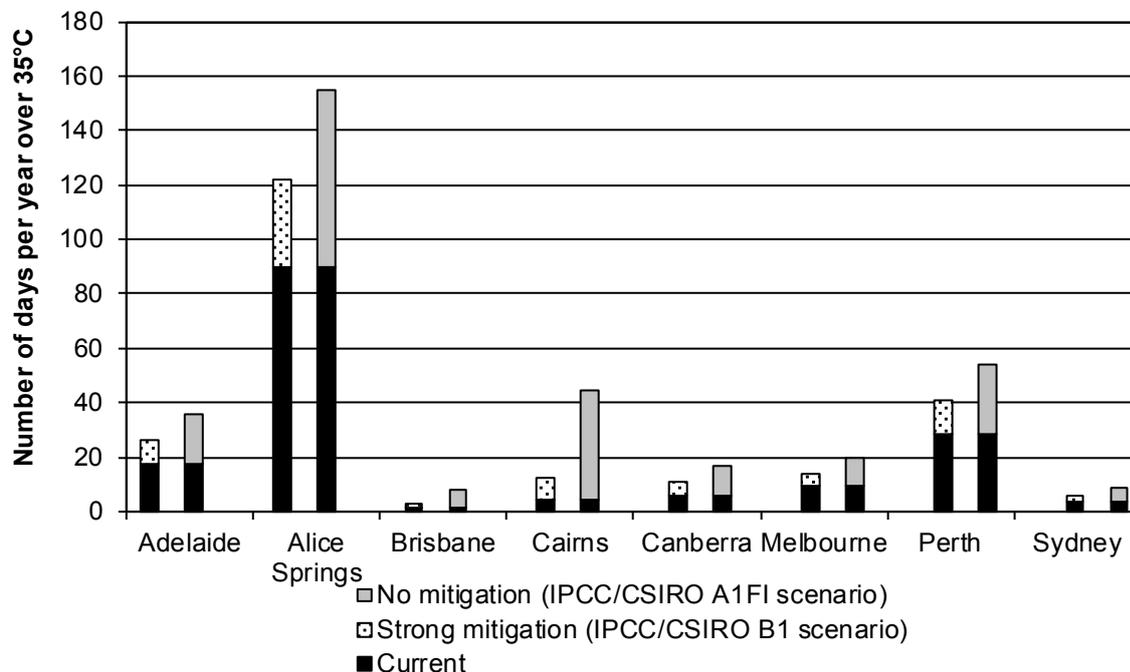
While some aspects of climate change will be experienced gradually over time, others may be felt more suddenly. Small changes in averages can translate into large changes in the probability of extreme values. Hence, small changes in the averages of climate variables are sometimes projected to lead to significant changes in the frequency of extreme weather events (IPCC 2007c; Katz and Brown 1992). For many people, the most noticeable impacts of climate change may come about through changes to the frequency and intensity of extreme weather events.

Extreme heat

The frequency of hot days (over 35°C) is projected to increase substantially. The size of the increase varies greatly by location (figure 2.3). The duration of heatwaves is also projected to increase (Alexander and Arblaster 2009).

² Katsman et al. (2011) assumed a global average temperature rise of 2–6°C by 2100. This range is roughly in line with, but slightly wider than, the IPCC A1FI scenario range.

Figure 2.3 **Projected frequency of days over 35°C per year in 2070^a**
Selected cities



^a Columns show the best estimate for the average number of hot days per year under each scenario.

Source: CSIRO and BOM (2007).

Extreme precipitation

In general, future precipitation is projected to be characterised by ‘longer dry spells interrupted by heavier precipitation events’ (CSIRO and BOM 2007, p. 73). However, precise projections of extreme rainfall are difficult due to the indirect relationships between climate change and precipitation. Projected changes in the intensity of extreme precipitation events also vary by location and season. Using a moderate estimate of future emissions, projections by the CSIRO and BOM (2007) suggest increases in annual extreme precipitation to 2050 are greatest in the far north of Australia, where average precipitation is little changed. However, the intensity of extreme precipitation increases over Tasmania and parts of Victoria and central Australia, while average precipitation is projected to decline in these areas.

Drought

Climate change is likely to affect the frequency of drought differently across regions. Using a soil-moisture measure of drought³ that reflects rainfall and evaporation, Mpelasoka et al. (2008) estimated the impact of climate change on drought using a range of climate models. Results suggest changes in the frequency of drought ranging from negative 20 per cent to positive 80 per cent by 2070 relative to present conditions, depending on location and the trajectory of future emissions. The largest increases in drought frequency are projected to take place in south-west Australia.

Bushfire weather

As much of Australia becomes hotter and drier, the risk of bushfire is projected to increase. A common measure of the risk of bushfire is the McArthur Forest Fire Danger Index. The index takes into account factors such as temperature, wind speed, humidity and fire-fuel availability, and is commonly represented as a fire danger rating ranging from ‘low’ to ‘extreme’. Analysis by Lucas et al. (2007) suggests the number of very high or extreme fire danger days is likely to increase significantly in most locations across south-east Australia. For example, in Melbourne, the number of these days is expected to increase from the current average (1973–2007) of 9.0 per year to between 9.8 and 11.1 by 2020 and to between 10.8 and 14.7 per year by 2050.

Hailstorms

The impact of climate change on hailstorms is difficult to forecast as storms are not captured by most global and regional climate models. However, analysis of conditions known to be favourable to hailstorms indicates that the frequency of hail is likely to decrease (perhaps by 1 to 2 days per year) along the southern coast of Australia and increase (perhaps by 4 to 6 days per year) along the eastern coast of Australia by 2070 relative to 1990 (CSIRO and BOM 2007).

The intensity of hailstorms may also be affected by climate change. Modelling of hailstorms over Sydney suggests that the frequency of storms with large hail could significantly increase. For example, using a moderate scenario for future emissions, the likelihood of hail with a diameter of 6 cm or more could increase from once

³ Soil moisture is just one of many possible measures of drought. Soil-moisture deficiency is most closely related to ‘agricultural’ and ‘hydrological’ definitions of drought. Drought may also be defined and measured solely in terms of rainfall (‘meteorological’ drought) or in terms of the effects on human wellbeing (‘socio-economic’ drought) (Hennessy et al. 2008).

every eight years to once every five years by 2050 (Leslie, Leplastrier and Buckley 2008).

Storm surge and coastal flooding

A storm surge refers to a temporary elevation of sea level in a particular region due to a combination of strong winds and falling atmospheric pressure (CSIRO and BOM 2007). Coastal flooding due to storm surge is likely to increase significantly with climate change as sea levels rise, because increases in average sea level have a ‘multiplier effect’ on the frequency of high sea-level events including those due to storm surge. While the timing and magnitude of future sea-level rise is uncertain, given a sea-level rise of 50 cm, sea-level heights that have historically occurred once every ten years could occur roughly once every ten days on average (Church et al. 2008).

Cyclones

Projections for tropical cyclones vary, reflecting a range of uncertainties about regional climate change and the tropical cyclone response (Grossmann and Morgan 2011). Researchers generally agree that an increase in the intensity of cyclones is likely, but that the overall impact on cyclone frequency is less clear (Abbs 2009; Leslie et al. 2007; McGregor, Walsh and Nguyen 2004). Simulations by Abbs (2009) suggest a substantial decrease in the frequency of tropical cyclones, a slight decrease in the duration of cyclones and a southward shift of cyclone activity across Australia by 2070. However, earlier studies focused on the east coast of Australia projected little to no change in cyclone frequency during the first half of this century (Leslie et al. 2007; McGregor, Walsh and Nguyen 2004).

2.3 The impacts of climate change

The consequences of climate change for life in Australia are likely to be numerous and diverse, posing threats and opportunities for households, businesses, communities and governments. For example, climate change will affect the yields and quality of agricultural outputs (table 2.1), fishery stocks (box 2.1), the productivity of forestry plantations and the viability of alpine and nature-based tourism (Garnaut 2008b). Changes to extreme weather events could also threaten public and private buildings and infrastructure.

Table 2.1 The impacts of climate change on agriculture

<i>Commodity or industry</i>	<i>Impacts</i>
Wheat	<ul style="list-style-type: none"> • The quality of grain is expected to fall as a result of higher average temperatures, increased carbon dioxide levels and heat stress. • In the medium term, yields are likely to increase in most regions due to higher carbon dioxide levels. • In the long term, yields may increase or decrease depending on the degree of warming that takes place.
Sugarcane	<ul style="list-style-type: none"> • In growing regions from northern New South Wales to central Queensland, higher average temperatures may allow for longer growing seasons, but increase pressure on already limited water availability. • In growing regions further north (northern Queensland), stronger winds and more intense cyclones may increase crop damage. • In some northern growing regions, reduced winter and spring rain may improve access for harvest equipment, but heavier rainfall during the wet season may also reduce paddock access during the growing season.
Cotton	<ul style="list-style-type: none"> • Reduced water availability and increased evaporation may reduce yields. • Higher average temperatures may allow for longer growing seasons but increased heat stress could reduce yield and quality.
Rice	<ul style="list-style-type: none"> • Reduced water availability is expected to reduce rice yields. • The impacts of higher average temperatures and carbon dioxide levels are less clear.
Horticulture	<ul style="list-style-type: none"> • Higher average temperatures may lengthen growing seasons and yields for some horticultural crops but also reduce the quality of others. • Warmer winters may increase the areas suitable for some crops. • More very hot weather may cause sunburn for some fruits and vegetables. • Inadequate chilling due to higher average temperatures could reduce the proportion of years suitable for growing stone fruits. • Pests, diseases and weeds may have a greater impact in southern regions as higher average temperatures allow for southward movement.
Viticulture	<ul style="list-style-type: none"> • Wine grape quality is likely to fall as higher temperatures bring forward harvest dates to hotter months and salinity increases. • Reduced differences in harvest dates between different varieties could place increased pressure on harvesting logistics. • Higher average temperatures and carbon dioxide levels may increase yields. • The geographic area of Australia suitable for growing quality wine grapes is likely to decline in size.
Broad-acre grazing	<ul style="list-style-type: none"> • In some regions, increased carbon dioxide may benefit pasture productivity but in others a lack of rainfall will inhibit these positive effects. • Increased forage production is likely to be offset by reduced forage quality. • Changes in rainfall patterns may reduce pasture productivity indirectly via increased soil erosion. • More hot weather could increase heat stress, reducing livestock productivity and decreasing reproductive rates, particularly in northern Australia.
Intensive livestock	<ul style="list-style-type: none"> • Increased heat stress could reduce the productivity of livestock. • Higher temperatures may increase energy use for cooling production sheds. • Warming and drying may have some beneficial impacts for the dairy industry in cooler regions.

Sources: Anderson et al. (2008); Crimp et al. (2008); Stokes and Howden (2008).

These direct economic impacts will flow through to households, businesses and governments, imposing new costs, changing the prices of goods and services, and affecting incomes, asset values and employment prospects across different industries. Overall, studies suggest that unmitigated climate change will have a significant negative economic impact (box 2.2).

Box 2.1 The impacts of climate change on fisheries

Fisheries are affected by a variety of climate changes including increases in sea surface temperatures, increase in surface winds, changes in current speeds, decreased rainfall in some areas, increased frequency and intensity of storms, sea-level rise, ocean acidification due to increased carbon dioxide levels and reduced sea ice.

In some areas these changes may result in reduced catches of certain species. For example, prawn, barramundi and mud crab catches in fisheries off the north coast of Australia are likely to be adversely affected by changes in rainfall. In other areas, there may also be some positive effects. For instance, in fisheries off the south-east Australian coast, fish such as tropical tuna may increase as the ocean current strengthens and shifts further south. There are also a large number of areas where impacts are uncertain. For example, in fisheries off the coast of Western Australia, the impact of a weakening ocean current for the rock lobster industry is not yet well understood.

Fisheries are also expected to feel a number of indirect impacts. Increased extreme weather such as storms may increase the cost of fishing, and changes in fish stock distributions internationally may alter demand for Australian products and could lead to the renegotiation of international fishing agreements.

Sources: ABARE (2008); Hobday, Poloczanska and Matear (2008).

The potential impacts of climate change are not limited to the economic sphere. There are also health and environmental impacts, with implications for community wellbeing and government management of health, emergency and environmental services. Climate change could lead to increased fatalities and mental health problems arising from extreme weather events, increased incidence of heat-related illness and death, increased transmission risks for mosquito-borne infectious diseases such as dengue fever (chapter 15) and a wide variety of significant impacts for ecosystems (box 2.3 and chapter 14).

The impacts of climate change for households, businesses and governments will vary by location and over time. For instance, the wheat industry is sensitive to a range of climatic factors and the overall impact of climate change on yields reflects the interaction of these factors. Recent analysis suggests that wheat yields can be expected to increase in most regions over the medium term (2030). However, over the longer term (2100) the projected impacts vary widely from region to region.

Localised changes in temperatures and rainfall patterns mean that yields could significantly increase in some regions and significantly decrease in others, with flow-on effects for local communities and economic activity (Crimp et al. 2008).

Box 2.2 Modelling the economic impacts of climate change

A number of studies have attempted to model the economic impacts of climate change. Estimates from global studies vary widely reflecting differences in modelling assumptions. Global GDP in 2100 is estimated to be somewhere between 1 per cent and 11 per cent lower with unmitigated climate change than with no climate change.

For Australia, Garnaut (2008b) and Gunasekera (2008) estimated that in 2100, GDP will be 5–6 per cent lower with unmitigated climate change than with no climate change.

Garnaut (2008b) also estimated the expected impact by industry and state. While output is expected to fall for most industries, the modelling suggests that the two most heavily affected industries are likely to be agriculture (a 20 per cent fall in output by 2100) and mining (a 13 per cent fall in output by 2100).

The most heavily affected states and territories in 2100 were estimated to be Queensland, the Northern Territory and Western Australia (with gross state product 9–10 per cent lower). The timing of the impacts also varies by state — for example, net impacts were estimated to be relatively minor for Western Australia in the early part of the century, due to its large wheat sector (which is expected to benefit from climate change initially).

Source: Appendix D.

Box 2.3 The impacts of climate change on ecosystems

Climate change entails a wide variety of threats to ecosystems, often exacerbating existing environmental problems. Direct and indirect threats include extended droughts, more prevalent invasive weeds and pests, altered fire regimes, direct temperature effects, increases in salinity and changes in water availability. Areas of the greatest biodiversity such as south-west Western Australia and the wet tropics of far north Queensland are expected to be the most severely affected.

Marine ecosystems are also particularly vulnerable to climate change. For example, mass coral-bleaching events at the Great Barrier Reef are likely to occur more frequently than in the past even if strong mitigation proceeds. If climate change continues unabated, the Great Barrier Reef is likely to be altered markedly as coral reefs deteriorate and many fish populations decline.

Sources: Australian Centre for Biodiversity (2008); CAWCR (2011); GBRMPA (2009).

The potential impacts of climate change are not just diverse but also complex. A vast array of interdependencies exist between different sectors of the economy, society and the natural environment. This complexity means that, for a given climate change impact, the indirect effects for households, businesses and governments may be difficult to predict.

The interdependencies of critical infrastructure (many elements of which may be potentially impacted by climate change (box 2.4)) illustrate this point. For example, an extreme weather event causing a large-scale disruption to electricity supply could have knock-on effects for telecommunications infrastructure and transportation systems. In turn, this could limit communications and transportation access, making it more difficult for emergency services to respond to the original extreme weather event and for victims to access hospitals.

Box 2.4 The impacts of climate change on critical infrastructure

Infrastructure for an array of critical services may be affected by climate change via increases in the frequency and/or intensity of extreme weather events, higher sea levels, higher temperatures and decreased rainfall. Critical services potentially affected include electricity, water supply, sewage treatment, telecommunications, water management and transportation. Facilities for various public services such as parks, hospitals and defence buildings may also be impacted.

Over the long term, sea-level rise coupled with high sea-level events such as storm surges could also have particularly significant implications for coastal settlements. At one end of the spectrum, the Department of Climate Change and Energy Efficiency estimated that a very high sea-level rise of 1.1 metres coupled with a high sea-level event could place more than 100 000 residential, commercial and industrial buildings at risk of inundation or erosion.

Sources: DCC (2009b); DCCEE (2011); Maunsell Australia (2008a, 2008b, 2008c).

Managing impacts is also complicated by the possibility of ‘coincident’ events with compounding impacts (CSIRO, sub. DR136). This could include two or more extreme weather events occurring simultaneously or successively, combinations of extreme weather events that are mutually reinforcing, or combinations of events that are not themselves extremes but have extreme impacts when combined (IPCC 2012). For example, the simultaneous and successive extreme weather events that occurred during 2010 and 2011 including floods in Queensland and Victoria, tropical cyclones in the Northern Territory, Queensland and Western Australia and bushfires in Western Australia (while not necessarily directly attributable to climate change) stretched the capacity of the Bureau of Meteorology (chapter 7).

2.4 Climate change uncertainty

A key challenge of climate change is dealing with uncertainty (box 2.5). Uncertainty is an inescapable aspect of making projections about the future, and the further into the future that impacts are projected, the greater the uncertainty about what those impacts will look like.

Box 2.5 What is uncertainty?

Uncertainty means different things to different people. Many academic disciplines have developed their own meanings and systems of classification for uncertainty (Thunnissen 2003). Consequently, the way in which estimates of uncertainty are presented in the inter-disciplinary field of climate change is the subject of much debate (Dessai and Hulme 2004). As the IPCC (2007a, p. 131) noted:

Communicating about risk and uncertainty is difficult because uncertainty is multi-dimensional and there are different practical and philosophical approaches to it.

Economists commonly draw a distinction between 'risk', to define a situation where an outcome is unknown but the likelihood of different outcomes can be quantified, and 'true uncertainty', where an outcome is unknown and the likelihood of different outcomes is not measurable (Dr Leo Dobes, sub. 63; Knight 2002). Many of the uncertainties in climate change fall somewhere in between these two definitions. Climate models can often be used to estimate the likelihood of different outcomes, but estimates from different models do not always agree due to differences in underlying data or assumptions. Hence, the likelihood of different outcomes can often be estimated, but the estimates of likelihood are themselves subject to uncertainty.

Some researchers also distinguish between reducible uncertainty that results from incomplete knowledge about the processes that influence events ('epistemic uncertainty') and irreducible uncertainty that results from the inherently unpredictable nature of human and natural systems ('stochastic and reflexive uncertainty'). Many climate change uncertainties arguably fall into the latter category, including future greenhouse gas emissions which are dependent on human behaviour, and aspects of the climate system which are chaotic in nature (Dessai and Hulme 2004; Walker et al. 2003). In other words, some aspects of climate change uncertainty may be reduced over time through further scientific research and observation, but others may be unknowable and hence irreducible.

Not all aspects of climate change are subject to the same degree of uncertainty. In many cases, the *direction* of changes to the climate is well established. As the CSIRO (sub. DR136, p. 4) notes:

... especially at a local scale — increases in maximum temperatures, heatwaves, fire weather conditions, minimum temperatures, ocean temperatures, ocean acidity, atmospheric CO₂ concentration, sea level and others all have an assured direction of change.

It is also increasingly clear from academic literature that there is little chance of avoiding an increase in global average surface temperature of at least 2.0°C above pre-industrial levels by 2100 (CSIRO, sub. DR136). For example, analysis by Arora et al. (2011, p. 6) suggests limiting warming to two degrees with a high likelihood would require ‘an immediate and rapid ramp down of [global] emissions followed by negative [global] emissions (sequestration) in the latter half of this century’. Other recent studies have reached similar conclusions (Anderson and Bows 2011; Rogelj et al. 2011).

To varying extents, uncertainty is greater with regard to the *timing, geographic location* and *magnitude* of changes to the climate and their social, economic and environmental impacts. Key sources of uncertainty include:

- the future trajectory of greenhouse gas emissions (which will be affected by the degree to which global mitigation is effective)
- the impact of feedback loops on the carbon cycle⁴
- the sensitivity of the global climate to greenhouse gas emissions
- how global climate change will translate to regional climates
- how regional climate change will affect individuals, firms and governments taking into account their ability to respond and adapt.

While climate models can estimate the minimum magnitude of change over the twenty-first century for some climate-related variables (such as sea level) (CSIRO, sub. DR136), the possibility of climate ‘tipping points’ and ‘abrupt’ change means that maximum changes are often harder to estimate (box 2.6).

More broadly, uncertainty about the future state of the world leads to uncertainty about how climate change impacts (and adaptation to the impacts) will affect future community wellbeing. For example, it is reasonable to assume that over the next century demographics will change, new technologies will be developed and patterns of trade will shift in ways that are difficult to predict. Some of these changes could exacerbate the future impacts of climate change, while others could moderate them.

⁴ The carbon cycle refers to the continual exchange and recycling of carbon through different parts of the Earth system including the atmosphere, the oceans, vegetation, and the organic matter in soil and sediments (including fossil fuels) (NOAA 2009). Carbon uptake by land and oceans is driven by physical and chemical processes, such as photosynthesis and oceanic circulation, which are affected by changes in climate and atmospheric carbon dioxide concentrations, creating a range of feedback loops (Field and Raupach 2004).

Box 2.6 Tipping points and abrupt climate change

Scientists have identified many examples of possible ‘tipping points’ in the earth’s climate. Passing tipping points could cause abrupt and possibly irreversible changes to the climate.

One well-known example is the possible disintegration of the Greenland Ice Sheet. Ice sheets may exhibit a non-linear response to temperature change due to a number of positive feedback processes. For example, water and land are less reflective of solar radiation than ice. As the melting of ice sheets exposes more land and water, more solar radiation is absorbed rather than reflected, increasing local warming and accelerating melting. Consequently, the complete melting of the Greenland Ice Sheet could be irreversible above a critical temperature threshold. This temperature threshold may be exceeded this century (IPCC 2007c).

If the Greenland Ice Sheet were to melt entirely, this would raise sea levels by about seven metres. However, it is important to note that the term ‘abrupt’ is used to mean ‘non-linear’, not ‘instantaneous’. Even under worst case scenarios, the complete melting of the Greenland Ice Sheet is estimated to take centuries (IPCC 2007c; Lenton et al. 2008).

Other possible tipping points that could lead to abrupt climate change include (but are not limited to) the collapse of the West Antarctic Ice Sheet, large-scale changes to ocean circulation systems, and the intensification of the El Niño-Southern Oscillation (a climate pattern that affects temperatures and rainfall in many parts of the world, including eastern Australia). The IPCC (2007c) considers that these abrupt changes are not likely to occur this century. However, not all tipping points are well understood and climate models often differ about the possibility of low-probability, high-impact scenarios (IPCC 2012; Lenton et al. 2008).

There also remains the potential for unanticipated tipping points — climate change ‘surprises’. Surprises are distinguishable from regular uncertainty because they refer not just to a lack of certainty about an outcome but to a lack of knowledge about the existence of an outcome (Stirling 2003). Climate change is susceptible to surprises because of the complexity and non-linearity of the climate system, incomplete understanding of that system, and the rapid rate of climate ‘forcing’ (that is, the increasing concentration of greenhouse gases) (Schneider 2004).

3 Adapting to a changing climate

Key points

- Adaptation involves actions to manage the impacts of climate change that are not avoided through climate change mitigation.
 - The size of the adaptation task will depend on the extent of global greenhouse gas emissions and the success of current and future mitigation efforts.
 - However, some significant adaptation is inevitable — some climate change is ‘locked in’ due to past emissions.
 - Unlike mitigation, which requires a global response, most climate change adaptation can occur locally.
- Adaptation could reduce the costs of climate change, but adapting to a changing climate also involves costs.
 - It may be too costly or difficult to adapt quickly to some climate change impacts.
- Adaptation is about effectively managing the risks of climate change.
 - Households, businesses and governments already face a wide variety of risks — climate change is one of the many risks that need to be taken into consideration.
 - Climate change risks are usually best managed within a broader risk management process.
- There are many ways to address climate change risks and many examples of risk management already underway that could be described as ‘adaptation’.
 - However, determining the extent of adaptation activity across Australia, and evaluating whether this is ‘too much’ or ‘not enough’, is problematic.
 - Specific adaptation measures can be difficult to identify. Risk management decisions are made for a variety of reasons, and households and businesses may differ in the choices they make.
- Effective adaptation requires an appropriate balance between the roles played by households and businesses, and those played by government.
 - In most cases, the costs and benefits of decisions to manage climate change risks are felt privately. This means that households and businesses have incentives to take adaptive action and manage the risks they face.
 - Governments have a role to play where climate change poses risks to government activities, where the goods and services necessary to facilitate adaptation are underprovided by the market, where regulatory and policy frameworks are necessary to manage adaptation decisions that affect the wider community and where there is a need to protect the vulnerable.

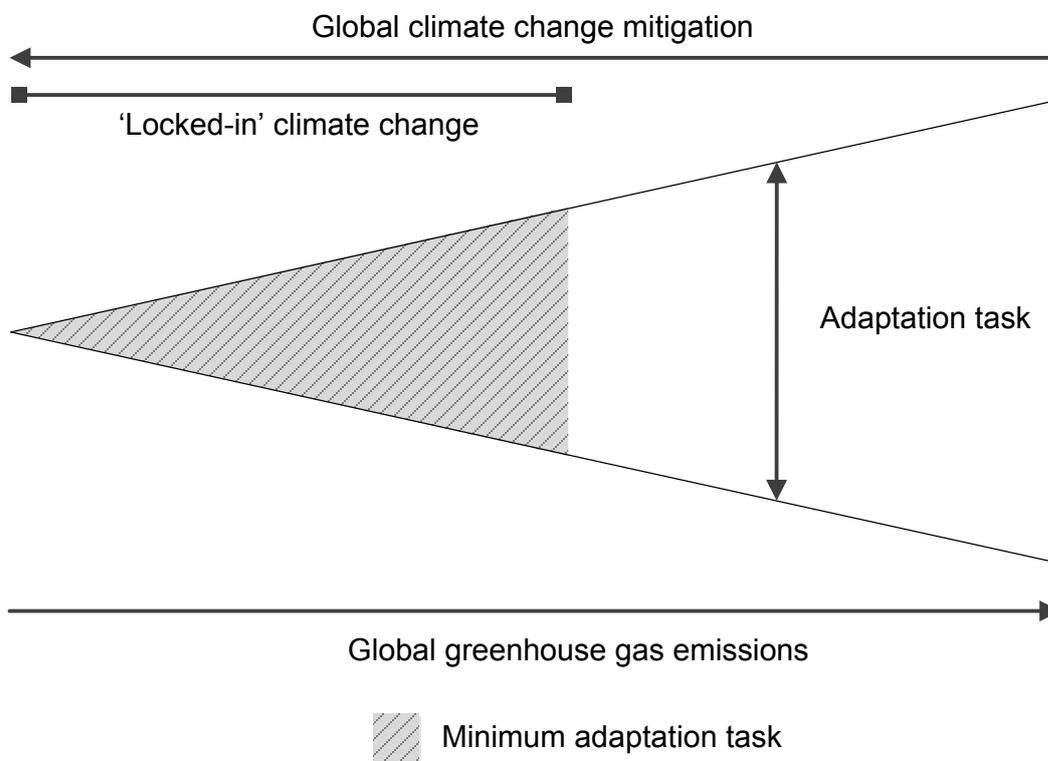
3.1 Adapting to climate change

Climate change poses significant challenges for households, businesses and governments (chapter 2). How these groups respond will have important implications for community wellbeing.

An effective response will require adaptation as well as mitigation. Measures to cut global greenhouse gas emissions can help to reduce future climate change (and consequently the amount of adaptation required), but some changes are already ‘locked in’ due to past greenhouse gas emissions and inertia in the climate system (IPCC 2007b). In other words, while climate change mitigation can reduce the scale of the adaptation task, the climate is already changing, and households, businesses and governments will need to adapt (figure 3.1).

In contrast to climate change mitigation, which requires cooperation at a global level, most climate change adaptation occurs at a local level through the actions of individuals, businesses and communities in response to locally specific climate change impacts.

Figure 3.1 **The mitigation–adaptation relationship**



There are many interdependencies between adaptation and mitigation activities. For instance, adaptation to higher temperatures could result in increased energy demand for cooling, increasing greenhouse gas emissions and making the future adaptation

task more difficult. On the other hand, urban-planning measures that reduce the heat island effect and building designs that incorporate passive cooling techniques may act as both adaptation and mitigation measures (IPCC 2007b).

The costs and benefits of adapting

Adaptation reduces the cost of climate change impacts, but adaptation measures also have costs. For example, a household or business might adapt to the increasing frequency of heatwaves by installing insulation or purchasing air conditioning, incurring a financial cost; or by avoiding highly-exposed activities (such as outdoor sport and construction work), leading to a loss of leisure or income. The net benefit of adaptation is equal to the benefits of reducing climate change impacts, less the costs involved in taking actions to adapt.

Not all climate change impacts are amenable to adaptation. For example, though actions can be taken to reduce some environmental stresses on the Great Barrier Reef, if climate change were to continue unabated, there may be no adaptation that can prevent significant changes to the Reef's ecosystem (Evans et al. 2012). The total cost of climate change with adaptation is therefore equal to the costs of adaptation measures plus the costs associated with unavoidable climate change impacts.

Incremental and transformational actions

Researchers sometimes draw a distinction between 'incremental' and 'transformational' adaptive actions. In essence, incremental actions are minor adjustments that allow a household, business or community to continue doing what it is doing. In contrast, transformational actions involve a fundamental shift in how, where or what things are done (Park et al. 2012).

For example, some farmers may be able to incrementally adjust to the impacts of climate change by changing crop management processes and shifting planting times. However, in regions where climate change significantly changes crop productivity, farmers may need to take transformational actions, such as relocating, or using the land for other purposes such as growing different crops, grazing or plantation forestry (CSIRO 2008a).

In practice, making a distinction between incremental and transformational adaptive actions can be difficult as it depends on perspective and timescale. A transformational change by one individual may appear incremental from a community-wide perspective. On the other hand, incremental changes pursued by a

large number of individuals over an extended period could give the impression of transformational adaptation.

3.2 Managing climate risks

Adaptation is about effectively managing the short- and long-term risks that climate change poses for households, businesses, governments and the natural environment. These risks may relate to the potential consequences of changes in the frequency, intensity or location of extreme weather events (such as heatwaves), or the effects of changes to other climate variables such as average temperatures and rainfall (or both).

Changes to climate averages are generally subject to less uncertainty than changes to the frequency or intensity of extreme weather events. However, all changes entail risks because the timing and magnitude of these changes, and their potential consequences (costs and benefits) for households, businesses, governments and the natural environment, are not entirely clear.

The risks associated with climate change are just some of the many risks households, businesses and governments face. Almost every aspect of life involves risk. Driving a car involves a risk of accident, playing sport involves a risk of injury and making a financial investment involves a risk of losing money. Individuals, businesses and governments regularly make decisions involving risks, reflecting their willingness to tolerate the risk and how much they value undertaking the activity that gives rise to the risk.

Appetites for risk can vary significantly between and among individuals, businesses and governments. For example, reflecting the risk of loss of life and property due to bushfire, some people may choose not to live in (or move away from) a bushfire-prone area. For others, the benefits associated with living in the area may be worth the risk. Rather than avoid the risk completely, these people may choose to reduce it, for example, by keeping well informed about potential threats during bushfire season, preparing a bushfire survival plan, removing vegetation in close proximity to their property or installing a bushfire shelter. They may also transfer some of the risk by taking out insurance.

Adaptation by households, businesses and governments is usually not a one-off change, but rather a continual process of adjustment as the intensity of existing climatic risks changes and new risks emerge over time. Most adaptation actions are likely to be small, incremental and even mundane. In many cases, existing strategies to manage risks associated with Australia's highly variable climate can be leveraged

to manage the risks of climate change and the day-to-day management of these risks may not even be thought of in terms of ‘climate change adaptation’.

Adaptation as risk management

Adopting a risk management approach to climate change adaptation means that decisions can be made within a framework that considers the consequences of a climate change impact, the likelihood of occurrence and the costs and benefits of alternative options to adapt. The costs of different options to address a risk can be traded off against the costs of exposure to the risk, taking into account the timing of the risk, attitudes to risk taking, and alternative uses of time, effort and money.

Businesses and governments often adopt formal processes for assessing and managing the variety of risks they face. Adopting a formal process may be preferable for organisations that face a large number of risks and those that need to engage stakeholders to assess acceptable levels of risk. Box 3.1 describes a formal process of risk management.

Box 3.1 The process of risk management

The Australian Government published guidance for managing climate-related risks, based on the Australian and New Zealand Standard for Risk Management (currently AS/NZS ISO 31000) in 2006. This process involves:

- establishing the context — identifying relevant stakeholders, clarifying objectives, and setting criteria against which risks to these objectives can be evaluated
- identifying the risks — assessing the range of risks that could affect the community
- analysing the risks — reviewing existing risk management processes, assessing the consequences of each risk and forming a judgment of its likelihood
- evaluating the risks — identifying the most severe risks and those for which more detailed analysis is required
- treating the risks — identifying options to manage risks or adapt to their consequences, and adopting the best options (this can include developing strategies to deal with a range of possible scenarios).

Each stage of the process should involve communication and consultation with all stakeholders in the community, along with ongoing monitoring and evaluation to adjust to changing circumstances.

Source: AGO (2006).

As climate change is just one of the many factors affecting the risks faced by households, businesses and governments, considerations of climate change are best managed in conjunction with all the other risks affecting a household, business or

government. Climate change risk management should be integrated within broader risk management processes (AGO 2006). Doing so ensures time, effort and money are concentrated on addressing the highest priority risks and that actions to address risk take place in a timely manner.

3.3 Measuring and evaluating adaptation activity

There are considerable challenges involved in measuring adaptation activity. Inquiry participants highlighted a range of adaptive actions that are already under way to manage the risks of climate change (box 3.2). However, these examples may not necessarily reflect the full suite of adaptive action being undertaken by the broader community (CSIRO, sub. DR136).

Box 3.2 Examples of adaptation already under way

Infrastructure

Some infrastructure owners are already considering the risks of climate change. For example, Brisbane Airport Corporation is considering climate change adaptation in its New Parallel Runway Development. The runway site is potentially subject to inundation. In order to mitigate these risks, the Corporation is raising the site for the development above the projected 1-in-100-year flood level and building a new seawall and tidal channels (chapter 12).

Local governments

Some local governments have undertaken climate change risk and vulnerability assessments, developed adaptation action plans and taken some actions in response. For example, Redland City Council (Queensland) (sub. 36) developed an adaptation plan covering the period 2010–15 in response to an assessment of the climate change risks facing its local area. Specific actions include further analysis of risks, updating bushfire mapping and management plans, and investigating options to manage risks, including ‘planned retreat’. Another example is Clarence City Council (Tasmania) (sub. 10), which adopted a risk management approach to addressing climate change in land-use planning decisions, including the use of ‘triggers’ where approval for development is given until a predefined event occurs.

Agriculture

Many farmers have responded to changing weather patterns by modifying crop planting times, crop types (including opportunistic planting of summer or winter crops), and choice of fungicides and fertilisers. For example, in parts of Queensland, wheat is now planted three to four weeks earlier than previously (CSIRO 2008a).

Adaptation activity by households, businesses and governments could be measured by direct observation, but this approach makes it difficult to identify intent and to distinguish actions motivated by climate change from those motivated by other, unrelated factors. For example, a farmer may switch to a more drought-tolerant crop because the frequency of drought is increasing with climate change, but the change could equally be motivated by water-market reforms that increase the cost of producing water-intensive crops, changes in commodity prices that mean the drought-tolerant crop is more profitable, natural climate variability or (more likely) a combination of factors.

Alternatively, one could survey and interview households and organisations to find out what actions they are taking and why they are taking them. Research by Gardner, Parson and Paxton (2010) provides an example of this approach (box 3.3). Their findings provide some indication of the level of adaptation activity underway and suggest that not all organisations are yet taking adaptive actions or planning for climate change.

Box 3.3 Adaptation benchmarking surveys

In 2008, Gardner, Parsons and Paxton (2010) undertook an adaptation benchmarking survey with funding from the Department of Climate Change and Energy Efficiency and the CSIRO Climate Adaptation Flagship. They surveyed 242 organisations across Australia to measure the nature and extent of adaptation activities underway. The survey results showed that:

- 83 per cent of respondents were ‘very’ or ‘completely’ convinced that climate change represented a ‘real problem’ for Australia
- 71 per cent of respondents considered climate change ‘very important’ or ‘extremely important’ to their organisation
- 59 per cent of respondents had conducted an assessment of their organisation’s vulnerability to climate change
- 42 per cent of organisations had taken actions to adapt.

A second survey was conducted in 2010 but the results are yet to be published.

Surveys and interviews can avoid the difficulty of identifying intent and can be useful for many purposes, such as tracking community understanding. However, they also have drawbacks. For example, many adaptation responses are likely to be incremental and even mundane as exposure to risks gradually changes and the prices of goods and services affected by climate change adjust. Often, households and organisations may be taking climate change into account without consciously acknowledging their activities as ‘adaptation’. This kind of activity may not be picked up by surveys and interviews.

Evaluating adaptation activity (to determine whether Australia is adapting at a rate faster or slower than what would be optimal) is even more challenging than measuring it. Some inquiry participants suggested that current progress in climate change adaptation is slow, and that this is evidence that there are barriers to effective adaptation. For example, the Department of Climate Change and Energy Efficiency (sub. DR163, p. 1) stated that:

... the relatively low awareness about climate vulnerability and low take-up of adaptation action suggests that information and other barriers are still prevalent.

In a contrary view, the Australian Industry Greenhouse Network (sub. 29, p. 1) observed that:

... just as the rate of climate change at a local level is not yet able to be measured, the rate of efficient adaptation for businesses is also unable to be assessed as ‘too much’ or ‘too little’ at any point in time.

There is no standard template of adaptation responses that can be used to judge whether the actions of households, businesses and governments are the right ones and/or are occurring at the right time. The most effective responses for any given household, business or government are likely to vary widely. Households, businesses and governments can adapt using an assortment of strategies and actions (table 3.1) and their responses will reflect differences in risk exposure, personal circumstances, perceptions of the future, risk preferences and underlying capacities to adapt (section 3.4).

Table 3.1 Possible adaptation strategies

<i>Risk strategy</i>	<i>Household example</i>	<i>Business example</i>
Avoid risk (change location, use or activity)	Relocate from a bushfire-prone area	Switch to a drought-tolerant crop
Reduce risk (prevent loss)	Insulate a house to reduce the effects of a heatwave	Use snow-making machines at alpine resorts
Transfer risk (spread or share loss)	Insure a property against extreme weather events	Purchase commodity futures to hedge against bad weather

These factors are relevant not just for the choice of response but also the timing of responses. As households and organisations face many competing priorities and risks, some may decide that planning for climate change is not as high a priority as other matters, or may judge that the costs of planning exceed the benefits at present.

However, effective adaptation by households, businesses and governments is not dependent on precise measurement of overall activity or detailed analysis of whether ‘too much’ or ‘too little’ overall activity is taking place. Households, businesses and governments can assess risks on a case-by-case basis to identify the

most effective responses and the most appropriate time to take action. Where barriers to effective adaptation (the focus of this inquiry) exist, they can be identified directly. An assessment that ‘not enough’ adaptation is occurring is unnecessary.

3.4 Building adaptive capacity

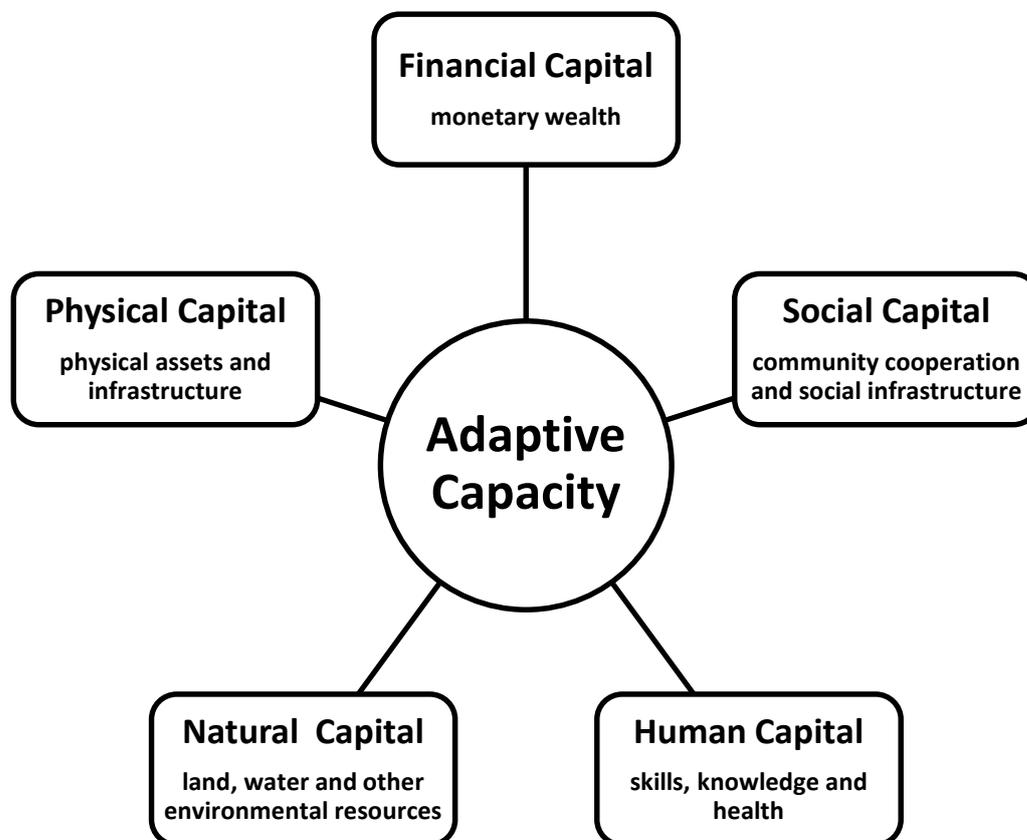
Effective adaptation is not just about managing exposure to specific climate change risks — it is also about reducing underlying vulnerability by building adaptive capacity. Adaptive capacity is the ability to adjust to new ways of doing things in the face of climate change (including moderating the potential damages, taking advantage of opportunities and coping with consequences).

Ellis (2000) highlighted five forms of capital that underlie the capacity to adapt — financial, physical, social, human and natural (figure 3.2). These resources tend not to be evenly distributed within and between communities and, consequently, not all individuals and communities are equally capable of adapting at any given point in time. However, these resources can also be accumulated over time, some by individuals and some — such as social capital — by communities, and converted from one form to another (PC 2005a).

Adaptive capacity also depends on how well resources can be used, in particular, the degree of flexibility in resource use, the capacity to organise resources and the capacity to learn from experience about the best use of resources (Cinner, Fuentes and Randriamahazo 2009; Stokes and Howden 2010). For example, the adaptive capacity of a community to respond to a bushfire depends on how easily people, vehicles and water can be deployed to different locations, how well people are organised to fight a fire and how well they have learnt from experience about the best ways to prepare to fight, or escape, a fire.

Building adaptive capacity to reduce vulnerability and manage climate risks can take place in many ways. Households, businesses and governments can improve their adaptive capacity by learning more about the likelihood and potential consequences of climate change risks, developing strategies to manage these risks, and accumulating resources adequate to undertake any necessary adaptation to address risks.

Figure 3.2 Five forms of capital underpinning adaptive capacity



Source: Ellis (2000).

3.5 Assigning roles and responsibilities for adaptation

Climate change adaptation at the national scale is the sum of innumerable decisions, large and small, made by households, businesses and governments in response to the threats and opportunities posed by climate change. In this sense, adaptation can be considered an example of structural adjustment.

Australia has confronted a variety of structural adjustments in the past including the information technology revolution and the liberalisation of trade. A crucial aspect of managing these adjustments successfully is to ensure an adequate balance between the roles played by households and businesses, and those played by governments.

Roles and responsibilities of households and businesses

Climate change generates threats and opportunities for the lives, livelihoods and property of households, and the assets, employees and profitability of businesses

(chapter 2). This means households and businesses have incentives to understand the climate risks they face and take steps to manage these risks.

Well-functioning markets can inform adaptation responses. For example, for homeowners in areas at increasing risk of extreme weather events, premiums for home and contents insurance may increase, sharpening existing incentives to move house or take other measures to reduce risk exposure (chapter 16).

Roles and responsibilities of governments

Governments can facilitate effective adaptation and provide appropriate incentives for risk management by households and businesses where markets are not functioning properly by providing public goods, and by adopting efficient and flexible regulations and policies. Governments also have roles to manage climate change risks to their own activities and to appropriately deal with the distributional impacts of climate change. Barriers to effective climate change adaptation may arise where governments fail to appropriately fulfil these roles (chapter 4).

Providing 'public goods' for adaptation

In some cases, government provision of goods and services that facilitate adaptation may be necessary because these goods and services would be underprovided in a private market. These include climate change research and information (chapter 7), and some disaster-mitigation infrastructure (chapter 13). Often, this role overlaps with managing risks to government activities. Public goods that facilitate adaptation may be provided by governments for other reasons (for example, disaster-mitigation infrastructure may be required regardless of climate change).

Providing efficient and flexible frameworks for regulation and policy

The adaptation decisions of households, businesses and governments are shaped by the regulatory and policy environment in which they are made. Governments have a role to ensure policy and regulatory frameworks are designed to facilitate effective adaptation. There are two aspects to this role.

First, policies and regulations need to be in place to prevent households, businesses and governments from making decisions that unduly transfer the risks of climate change to third parties. This includes ensuring building codes and land-use planning policies appropriately take climate change into account (chapters 9, 10 and 11).

Second, policies and regulations need to be efficient so that adaptation by households, businesses and governments can proceed at least cost. This includes ‘no regret’ reforms to taxes, transfer payments and regulations that strengthen incentives and build the capacity to adapt (chapter 6), and ensuring land-use planning (chapter 9) and infrastructure regulations (chapter 12) are appropriately flexible.

Managing risks to government activities

Climate change poses risks for an array of government activities including the maintenance of public infrastructure, such as roads, bridges, railways and ports (chapter 12); the provision of public services, such as emergency services and health (chapters 13 and 15); and the protection of the natural environment (chapter 14). Often, effective management of these risks will require governments to ‘embed’ considerations of climate change into existing risk management processes. Effective risk management also requires policies and governance arrangements that clarify the roles and responsibilities of different jurisdictions and agencies, and align responsibilities with sufficient funding (chapter 8).

Managing the distributional impacts

The costs and benefits of climate change will not be evenly spread across all households and businesses. Some industries and regions will suffer more severe climate change impacts than others (chapter 2). The structural adjustment that accompanies climate change will affect the costs of goods and services, change the returns to firms and workers, and shift the location of economic activity and employment opportunities.

In many cases, these adjustments could have particularly adverse effects for individuals and communities that are already financially vulnerable (for example, by increasing the price of basic goods and services such as electricity). Financially vulnerable individuals are also likely to have the least capacity to adapt to, or recover from, climate change impacts. For example, managing the risks of extreme weather events by retrofitting housing or relocating to lower-risk areas is likely to be beyond the financial capacity of these individuals. (If housing or rental accommodation tends to be cheaper in high-risk areas, financially vulnerable individuals may be concentrated in these areas.)

Governments have a role to protect the vulnerable and address equity concerns. However, it is important to recognise that dealing with the impacts of climate change is just one of many challenges that vulnerable individuals and communities

may face. For example, the prices of essential goods and services largely depend on factors unrelated to climate change, such as the costs of inputs and the effects of government policy. Furthermore, climate change is only one of many forces driving structural changes to the economy.

The role of government to address equity should reflect broad distributional concerns rather than just those related to climate change. In general, the existing social security and tax systems, and other standard adjustment measures (such as job search, placement and training services), will be the most appropriate means of assisting the adjustment process and moderating adverse distributional impacts (PC 2001b). However, in some cases there may be scope for targeted assistance, for example, to assist vulnerable people to prepare for and recover from natural disasters.

Allocating roles and responsibilities between levels of governments

Clearly allocating responsibilities for adaptation to different levels of government is important to ensure accountability and effective management. The principle of subsidiarity — that responsibility for a particular function should reside with the lowest level of government competent to deal with the issue — can help guide the allocation of responsibilities. As the impacts of climate change are mostly local, this principle implies that local governments, followed by state and territory governments, may be best positioned to implement adaptation responses.

However, there are many cases where it may be appropriate for higher levels of government to take responsibility for adaptation and/or for governments to cooperate and share responsibility. These include where:

- actions have positive or negative impacts on other jurisdictions. For example, where climate change affects a natural asset that crosses state boundaries, or has national environmental significance, Australian Government involvement or cooperation between state and territory governments may be appropriate
- there are areas of shared interest and economies of scale from a more centralised or coordinated provision of services. For example, it may be more efficient to undertake some climate change modelling exercises at a national level, rather than at the state, territory or local government level
- diversity in approaches to adaptation imposes costs that exceed the benefits. For example, there is a tension between allowing state and territory governments to tailor responses to their own circumstances and minimising costs for businesses that operate across state and territory borders. In areas such as construction and

building regulation, the adoption of national standards and other cooperative approaches may be more effective than state-based regulation alone.

The division of policy responsibilities and accountabilities between levels of government will also inform who does what in adaptation. For example, responsibility for emergency management (chapter 13) and health services (chapter 15) is currently split between all three levels of government.

It is also important to consider whether the responsible level of government has the capacity to effectively deliver outcomes. For example, local governments often lack financial resources and suitably qualified staff to effectively manage climate risks. As local governments are created under state and territory constitutional powers, state and territory governments have a role to play in establishing appropriate governance arrangements that ensure local governments' responsibilities are carried out effectively (chapter 8).

There may also be benefits to adopting collaborative, regional approaches. The South Australian Government's proposed regional climate change agreements and regional integrated vulnerability assessments are examples of a regional approach that includes natural resource management boards, local governments, and regional development boards (SA Government 2010a, sub. DR88).

Coordination and collaboration will also be required in areas where the level of government that is responsible for implementing policy is different to the level of government that is responsible for establishing the policy framework. For example, planning regulation is set by state governments but mostly implemented by local governments.

Given these existing divisions, shared responsibilities, and the multitude of policy areas in which adaptation is relevant, effective adaptation will require that all levels of government play a role. In May 2012, the Council of Australian Governments' Select Council on Climate Change released a discussion paper that proposed a number of specific roles and responsibilities for adaptation for each level of government in Australia (box 3.4). The roles and responsibilities set out in the paper are broadly consistent with the principles outlined above.

Box 3.4 COAG's proposed government roles and responsibilities for adaptation

Australian Government roles

- Provide national science and information.
- Manage Commonwealth assets and programs, including defence facilities, some national parks and reserves and other areas where the Australian Government has significant responsibility or provides funding such as environmental protection, community health, emergency management and national security.
- Provide leadership on national adaptation reform. Ensure that national efforts to adapt to climate change meet any relevant international treaty requirements and work with the states and territories to develop consistent adaptation approaches where there is a need.
- Maintain a strong, flexible economy and a well-targeted social safety net.

State and territory government roles

- Provide local and regional science where information is most effectively delivered at the local or regional level.
- Manage the risks of climate change to state and territory assets and programs, including natural assets and publicly-owned infrastructure, and services such as emergency management, land-use planning and health services.
- Work with the Australian Government and other jurisdictions to implement national adaptation reform where there is a need for consistent approaches.
- Encourage climate resilience and adaptive capacity. Promote a risk management approach by governments and private parties; ensure that regulatory and market frameworks are effective; and support local governments, in particular, to ensure that policies and regulations are consistent with state approaches.

Local government roles

- Administer relevant Australian, state and territory government legislation.
- Manage risks to public assets and services delivered by local governments.
- Ensure local government policies (such as local planning and development regulations) incorporate climate change considerations.
- Work in partnership with the community to manage risks and provide information about climate change risks to build adaptive capacity.

Source: COAG Select Council on Climate Change (2012b).

4 Defining barriers to effective adaptation

Key points

- A barrier to effective adaptation prevents the community from using its resources in the most advantageous way to respond to climate change impacts.
 - The existence of a barrier suggests the *potential* for government intervention in ways that make better adaptation actions possible and in turn improve the wellbeing of the community as a whole.
 - However, in some cases intervention by governments (if ineffective or inefficient) could leave the community worse off.
- A barrier could mean that adaptation actions:
 - are the wrong sort of actions
 - are insufficient or are over and above what is needed
 - do not occur at the right time, or at all.
- A range of market failures may constitute barriers. For example:
 - goods or services that improve adaptive capacity but have 'public good' characteristics may be undersupplied by the private sector (or not provided at all)
 - where activities have adverse impacts on adaptation efforts by others in the community (beyond those directly involved).
- Government regulation has the potential to impact on the adaptation decisions of individuals, businesses, organisations and other levels of government, and could impose a barrier where the costs of regulation outweigh the benefits.
- Adaptation to climate change poses governance challenges. Arrangements inconsistent with good governance principles may create a barrier.
- Behavioural barriers could arise as a result of the way individuals and communities identify the need to adapt and the adaptation responses they choose.
- Some individuals or communities have poor adaptive capacity so will be less able to manage the risks of climate change than others.
- Effective adaptation can be impeded by one barrier or multiple barriers interacting.
- Barriers to effective adaptation may not be easy to identify.
 - Adaptation decisions that do not appear effective (from the perspective of an outsider) may reflect differing preferences, circumstances or attitudes to risk.

4.1 What is a barrier to effective adaptation?

A ‘barrier’ to effective climate change adaptation restricts people’s ability to identify, evaluate or manage climate risks in a way that would deliver net benefits to the community. A barrier can be anything that prevents the community from using its resources — natural, financial, human, social and physical capital — in the most advantageous way to respond to climate change.

A key element of this definition is the requirement for a barrier to reduce *community-wide* wellbeing (the sum of individual wellbeing) from the level it would be if the barrier did not exist.

Barriers to effective adaptation can manifest themselves in a range of ways. A barrier could impede effective adaptation by leading to a poor appreciation by individuals or organisations of the need to adapt, inappropriate incentives for adaptation, or insufficient capabilities of individuals/organisations to adapt effectively (in the form of inadequate resources, knowledge and skills). Further, a barrier could prevent effective adaptation to current climate variability in addition to future climate change. The existence of a barrier could mean that adaptation actions are the wrong sort of actions, are insufficient, exceed what is needed, or do not occur at the right time.

Irrespective of the way in which the barrier impedes adaptation, the existence of a barrier signifies a *potential* for resources to be reallocated in ways that improve how we adapt.

Barriers to effective adaptation may not be immediately apparent. The adaptive capacity of individuals, communities, businesses, governments and natural systems (and their willingness and capacity to tolerate climate change impacts) will vary markedly and these differences will be reflected in the diversity of climate change adaptation responses (chapter 3). Consequently, from the perspective of an observer, it is difficult to determine whether a *seemingly* effective adaptation option is not being pursued because of the existence of a ‘barrier’ or because it would not lead to a net benefit.

4.2 A classification of barriers to effective adaptation

Potential barriers to effective adaptation take many forms, including market failures, policy and regulatory barriers, governance and institutional barriers, and behavioural barriers. Effective adaptation can be impeded by one type of barrier or as a result of multiple barriers interacting.

Market failures

For resources in a market economy to be allocated to the areas where they are most highly valued, a range of conditions must be met. An efficient market requires competition, access to information and prices that reflect the value the community places on goods and services. Where these conditions are not fulfilled, markets can fail to allocate resources efficiently.

In this context, market failure has a very specific meaning. It does not refer to situations where markets do not deliver the outcomes that a given individual or firm would desire. Rather, it requires a set of circumstances where the market, left to itself, is not delivering the best possible outcome for the community as a whole. One element of the Commission's task is to identify these market failures.

Public goods

Public goods are goods and services which, once provided to one person, are then available to all people at no additional cost. This occurs where a good or service can be consumed by one person without diminishing consumption by others and where it is difficult or infeasible to exclude anyone from benefiting from the good.

A barrier to adaptation could occur where goods or services that improve adaptive capacity are undersupplied by the market (or not provided at all) due to their public good characteristics. Where governments do not recognise this and ensure appropriate provision of these goods and services, the welfare of the community may be less than it would be otherwise.

A specific application could be in the area of emergency management (chapter 13). For instance, early-warning systems for natural hazards have public good characteristics and are generally provided or funded by governments. Where climate change leads to an increase in the frequency or intensity of natural hazards, community wellbeing may be improved by enhancing early-warning systems.

While the nature of public goods makes it difficult to determine the optimal level of provision, this market failure can be addressed by governments making judgments about the type and quantity of public goods to provide or fund.

Imperfect information

Imperfect information can lead to market failure where there is inadequate information for consumers and the public and private sectors to make well-informed decisions. Information may be imperfect because of its public good characteristics

or because one party to a transaction has more or better information than the other party (‘asymmetric information’).

An example of how asymmetric information could impede effective adaptation is where insurers and those they insure have differing information about the extent of risks faced or of any actions taken to manage risks. This can lead to a situation where those at higher risk are more likely to purchase insurance and the greater frequency of payouts leads to an increase in premiums (‘adverse selection’). It can also lead to buyers of insurance not having strong incentives to manage their risks where insurers cannot observe all actions that they take (‘moral hazard’). In both cases, premiums may increase and deter individuals or organisations from buying insurance, and in some instances result in the absence of insurance cover for particular risks. This limits the range of risk management options and could reduce the effectiveness of adaptation efforts.

In some instances, markets can address problems of imperfect information through intermediary products — for example, consumers purchasing advisory services. However, where the information has considerable public good characteristics, the government may commit to provide the information itself or alternatively to complement or verify market-supplied information. Of course, households and companies often have access to very specific or local information that is not available to governments.

Split incentives

Split incentives arise where adaptation decisions involve multiple parties with different incentives. As a result of these differences, adaptation may not maximise the wellbeing of all parties. For example, landlords may not have strong incentives to install more energy efficient appliances because they might not be able to recoup the capital costs through increased rent. Tenants on the other hand might be prohibited from replacing appliances, or might not be confident that they will be able to recoup the savings (through lower energy bills), when the term of their lease is uncertain (PC 2005b).

Spillovers

Some activities or transactions can involve ‘spillovers’ (also known as externalities) of positive or negative impacts on other individuals in the community, which are not taken into account by the parties to that activity. Both negative and positive spillovers could impede effective climate change adaptation by resulting in too much of an activity that negatively impacts on the community’s adaptation efforts

or not enough of an activity that improves adaptive capacity. For example, where a private land owner undertakes activities in order to protect his or her property from sea-level rise, such as constructing a boulder wall, a ‘negative spillover’ could occur where erosion to an adjacent property is increased as a result. The cost of increased erosion on other properties is not reflected in the price of the protective activity nor is it borne by the private property owner. As a result, the land owner may not take these external costs into account when making a decision about how best to adapt to climate change.

Governments often subsidise activities that positively impact others in the community (beyond those individuals directly involved in the activity). For example, governments subsidise disease immunisation, which protects the individual, but also lowers the general risk of disease for everyone. Conversely, governments can use legal restrictions and/or pricing mechanisms in order to address activities that generate negative impacts on others. For example, planning and development regulations may restrict the type of buildings in a given area in order to maintain the amenity of existing residents (for example, restricting the construction of large buildings that block sunlight to their neighbours or factories that produce noise and air pollution). The intention of government intervention in these cases is not necessarily to prevent all activities that generate negative spillovers. Rather, it is to ensure that resources are allocated in a way that takes account of the benefits and costs of activities to all parties involved.

Policy and regulatory barriers

Government policy and regulation affects the adaptation decisions of individuals, communities, businesses and non-government organisations in many ways. For example, coastal planning and development can influence where people live and the type of protective measures they purchase for their properties, and regulation of monopoly infrastructure (such as electricity and water networks) can affect the investments these businesses undertake to protect infrastructure from the impacts of climate change.

While government policy and regulation can deliver economic, social and environmental benefits, they can also entail costs (box 4.1). The focus in this inquiry is on policies and regulations that impede effective adaptation. For example, regulations that restrict the removal of vegetation on private property may mean that landholders are not able to create buffer zones around their dwellings to provide protection from bushfire. Where climate change leads to more frequent bushfires, these land-clearing regulations could impose significant costs in the form of damage to life and property.

In many cases, such costs may be a by-product of pursuing policy objectives unrelated to adaptation policy. However, in other cases, policy or regulation may be creating barriers to adaptation while not effectively meeting their stated objectives. Addressing these barriers would constitute a ‘no regrets’ policy measure (chapter 6). In either instance, there may be a prima facie case for exploring alternate policy and regulatory tools that deliver similar benefits without impeding effective adaptation.

Box 4.1 The costs of regulation

The costs of regulation include:

- substantive compliance costs — costs borne by households and businesses to meet regulations. For example, the costs associated with meeting regulatory requirements for the construction of coastal protection works on private properties
- administrative costs — costs borne by government in administering the regulation or costs faced by businesses, such as paper work and reporting time, or fees and charges imposed by the regulator
- economic impacts — costs (often unintended) imposed where regulations create barriers to entry in markets, limit innovation, or impose delays on businesses and individuals. This includes costs from poorly designed or implemented regulation. For example, where land-use and development approval processes for hazard-prone areas delay the development of a site that is not hazard-prone. Even if regulation is well designed and governance arrangements are appropriate there could still be scope for regulatory error in the application of that regulation
- other costs — such as unintended social and environmental effects of regulation and benefits forgone if the regulation is ineffective.

Sources: NSW Department of Premier and Cabinet Better Regulation Office (2008); PC (2011d).

Governance and institutional barriers

Due to the nature of the federal system, Australian governments are pursuing climate change adaptation policy in varying ways (appendix B). Further, the pervasive nature of the adaptation task means that adaptation policy is likely to interact with a broad range of other government policies.

Governance refers to the use of institutions, structures of authority and other bodies to establish policies and rules, to allocate resources for implementation, and to coordinate and control the resulting activities (PC 2011b). This can encompass a broad range of activities and processes, including policy processes, legislative settings, organisational arrangements and administrative procedures. Thus, governance arrangements can refer to the mechanics of how public servants make

day-to-day decisions in local governments right up to the separation of Australian and state government powers in the Constitution. Similarly, governance and institutional barriers could arise in private organisations if authority, responsibility and accountability is not aligned between different layers of decision making.

The appropriateness of governance and institutional arrangements can affect the way governments and the community respond to climate change. Addressing barriers to effective climate change adaptation will therefore involve a continuous emphasis on good governance. However, there is no single ‘good governance’ approach that can be universally applied to minimise any negative impacts of governance arrangements on adaptation decisions. There are generally accepted principles for good governance and it is common practice for a principles-based approach to be adopted to strengthen governance arrangements. There are a number of different formulations of good governance principles, although these generally encompass similar elements. For example:

- *Accountability and transparency.* Where responsibility for decisions and actions is not clearly allocated or prioritised, or where these decision-making responsibilities are not adequately supported, adaptation could be impeded. For example, the current legal liability of councils when making land-use planning decisions may be uncertain. In such cases, councils may not make appropriate decisions as they are uncertain about the legal implications of their decisions. Ensuring that government agencies undertake appropriate and transparent monitoring and evaluation of policies is also an important element of accountability.
- *Coordination and interaction.* Adaptation could be impeded where adaptation policies are not well coordinated across different government bodies. For example, a range of bodies are responsible for providing emergency management services in each state and territory. Where these bodies do not work together to coordinate service provision this could impede the ability of providers of emergency services to respond effectively to the expected increase in extreme weather events.
- *Flexibility.* Society’s understanding of the likely impacts of climate change is incomplete and uncertain, but constantly improving. Consequently, governance systems will need to provide for flexibility in order to accommodate this uncertainty. For example, inflexible planning systems that assume that land boundaries do not alter over time may lead to ineffective adaptation to climate change if, for example, coastal erosion affects land boundaries.
- *Community involvement.* Where opportunities to participate in and influence decision-making processes are not widely available to the community,

adaptation policy and options may not match the community's views on risk, or protect highly valued community assets.

- *Capability*. Government authorities require appropriate resourcing to effectively carry out their functions (this includes financial resources and suitably skilled staff). For example, local governments are responsible for a raft of policies that will influence adaptation, including local land-use planning systems, management of local infrastructure and information provision. Where councils have insufficient resources to effectively meet their responsibilities and deliver appropriate policy outcomes, this could impede adaptation.

Governance arrangements tend to be complex, dynamic and inherently imperfect — consequently there is always room for improvement. Further, due to the subjective nature of 'good governance', there may be different views on the importance of strengthening arrangements and how they should be improved.

In some cases, there may be well-defined ways to strengthen governance arrangements to remove a barrier to adaptation and improve the wellbeing of the community — for example, by clearly defining roles and responsibilities of government agencies. However, this may not always be the case and a consideration of the feasibility of improving arrangements is necessary, as is an assessment of the expected costs and benefits of any improvement.

Behavioural barriers

Adaptation involves individuals, communities, businesses and governments processing information about climate change, assessing risks and selecting adaptation responses. The Australian Psychological Society (sub. 35, p. 3) noted that considerable psychological preparation for adaptation to climate change takes place, including 'how people perceive and understand the problems, how they react emotionally, how they decide what to do, and how they behave in response to the problems'. Consequently, there is a significant behavioural component to adaptation and behavioural barriers can arise as a result of the way individuals and communities identify the need to adapt and the adaptation responses they choose. This is not to say that all decisions regarding climate change adaptation are affected by cognitive constraints, but rather that behavioural factors, on a community-wide scale, could constitute barriers to effective adaptation.

Cognitive constraints on decision making

Effective adaptation requires people to absorb information on the impacts of climate change and to choose between different adaptation options based on their

perceptions of the costs and benefits and the uncertainties involved. However, research has shown that people can take short cuts in order to make decisions, either consciously or subconsciously, particularly where these decisions require complex information to be gathered and processed (Crowle and Turner 2010). This could result in sub-optimal adaptation decisions that are chosen out of habit.

Further, in some circumstances people can find it difficult to assimilate multiple sources of information and consequently additional information on climate change impacts or adaptation options may not improve matters (Nicholls 1999). Shafir (2008) noted that the existence of multiple choices may reduce the likelihood of a rational decision, and may lead to the decision maker delaying a decision indefinitely.

Behavioural factors could also have implications for the timing and likelihood of individual adaptation actions. For example, individuals can exhibit time-inconsistent preferences and may have trouble weighing up costs and benefits that occur over long timeframes. That is, one year from now can seem much further into the future than one year in ten years' time. This can lead to individuals placing priority on short-term gains and making decisions contrary to their longer-term interests (Crowle and Turner 2010; Kahneman 2011). This can also mean that more tangible and immediate impacts can take precedence over distant, yet more serious, outcomes (Shafir 2008). As a result, some individuals may respond to the long timeframes and uncertain impacts of climate change by procrastinating and deferring adaptation decisions that would be in their own best interest.

Social and cultural influences on decision making

Adaptation decisions do not take place in a vacuum and the decisions we make are likely to be influenced by the information we have, how we interpret this information and our perceptions of how others in the community are responding. Studies have shown that the behaviour and attitudes of family members and friends can have a strong impact on the decisions and actions of individuals. For example, Ajzen and Fishbein (2005) found that individuals have difficulty maintaining an attitude that differs from that of those around them. Further, the way in which people process information is strongly influenced by existing attitudes (Gardner et al. 2009). People tend to ignore, or not seek out, information that is inconsistent with their current views, and additional information can tend to cement their pre-existing views (Kahneman 2011; Nicholls 1999).

Identifying behavioural barriers

Behavioural factors can help explain how people make the decisions that they take. However, there is limited knowledge regarding the extent to which these factors affect decisions. Better understanding the behavioural factors that influence decision making may be useful to inform the way information is provided by governments and to whom it is targeted. Community wellbeing may be improved where governments ensure that the information they provide is easy to use and understand (chapter 7).

Path dependency

Path dependency refers to circumstances where an outcome depends on previous outcomes, rather than simply on current conditions. Path dependency incorporates the ideas of ‘technical’ path dependency (box 4.2) and ‘political’ path dependency, which recognises that policy settings can be locked in as a result of government commitment issues (chapter 5).

It has been argued that technical path dependency can lead to inefficient technology or capital becoming ‘locked in’ (Arthur 1989; David 1985). The widespread adoption of the QWERTY keyboard over other, potentially more efficient, keyboard configurations (such as the Dvorak keyboard) is often cited as an example of path dependency (although this example is disputed). This ‘lock in’ occurs due to ‘historical accidents’ rather than any inherent superiority of the given invention or technology (David 1985, p. 335).

While history can influence outcomes well into the future, resulting in path dependency, it is not clear that there is anything that governments can or should do about this. Liebowitz and Margolis (1995) argue that path dependency that is capable of being remedied is highly unlikely to persist as those who stand to benefit from moving to a better path will be willing to pay to bring about the improvement. In other cases, path dependent outcomes are only unable to be remedied due to the extent of transaction costs involved in moving to a new path, and the fact that it is only in hindsight that it can be seen that the path taken was the wrong choice (Margolis 2005).

Box 4.2 **Conditions required for technical path dependency**

Several conditions are required for technical path dependency to occur:

- durability of capital equipment — where obsolete or inferior capital equipment remains in use because its fixed cost is already 'sunk' while its variable costs are lower than the total costs of replacing it
- compatibility — where there is a link between different components of a technology, which leads to the technology being retained beyond the lifetime of the durable capital that uses the technology. For example, railway tracks and train wheels must operate on the same track gauge — as railways rarely replace all their track and rolling stock at the same time, the gauge persists beyond the life of both types of equipment
- increasing returns to adoption — where the value of a product or technology is greater as the total number of users increase. This can arise as a result of positive 'network' externalities (spillovers) or as a result of learning effects that lower the cost of a product. For example, a railway will find a particular gauge more valuable the greater the number of connecting railways using that gauge.

Sources: David (1985); Margolis (2005); Puffert (2000, 2003).

Inadequate adaptive capacity

There may be some circumstances where individuals or communities currently experiencing disadvantage have inadequate capacity to adapt to the impacts of climate change. Disadvantaged groups may find it more difficult to identify the climate risks they face and may have less capacity to manage those risks than others.

Inadequate capacity to adapt to climate change can result from insufficient financial resources, a lack of appropriately targeted information, and/or an inability to develop or access social support networks (Brotherhood of St Laurence, sub. 74). Community wellbeing could potentially be improved through government policies aimed at addressing these sources of disadvantage.

4.3 How should we respond to barriers?

The existence of barriers to effective adaptation suggests that there is potential for government to improve outcomes by removing these barriers. However, this will not always be the case. Some government policy responses may be more costly than the barrier itself. Moreover, it may not always be clear if there is much that governments can do to address barriers. This could be the case for some behavioural

barriers or in instances where policy intervention would require governments to be able to foresee outcomes — as is the case with barriers that may arise from path dependency. Reforms should only be pursued where they deal with identified barriers to adaptation and where the chosen reform is expected to improve community wellbeing. These issues are taken up in chapter 5.

5 Assessing reform options and identifying priority reforms

Key points

- Assessment of reforms to barriers to effective climate change adaptation should identify options that are most likely to increase the wellbeing of the community (broadly defined). There is an established approach to assessing policy reforms that is well suited to the issue of climate change adaptation. It involves:
 - defining the problem in a way that allows consideration of a variety of solutions
 - describing the objectives of reform
 - identifying options to address the problem
 - considering the positive and negative impacts of each reform option
 - considering any potential risks to effective implementation and operation.
- Uncertainty about the impacts of reforms should not lead to inaction.
 - Where there is a threat of serious or irreversible damage, uncertainty should not be used to justify postponing cost-effective measures to prevent damage (the ‘precautionary principle’)
 - Reform options should be considered on a case-by-case basis to identify the options that are most likely to contribute to effective adaptation.
 - Sensitivity analysis and scenario planning can show the effects of different climate scenarios on policy outcomes, and can help to identify reform options that will deliver net benefits to the community under a range of scenarios.
 - ‘Real options’ analysis is a tool that can demonstrate the benefits and costs of flexible responses where there is uncertainty, and of taking action today compared to delaying action until more information is available.
 - Given the long lead times for some reforms to address barriers to effective adaptation, it is important to consider any risks that might undermine their effective implementation and operation.
 - Regular reviews can lead to improvements to individual policies, and can also help to identify leading practices and future reform priorities.
- Reform priorities fall into two groups.
 - Some reforms would address barriers that reduce the ability of the community to deal with current climate variability and extreme weather events. These reforms would also help prepare the community for future climate change.
 - Other reforms would address barriers to adaptation to long-term climate impacts.

5.1 Assessing reform options to increase wellbeing

Various policy instruments could be used to remove barriers to effective climate change adaptation (box 5.1). Case-by-case analysis of reform options, including consultation with the community, can help policy makers identify the options that are likely to facilitate effective adaptation and increase community wellbeing. It also adds accountability and transparency to the policy-making process.

Box 5.1 Some policy responses to address barriers to adaptation

Taxes — Reforms to tax systems could reduce or abolish taxes that act as barriers to adaptation (such as state taxes and levies on insurance premiums).

Transfers — Government transfers could overcome some types of barriers to adaptation. For example, transfers from state and territory governments to local governments could help them address barriers related to local government capability.

Regulations — Governments could directly regulate to fix barriers to adaptation. This could include regulations in areas such as building, planning and infrastructure.

Government provision of goods and services — Some barriers to effective adaptation could be removed through government provision of goods and services, such as information about the impacts of climate change and advice on how to use that information to aid adaptation.

Making no change — In some cases, governments may be unable to remedy barriers to effective adaptation in a way that is efficient or cost effective.

Increasing community wellbeing

The broad objective of public policy should be to increase community wellbeing. The Treasury's 'wellbeing framework' sets out several factors that have important implications for wellbeing. They include:

- the set of opportunities available to people (including consumption opportunities, good health, environmental amenity, leisure, community participation and political rights and freedoms)
- the distribution of these opportunities across the community
- the sustainability of those opportunities over time
- the level and allocation of risk borne by individuals and the community
- the complexity of the choices that people face (excessive complexity can have negative implications for wellbeing). (Treasury nd)

Reforms to address barriers to effective adaptation are likely to have positive and negative impacts across the range of factors that influence wellbeing. Policy analysis involves identifying the impacts of each policy option and weighing it up against the alternatives. If the positive impacts (benefits) outweigh the negatives (costs), the reform will increase overall community wellbeing, and would contribute to more effective climate change adaptation. By assessing reform options case-by-case, and implementing the reforms with benefits that exceed their costs, policy makers can progressively increase the wellbeing of the community.

The standard approach to assessing reform options

In Australia, a well-established approach to policy assessment exists. Developed by agencies including the Productivity Commission and the Office of Best Practice Regulation, it involves clearly stating the problem, setting out the reform options, using a cost–benefit framework to assess the impacts of the reform options, and considering implementation issues (box 5.2).

Box 5.2 General principles for policy assessment

1. *Clearly specify the problem* — Detail the nature of the problem, the size of the impacts and the risks and consequences of failing to address the problem.
2. *Consider whether there is a need for government intervention* — Government intervention is not costless, and should only proceed if the government has the capacity to deal with the problem and a sound justification for doing so.
3. *Clearly describe the objectives of reform* — The objectives of reform should be specified in a broad way, to enable consideration of all possible options.
4. *Identify any regulation or policy that is currently in place to address the problem* — If the existing regulations are not addressing the problem, is it because the regulations are flawed, or is it a failure in compliance?
5. *Identify the feasible options* — Identify the options that could feasibly achieve the objectives of the reform. This could include different types of instruments and the option of making no change to the status quo.
6. *Assess the impacts of the options* — Impacts include the direct effects of the reforms, any indirect ‘flow-on’ effects and unintended consequences. Impacts can include the financial, social and environmental effects of reform options. The distribution of the benefits and costs and the equity impacts of the reform should be assessed. Impacts can be assessed through quantitative analysis or a detailed qualitative analysis (augmented where possible with quantitative data).
7. *Consider implementation and enforcement, and establish a review strategy.*

Sources: Australian Government (2010b); PC (2005b).

Use cost–benefit analysis to assess the impacts of reforms

Cost–benefit analysis involves methodically identifying and comparing the positive and negative impacts of reform options. This includes non-financial impacts (such as environmental and social impacts) as well as the more easily-quantified financial impacts (box 5.3). It also includes the direct effects of policy changes, and any indirect ‘flow-on’ effects. Both the immediate and longer-term impacts of reform options are taken into account, as well as the distributional effects (who benefits and who loses).

Box 5.3 Valuing non-market impacts

Reforms to address barriers to effective adaptation could have impacts that are difficult to value, such as effects on ecosystems and human health, and intangible benefits that people gain from measures that reduce the risks they face. In a cost–benefit framework, these impacts can be difficult to compare to impacts that can be more accurately expressed in monetary terms. One option is to estimate the value that people place on these non-market impacts by observing their actions or asking them how they value non-market goods and services. (Appendix J of the Commission’s report on *Identifying and Evaluating Regulation Reforms* (PC 2011d) sets out more detail on approaches to quantifying benefits and costs that are difficult to measure.)

Even if it proves impossible to estimate the value of non-market impacts, they can still be considered within a broad cost–benefit framework. The expected impacts of reforms should be explicitly stated and preferably quantified (for example, the number of hectares of land conserved, or the number of cases of heat-related illness expected to be avoided). With this information, policymakers can at least consider the impacts of various policy options.

Where possible, it is helpful to quantify the impacts in a common metric (usually dollars) so the benefits and costs can be directly compared (box 5.4). In cases where the benefits and costs cannot all be compared in dollar terms, they should still be identified and described to help decision makers understand the trade-offs involved in decisions.

Cost–benefit analysis can also add transparency to the policy-making process. Policy decisions can be subject to lobbying, biases and prior assumptions. Cost–benefit analysis clearly sets out the feasible policy options, and their potential impacts. This can encourage policy makers to choose options that are more likely to contribute to increased overall wellbeing, rather than favouring sectional interests or short-term gains.

Box 5.4 Cost–benefit analysis for adaptation reforms

Fankhauser et al. (1999) set out a formal approach to comparing the benefits and costs of ‘adaptation investments’ — investments that reduce the damage caused by climate change. If an adaptation investment costing C^N is undertaken in period 0, there is unmitigated damage of d_0^N in that period, and partially mitigated damages of d_t^N in subsequent periods (t). Future benefits and costs are ‘discounted’ — adjusted to reflect people’s preferences to accrue benefits sooner and incur costs later — with a discount rate (r). Calculating the ‘net present value’ of the cost of an adaptation measure, and the cost of future climate change damages associated with the investment, is a way to express the value of the future stream of costs in current dollars. It is given by:

$$NPV D^N = C^N + d_0^N + \frac{d_1^N}{(1+r)} + \frac{d_2^N}{(1+r)^2} + \dots + \frac{d_{2t}^N}{(1+r)^t}$$

Postponing the adaptation investment for one period (making an investment of C^L) would lead to unmitigated damages in period 0 and in period 1. From then, the damages in each period would be d_t^L . The benefits of delay would exceed the costs if:

$$C^N - \frac{C^L}{(1+r)} > (d_0^L - d_0^N) + \frac{(d_1^L - d_1^N)}{(1+r)} + \frac{(d_2^L - d_2^N)}{(1+r)^2} + \dots + \frac{(d_t^L - d_t^N)}{(1+r)^t}$$

Whether the benefits of delaying the adaptation investment exceed the costs depends on the discount rate, the costs of making the investment in the current period or one period later, and the costs of mitigated damage compared to unmitigated damage. The calculation could be repeated as new information comes to light, and this could lead to different conclusions. For example, an investment that would not deliver a net benefit this year might be shown to deliver a net benefit if undertaken next year.

Reforms to address barriers to adaptation have a flow of costs and benefits over time, so if the positive and negative impacts could be quantified (or estimated), reforms could be analysed using Fankhauser et al’s (1999) framework. In practice, it will not always be feasible to quantify all of the impacts of reforms to address barriers to climate change adaptation. In these situations, a pragmatic approach is to consider qualitative evidence in any cost–benefit analysis of adaptation.

Consider a range of discount rates

Because the impacts of climate change will arise over a long period, reforms to address barriers to adaptation might not deliver material benefits for many years. In general, people prefer to receive benefits sooner and face costs later. In formal cost–benefit analysis, future impacts are ‘discounted’ to express the degree to which people are prepared to trade off current and future benefits and costs. The future benefits and costs are estimated, and a ‘discount rate’ is applied to estimate the value that people today place on impacts that will arise in the future. The higher the discount rate, the lower the weight placed on future benefits and costs.

Private investors making decisions about whether to pursue a project typically apply discount rates that are based on their cost of capital with a premium added to reflect the risk attached to the project. For governments, choosing a discount rate has proven to be more controversial.

Harrison (2010) described two approaches to selecting the ‘social’ discount rate: the ‘descriptive’ approach and the ‘prescriptive’ approach. The descriptive approach involves selecting a discount rate based on the opportunity cost of capital — the return the community would receive if it chose to invest the capital it devotes to adaptation in an alternative activity. Harrison favoured using a descriptive approach to select discount rates for government projects, and recommended calculating the present value of future benefits and costs using three rates: 3, 8 and 11 per cent (in real terms). Using several discount rates clearly illustrates how changes to the discount rate affect the analysis.

The prescriptive approach involves selecting the discount rate that society ‘should’ use to value the future, based on ethical considerations and value judgments. There is no ‘right’ answer when using this approach: ultimately the decision rests on the values of the decision maker. In some cases, the prescriptive approach has been used to justify discount rates set at low levels. In particular, where benefits of current investment will occur in the distant future (say, in more than 100 years), some authors have advocated using very low discount rates. For example, the Stern Review (Stern 2007) used discount rates of around 1.4 per cent (in real terms). This led Stern to conclude that the current generation should expend resources reducing greenhouse gas emissions, even if the majority of the benefits of mitigation would not arise for many decades (or even centuries). More recently, Maddocks (2011, p. 127) stated:

Given the long life of infrastructure and the potential impact of climate change on future generations, a significantly lower discount rate [than 7 per cent] may be appropriate.

Selecting a prescriptive discount rate at a low level gives greater weight to the interests of future generations. This attention to the interests of people in the (possibly distant) future comes at a cost to the current generation. Reforms that impose a net cost on the current generation could pass a cost–benefit test with a very low discount rate, when they would not pass with a rate based on the opportunity cost of capital. Assuming that future generations are likely to be substantially wealthier than their predecessors, this intergenerational transfer of wealth could be seen to have negative implications that might outweigh the altruistic considerations that would lead to the prescriptive adoption of a low discount rate.

In general, the approach of the Productivity Commission has been to use a range of discount rates in its analysis. For example, in its analysis of emissions-reduction policies in key economies (PC 2011b), the Commission used rates of 3, 7 and 11 per cent (in real terms). Using this range of rates shows the effects of using relatively high and relatively low discount rates. If a project only passes a cost–benefit test with a relatively low discount rate, this can tell the decision maker something about the characteristics of the project, and encourage deeper consideration of the intergenerational equity issues involved.

The Australian Government recommended that when considering the risks of climate change, governments and businesses should adopt a planning horizon of 25 years ‘in the first instance’ (AGO 2006, p. 9), but this could be extended to 50 or even 100 years. This is analogous to using a range of discount rates in decisions about climate change adaptation. Again, using a range of values can give a better insight into the nature of the benefits and costs of a reform.

5.2 Assessing reform options under uncertainty

The future is inherently uncertain, and this makes it difficult to predict what effects climate change impacts will have on subsequent generations. Demographic changes, technological changes, changes in patterns of work and shifts in where people choose to live could exacerbate or moderate the impacts of climate change. On top of this general uncertainty about the future state of the world, there is uncertainty about the timing, location and magnitude of many climate change impacts (particularly extreme weather events). This leads to uncertainty about how much damage would be prevented by reforms to address barriers to adaptation and when those benefits would arise. These uncertainties are relevant from a policy perspective because the size and timing of avoided damage determine the value of the benefits of policy options.

Uncertainty about the outcomes of reform should not lead to inaction. Nor should it imply that the standard approach to policy analysis cannot be applied to climate change adaptation. Even where the benefits and costs of reform options are uncertain, case-by-case analysis remains the best way to identify options that are most likely to deliver net benefits and contribute to effective adaptation to climate change. The following sections explain some approaches to doing cost–benefit analysis in a context of uncertainty, including starting with a precautionary approach, considering a range of climate change scenarios, identifying flexible options, and giving attention to implementation issues.

Precaution and the ‘precautionary principle’

Where the future is uncertain, but there is potential for damage, decision makers could choose to take a precautionary approach to safeguard the community against negative impacts. Precaution involves ‘being alert to possible future dangers and exercising an appropriate level of caution or prudence to safeguard against, or ward off, possible harm in advance of danger’ (Weier and Loke 2007, p. 2). Depending on how decision makers deploy precaution, it can be consistent with increasing community wellbeing.

The well-recognised potential for climate change impacts to cause harm means that precaution — being alert to future dangers — is a sensible starting point when considering policy options. The challenge for policy makers is to identify the ‘appropriate’ level of caution in each case. Excessive caution can impose costs that are unlikely to be justified by the future benefits, just as inadequate caution could lead to avoidable damage in the future.

There are many ways to take a precautionary approach. A modest example is research to better understand the dangers the community might face from climate change. Where research suggests that policy action is required, a precautionary approach could be to look for flexible responses that will achieve policy objectives under a range of possible future scenarios. A more extreme precautionary response would be for governments to regulate or totally ban activities if the dangers are thought to be too severe to be tolerated. Along the spectrum of precautionary responses, the various options will each generate a unique combination of benefits and costs. So while precaution is a sensible starting point when facing potential future threats, it does not tell decision makers which options are likely to increase overall community wellbeing (and constitute effective adaptation).

The ‘precautionary principle’

The ‘precautionary principle’ was developed as a response to the inherent difficulties that uncertain outcomes present to decision makers (Weier and Loke 2007). The most commonly cited definition comes from the 1992 United Nations Conference on Environment and Development.

Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation. (UN 1992a)

Similar definitions of the precautionary principle are incorporated into many pieces of Australian and state government legislation, particularly regarding environmental conservation and resource management policies. In this form, it can be compatible

with the objective of maximising community wellbeing. Such ‘flexible’ definitions of the precautionary principle do not compel policy makers to take any particular action. Instead, they reinforce the sensible principle that a lack of certainty about the future is not a justification for inaction.

There are other definitions of the precautionary principle that are more prescriptive. These definitions would limit decision makers’ flexibility to take into account non-environmental impacts of actions (such as social and economic impacts) (Weier and Loke 2007). Ultimately, the prescriptive definitions of the precautionary principle involve giving a greater weight to concerns about environmental damage than any other factor. Instead of seeking to maximise community wellbeing, an approach to climate change adaptation that was based on prescriptive versions of the precautionary principle would tolerate a reduction in overall community wellbeing if it meant that a particular type of damage was prevented. This essentially amounts to prioritising one interest over all others. So while it is sensible to acknowledge that uncertainty about the future does not justify inaction, decisions about whether or not to implement reform options should not be based on the precautionary principle alone.

Consider the potential for regret

One motivation for taking a precautionary approach is the potential for decisions taken (or not taken) today to lead to regret in the future. If barriers to adaptation are identified today, but reforms to remedy them are not implemented (for example, because they are considered too costly), future generations might regret the lack of action. Likewise, if reforms to address barriers are implemented, but it turns out that they were not necessary (perhaps because climate change impacts are not the same as were projected), future generations might regret the cost incurred for little benefit.

The potential for regret is a valid consideration in determining whether or not a reform would deliver a net benefit to the community. In deciding whether to implement a reform, decision makers should consider whether they (or their successors) might regret doing so (or not doing so), and the weight they place on the future regret. This could be influenced by:

- *the likelihood that the decision will be regretted*
- *the level of future regret* — How much will people regret the decisions in the future? For example, the more severe the impacts of climate change, the more future generations might regret that adaptation actions were not taken today.

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- *the timing of regret* — Current generations might not be concerned if decisions they make today are regretted in the distant future. (The present value of discounted future regret might be small.) But if decisions made today could lead to regret in the near future, the potential for regret could weigh more heavily on decision makers.
 - *attitudes to risk* — Some decision makers will be more concerned about future regret than others. For example, some might seek to minimise the damage incurred under ‘worst case scenarios’, while others might choose to implement reforms that are expected to deliver the largest net benefits under ‘central’ estimates of future climate change.

The potential for decisions made today to be regretted in the future should be considered when deciding which reforms should be implemented. However, potential regret does not imply any particular course of action. Instead, it strengthens the case for thorough analysis of the full range of options to address barriers to adaptation.

Consider a range of climate change scenarios

The benefits and costs of reforms to reduce barriers to effective adaptation will vary according to the future state of the world. Cost–benefit analysis should identify how different future scenarios would influence the benefits and costs of reform options. This should include consideration of a range of potential future climate change scenarios, and potentially other relevant factors, such as demographic change, patterns of settlement and economic development.

Sensitivity analysis

Cost–benefit analysis of adaptation reforms is built on assumptions, including assumptions about the future climate. Each assumption influences the estimates of the benefits and costs of policy options, and these results can be highly sensitive to changes in assumptions.

Sensitivity analysis involves systematically varying key parameters to see what effect this has on estimates of benefits and costs. For example, the benefits of building a flood levee to protect a town depend on flood levels. Under an assumption that a major flood would reach a height of three metres, the levee might look like a sensible investment. But if it is assumed that a major flood would only reach a height of one metre, the benefits of building the levee would be smaller, and other options might be preferred. Sensitivity analysis would involve estimating the benefits and costs of building the levee compared to other options for a range of

plausible estimates of flood levels. These estimates would all be reported, along with the best available information about potential future flood scenarios. Decision makers could then consider the risks they face and the potential benefits of reducing them.

As well as showing how different assumptions can change estimates of the benefits and costs of policy options, sensitivity analysis can highlight where policy outcomes are heavily influenced by one or two key assumptions or parameters. This could identify ‘pressure points’, which might require further analysis or consideration of other policy options to directly address them.

Scenario planning

One variant on sensitivity analysis that has been used in climate change adaptation is ‘scenario planning’. Scenario planning has been described as ‘a disciplined method for imagining possible futures’ (Shoemaker 1995, p. 25). Practitioners develop ‘scenarios’ that reflect possible future states of the world, and use these scenarios to inform decision making.

Scenario planning is related to, but not the same as, sensitivity analysis. Sensitivity analysis involves systematically varying parameters one at a time and tracing the effects of the change. Scenarios used in scenario planning ‘change several variables at a time, without keeping others constant’ (Shoemaker 1995, p. 27) to ‘explore the joint impact of various uncertainties, which stand side by side as equals’ (Shoemaker 1995, p. 26). So where there are numerous uncertain variables, sensitivity analysis might return dozens (or hundreds) of possible outcomes. Scenario planning would focus on a smaller number of possible outcomes.

For example, if a state government was considering new land-use planning laws to reduce the risk of damage from coastal inundation, it might choose to assess the policy options against ‘low’ and ‘high’ scenarios. The ‘low’ scenario could involve a small increase in inundation risk due to sea-level rise and modest population growth. The ‘high’ scenario could involve a significant increase in inundation risk and a large increase in population.

Where numerous important variables are subject to uncertainty, scenario planning can give a flavour of how changes in the state of the world will influence policy outcomes. While scenario planning might not be as thorough as sensitivity analysis (because fewer permutations are considered), it can be useful and informative if it is done rigorously.

Scenario planning has been used in many areas — the initial applications were in military planning, and it has since been adopted by many companies, as well as government and research organisations. Biggs et al. (2011) identified more than 30 examples where scenario planning has been used for climate change adaptation in Victoria.

Threshold effects, tipping points and non-linear changes

Climate change impacts are subject to threshold effects, ‘tipping points’ and non-linear changes in climate variables (chapter 2). The CSIRO (sub. DR136, p. 3) suggested that these characteristics mean that conventional economic analysis is not applicable to climate change adaptation.

Adaptation to climate change is a complex systems topic that, like sustainable development, is not adequately analysed in a conventional economic framework that is implicitly constrained by equilibrium thinking. Issues such as non-stationarity in the operating environment, thresholds and non-linear change, and emergent properties across scales cannot be addressed from within this framing.

These characteristics pose challenges for analysing the impacts of climate change. In turn, this can complicate the task of identifying the benefits of adaptation, and of reforms to address barriers to adaptation.

However, threshold effects, tipping points and non-linearity do not mean that the conventional approach to assessing reforms is not applicable to reforms targeting barriers to effective adaptation. Instead, these characteristics strengthen the case for rigorous case-by-case analysis of the benefits and costs of reform options, including sensitivity analysis and/or scenario planning. Decision makers should consider how threshold effects, tipping points and non-linearity influence the outcomes of reforms to address barriers. They can then make a decision based on the potential outcomes of the reforms, given the various possible scenarios.

Identifying ‘robust’ or ‘no regrets’ options

Using sensitivity analysis (or scenario planning) can help to identify policy options that are robust — options that will have benefits that exceed their costs under any future scenario (Ranger et al. 2010). Such options can also be thought of as ‘no regrets’, as they will not be regretted, regardless of how the future turns out. In general, the case for implementing ‘no regrets’ reforms is strong.

Consider the benefits and costs of flexible options

Several inquiry participants suggested that where the impacts of climate change are uncertain, policy responses that are flexible can have benefits over more rigid options. For example, the Department of Climate Change and Energy Efficiency (sub. 57, p. 2) suggested that:

‘Effective adaptation’ is the ability to make and implement the best possible decisions. In dealing with climate uncertainty, these decisions need to be timely, creative and flexible.

When analysing reform options, it is not sufficient to assert that flexible options are preferable. Rigorous analysis requires an assessment of the benefits of flexibility compared to less-flexible approaches. The most well-developed approach for assessing the benefits of flexibility is ‘real options’ analysis.

Real options

The idea of ‘real options’ is derived from the use of financial options. A financial option gives the option holder a right — though not an obligation — to take a particular action in the future (for example, to buy a share on a set date at an agreed price). ‘Real’ options are similar to financial options, but are exercised over real assets (rather than financial assets). This can include hard infrastructure (such as the option to build or extend a bridge or seawall), or less tangible actions (such as the option for a local government to exercise controls over a piece of land in the future).

The real options approach is based on the observation that few investment decisions are ‘now or never’. The same observation holds for decisions about reforms to address barriers to effective adaptation — given the long time frames involved, few policy options will be permanently closed off if they are not implemented immediately. Dixit and Pindyck (1995) observed that where this is the case, and where investments (or policy reforms) have high costs (particularly if the costs are irreversible) and there is uncertainty about the future, there can be benefits from:

- delaying the decision until better information about the future is available
- identifying options that allow for flexible responses as new information emerges
- taking action to reduce the level of uncertainty about the future.

Real options analysis seeks to identify and evaluate the benefits and costs of various policy options (including flexible and inflexible options) to help policy makers identify the best approach to take. This approach is likely to be useful where there is uncertainty about the future, but a reasonable expectation that the uncertainty will be reduced over time. Climate change adaptation could involve large, costly and

potentially irreversible investments made in the context of uncertainty about the future. Dobes (2008, 2009, 2010) suggested that these characteristics mean that the real options approach can lead to better climate change adaptation decision making.

Linquiti and Vonortas (2011) demonstrated a technique for estimating the value of real options for climate change adaptation. Using simulations of possible sea-level rise scenarios over the next 100 years, they assessed various strategies for the coastal defence of two cities: Dhaka (Bangladesh) and Dar-es-Salaam (Tanzania) (box 5.5). A general conclusion from the results of Linquiti and Vonortas is that the benefits and costs of adaptation strategies depend on circumstances. For example, their results suggested that for each strategy, the estimated number of fatalities in Dhaka would be greater than in Dar-es-Salaam — the ‘predict and respond’ strategy, which incorporates a real option, would almost entirely avoid fatalities in Dar-es-Salaam, but would lead to almost 18 000 fatalities in Dhaka. This emphasises the importance of case-by-case analysis of policy options, taking into account all of the relevant circumstances.

Linquiti and Vonortas reached a number of conclusions about the value of real options in cases where there is uncertainty.

- There can be value in flexibility, but it is not always the case that a more flexible option is more valuable.
- Real options are more valuable if there is greater volatility in the underlying variable. Linquiti and Vonortas found that the value of flexibility increased if future sea-level rise is more volatile (that is, there is a larger ‘spread’ of possible sea-level outcomes).
- For flexible options to deliver benefits, they need to be structured in a way that gives the decision maker time to respond as uncertainty is resolved.
- Reactive strategies can have high costs. In both cities, the ‘sense and respond’ strategy was estimated to have the highest costs of any option.

These conclusions suggest that policy makers should consider (but not automatically favour) policy options that build in flexibility to respond as uncertainty is reduced in the future. Real options analysis can help to identify the potential benefits and costs of more and less flexible strategies, of delaying action, and of taking action to reduce the level of uncertainty about the future.

Box 5.5 Comparing adaptation strategies

Sea-level rise could make the cities of Dhaka and Dar-es-Salaam increasingly vulnerable to inundation. This could lead to fatalities, population displacement and damage to economic assets. This damage could be partly or fully mitigated by building seawalls. However, building a seawall would have costs. Planners have to decide whether to build a wall, how high to build it and when to commence construction.

Linquiti and Vonortas (2011) assessed three strategies for coastal defences for each city to determine which would have the lowest total cost. The total cost of each strategy depends on the height of the seawall. It consists of two elements.

- Building and maintenance costs — based on the height of the seawall.
- Damage costs — the damage that occurs in each year (to economic assets and populations). If the maximum simulated sea level in a given year was less than the height of the wall, damage would be zero. If the maximum sea level exceeded the height of the wall, there would be some damage.

Strategy 1: Inflexible

The 'inflexible' strategy involves making a single decision at the beginning of the 100 year period. Planners estimate the likelihood of various future inundation scenarios and based on those decide to build a seawall between 0 and 10 metres high.

Strategy 2: Sense and respond (real option)

Planners continuously observe the sea level, and have the option to raise the height of the seawall at any time. If the sea level comes to within a pre-determined height of the top of the wall, the wall is extended to give an additional safety margin.

Strategy 3: Predict and respond (real option)

Planners continuously observe sea-level trends. However, they only have the option to raise the height of the wall once every 20 years (that is, in years 1, 21, 41, 61 and 81). The decision is based on observations of changes in the sea level over time, and forecasts of the trend for the next 20 years.

Consider implementation issues

Just as there is uncertainty about the impacts of climate change, there will be uncertainty about the effectiveness of reform options. A reform that looks like an effective way to address a barrier to adaptation might run up against circumstances that diminish its effectiveness in practice. These could include legal, political and cultural factors that were not considered at the time the reform was introduced. This is why consideration of practical issues and their potential to stymie the implementation, or undermine the effectiveness of reform options, is part of the standard approach to policy analysis (box 5.2).

Where reforms to reduce barriers to effective adaptation involve effectively ‘one-off’ actions, such as removing taxes or regulations that reduce the adaptive capacity of the community (chapter 6), analysing the risks to their implementation should be relatively straightforward. Other reforms to address barriers might require ongoing commitment, and their effectiveness could be undermined if they do not prove durable. These types of reforms are potentially subject to a wider range of risks to their implementation and effectiveness.

Previous experience with structural changes provides some guidance on the kinds of issues that could reduce the effectiveness of reforms with long lead times. Drawing on the example of industry assistance, Banks (2010, p. 55) observed that where policies create *de facto* entitlements, ‘pressures for their retention ... can be politically difficult to overcome’. These pressures can mean that policies that require particular actions by future governments may not be adhered to.

The potential for policies to fail to achieve their objectives is pervasive through all areas of public policy. It is not necessarily more significant for climate change adaptation than for any other issue. However, the long lead times and uncertainty about the circumstances under which policies will be operating in the future strengthens the case for reflection on the risks that might undermine their effective implementation and operation.

5.3 Identifying priority reforms

Based on research, consultation with stakeholders and evidence received in submissions, the Commission identified a number of areas where reforms to address barriers could facilitate effective climate change adaptation. Some broad economic reforms would increase the flexibility of the economy to adapt to the current climate and build capacity to adapt to future climate change (chapter 6). In other cases, reforms that are targeted at particular sectors or policy areas would be justified.

There are some areas where the most material barriers to climate change adaptation could be reduced through broad reforms, without the need for sector-specific reforms. For example, the Commission did not identify any material barriers to adaptation that are specific to the transport, forestry or tourism sectors. Other reforms with cross-cutting effects (such as in land-use planning, hazard information provision and disaster-recovery arrangements) would facilitate adaptation in a range of sectors.

Addressing barriers to risk management in the current climate

Climate variability and extreme weather events are imposing costs on people today. Climate change is expected to lead to greater variability and potentially more frequent or intense extreme weather events. This implies that there are almost certain to be benefits from reforms that address barriers to managing the risks people face today. Further, these types of reforms are likely to provide a sound basis for adaptation to future climate change. Provided the costs are proportionate, it is highly likely that such reforms would deliver net benefits, leading to an overall increase in the wellbeing of the community.

Other organisations assessing different types of climate change adaptation action have reached similar conclusions. For example, the *Economics of Climate Adaptation Working Group* was formed in 2008. It included governments, non-government organisations, Swiss Re — a global reinsurer — and McKinsey and Company — a consulting firm. The Working Group sought to develop a framework to quantify the risks posed by climate change, and the costs and benefits of adapting to the risks. As part of developing its framework, the Working Group assessed the potential impacts of climate change in eight countries, including developed and developing countries. It found that ‘the greatest risk posed to most economies over the next two decades stems from historical climate patterns’ and that impacts from existing climate patterns could lead to losses of between 1 and 12 per cent of GDP (Economics of Climate Adaptation Working Group 2009, p. 36). The Working Group found a compelling case for taking action to increase resilience to today’s risks. It stated:

Not only will this address today’s greatest climate-related losses, it will also be an important precautionary measure against a range of possible climate change scenarios — including those towards the severe end of the range. (Economics of Climate Adaptation Working Group 2009, pp. 43–4)

The UK Adaptation Sub-Committee assessed progress in adaptation to climate change and made recommendations for steps that the United Kingdom should be taking now (appendix C). One recommendation was that:

... the UK should focus early adaptation efforts on decisions ... that are sensitive to present-day climate variability and therefore where preparing for climate change will provide both immediate and future benefits. (Adaptation Sub-Committee 2010, p. 8)

The Commission has identified a number of reforms across the priority areas that would reduce or remove barriers to dealing with current climate variability, and would contribute to adaptation to future climate change.

Addressing barriers to adaptation to future impacts

Some barriers to effective adaptation are not having material effects today, but could prevent effective adaptation to the long-term effects of climate change (such as sea-level rise). In some cases, reforms to address these barriers would have benefits in the short term that exceed the costs, and the case for action is clear. In others, the benefits of the reforms are less certain. In these cases, it may be preferable to focus the reform effort on preparatory action, including research and community consultation.

While policy options should be assessed on a case-by-case basis, where there is a relatively long period between the costs being incurred and the benefits being received, it is more likely that the benefits will exceed the costs if:

- the up-front costs are relatively low, and the potential benefits are large
- the reform is expected to deliver benefits under a range of climate scenarios.

Ongoing review

If reforms are implemented to address barriers to effective adaptation, governments should establish a review process to evaluate their effects. This is part of the standard approach to good-practice policy making, and is important in the case of climate change adaptation.

Individual policies should be evaluated once they have been in operation for long enough to draw conclusions about their effectiveness and efficiency. Such reviews can lead to improvements to individual policies, and can also help to identify leading practices and future reform priorities.

RECOMMENDATION 5.1

Reforms to address barriers to effective climate change adaptation should be assessed on a case-by-case basis to determine whether they are likely to deliver net benefits to the community. This should include consideration of any risks to their implementation.

If there is a high degree of confidence that reforms will deliver net benefits, they should be implemented without delay.

If there is uncertainty about the net benefits of reform options, there could be a case for delaying implementation or adopting a flexible approach until decision makers have better information on the factors that affect their decisions, particularly if the up-front costs are large and the benefits are likely to be distant.

6 ‘No regrets’ policies

Key points

- Policy reform options that are aimed at responding to market failures and improving existing policies and regulations would help the community both deal with the current climate and build capacity to adapt to future climate change.
- These ‘no regrets’ reforms enhance the capacity of the community to respond to climate change.
 - They would increase the prosperity of the community, providing the means to better respond to changes.
 - They would encourage a more efficient allocation of resources — land, labour, and capital — which will support many kinds of adaptation decisions.
- Poorly designed government policies can reduce the capacity of the community to respond to both the current climate and future climate change.
 - Taxes can impede effective climate change adaptation if they limit or delay adaptation decisions.
 - Government transfers can reduce incentives to adapt to change over the longer term.
 - Regulations can increase the costs of adaptation, impede the mobility of workers and businesses, limit the efficiency of markets, and distort resource allocation.

6.1 Economic reform and adaptation

Policy reform options that are aimed at addressing market failures and improving existing policies and regulations would also help the community both deal with the current climate and build capacity to adapt to future climate change. These options are sometimes referred to as ‘no regrets’ or ‘win win’ policy measures. They include economic reform in a broad range of areas (box 6.1). These reforms are justifiable in their own right, and they would also enhance the adaptive capacity of the economy and enable the community to more effectively respond to future climate change. Climate change therefore strengthens the case for such reform.

Box 6.1 **Objectives and benefits of economic reform**

Economic reform involves changes in government policies, regulations and institutional arrangements that affect the incentives and economic behaviour of governments, firms, individuals and households. The objective of economic policy generally is to improve community living standards. The scope for reform is therefore very wide. It can be applied to the processes of production, distribution and consumption in all areas of the economy.

Economic reform often entails the use of market-oriented approaches to delivering outcomes. These approaches can improve the allocation of resources, enhance consumer choice, and reinforce incentives for firms and individuals to be more productive.

Reform that strengthens incentives for resources to move to activities and areas where they are most valued is particularly relevant to climate change adaptation. This is because climate change can be expected to change the economic value of certain activities and resources, such as water, tourism, and land. Thus, policy settings that enable resources to move flexibly through the economy are likely to improve adaptive capacity and enhance the wellbeing of the community.

While market-based mechanisms can play an important role in increasing efficiency and productivity, and ultimately raising the living standards of Australians, they may not be appropriate in all circumstances. This is particularly the case where there are tradeoffs between efficiency and equity outcomes, or when markets cannot adequately reflect all values, such as the cultural or amenity value of the environment. This is important for climate change adaptation as climate change is likely to affect a broad range of environmental assets and ecosystems that are valued by Australians.

In these cases, the challenge is to implement reforms that are efficient yet also recognise other equity objectives and community values. Thus, there is a role for governments to intervene where markets fail and where intervention can improve market outcomes.

Sources: PC (1996, 1999).

Economic reforms that improve the operation of the economy enhance the adaptive capacity of the community by enabling continual adjustment to change — including but not limited to climate change. These reforms would increase the productivity and flexibility of the economy and ultimately increase the prosperity and wellbeing of the community. They would also facilitate the reallocation of resources that will occur in response to long-run climatic changes (such as increasing temperature and changing rainfall patterns). This will be important for adaptation because, for the most part, adaptation will occur autonomously through market exchanges of goods and services (chapter 3). Economic reform would also provide the means to better respond to shocks, such as those related to extreme weather events, which are expected to become more frequent and/or intense as a result of climate change.

Governments sometimes initiate economic reform to address a market failure or in response to equity considerations, for example, to moderate the distributional impacts of policies or market outcomes. Reforms are also often initiated to address the unintended outcomes of poorly designed or implemented policies. For example, where regulations or taxes have perverse effects on behaviour this could affect some adaptation decisions. Regardless of the motivation for economic reform, the ultimate objective is to improve the wellbeing of the community through a more efficient and equitable allocation of resources.

While broad-based economic reforms should be high priority, they are not sufficient to address all barriers to climate change adaptation. Some reforms that increase prosperity could in some circumstances increase exposure to climate change impacts — for example, higher incomes may raise the demand for larger, more expensive, houses located in areas at high risk from natural hazards. This reinforces the case to address specific policy barriers to adaptation in addition to implementing broad-based economic reform.

Governments have a number of policy levers available to achieve reform objectives, including taxes, transfers, and regulations (chapter 5). This chapter focuses on broad-based economic reform in these areas, drawing on specific examples where the case for reform has already been well established. Other reforms that would address more specific barriers to adaptation and that would also improve the adaptive capacity of the community in the current climate are discussed in the following chapters.

6.2 Taxation

Some taxes can distort the way people use resources and can result in an allocation of resources that does not maximise the wellbeing of the community. They can be a barrier to effective adaptation to climate change if they influence the adaptation decisions or actions of households, firms or consumers. Some existing taxes have the potential to do this, notably, state-based property taxes. Replacing these taxes with less distortionary taxes would benefit the community and facilitate adaptation by enabling resources to be used where they provide the greatest value.

Example: property taxes

There are two property taxes in particular that, in their current form, have a distortionary effect on property decisions and could impede climate change adaptation. These are conveyancing duty on property (imposed at the time of the

transfer of property ownership) and land tax exemptions (land tax is imposed annually on the value of some classes of land).

Conveyancing duty

Conveyancing duty imposes additional costs on property transactions. Duty is applied at a progressive rate and thresholds and rates differ between property types and states and territories. This results in a lower level of property exchanges than would occur in the absence of the tax, which could affect climate change adaptation in a number of ways. By making housing transactions more expensive, conveyancing duty could cause some property owners to remain living in a property for longer than they otherwise would — the so called ‘lock-in’ effect (PC 2004a).

For example, homeowners who desire to move out of areas at greater risk from extreme weather events may be discouraged from doing so due to conveyancing duty. This view was supported by the Council of Capital City Lord Mayors (sub. 67, p. 5), who stated that ‘state government transfer duty on land limits the mobility of communities to adapt to our changing climate by increasing the cost of any relocation’.

The ‘lock-in’ effect could also affect labour and capital mobility if it inhibits people from moving and changing jobs, or businesses from changing locations. This may be important for some types of adaptation strategies. Businesses also tend to be more mobile than consumers and face incentives to minimise their costs, including costs associated with transactions and investment in property (Treasury 2010a). Therefore, the ‘lock-in’ effect could prevent them from adjusting to market conditions and result in land being retained in less productive uses.

As conveyancing duty applies to the value of the whole property (land and buildings) it also taxes buildings and other capital improvements (SBTRC 2001; Treasury 2010a). This could affect adaptation if it deters property owners from undertaking improvements that protect their property from the effects of climate change.

Reform areas

The distortionary effects of conveyancing duty have led the Commission and others to urge state and territory governments to consider their removal, or significant reduction, with greater reliance on more efficient taxes, such as broad-based land taxes (discussed below) (Gabbitas and Eldridge 1998; IPART 2008; PC 2004a; SBTRC 2001; Treasury 2010a). Depending on the precise changes, such an

approach could maintain the revenue base of the states and territories and have little effect on housing prices in the short term. This is because the increase in housing prices resulting from the removal of conveyancing duty could be offset by increased obligations to pay ongoing land tax (PC 2004a). The ACT Government recently announced that it would abolish stamp duty over a 20 year period, from July 2012, with the revenue loss mainly offset by changes to the land tax and general rates system (ACT Government 2012b). A number of states also have exemptions or concessions from conveyancing duty for particular types of property, for example, for property that is intended to be used as a principal place of residence and for property purchased by first home buyers.

Land tax exemptions

In comparison to conveyancing duty, land tax is an efficient form of taxation as it does not distort decisions on how land is used or how much land is used — land is immobile and in fixed supply. However, this depends on a broad land tax base, with no or few exemptions.

State and territory governments provide various land tax exemptions, most importantly for land used for owner-occupied housing and agricultural purposes (NSW Treasury 2011). These exemptions are often provided due to concerns about cash-flow difficulties for the ‘asset-rich income-poor’.

Exemptions can encourage land to be devoted to exempt activities (Gabbitas and Eldridge 1998; IPART 2008; Treasury 2010a). This could impede climate change adaptation. For example, exemptions for agricultural land could encourage marginal farming businesses to continue using land (and associated labour and capital resources) for agricultural purposes rather than for more productive, non tax-exempt, activities. While this distortion may be small it could nonetheless contribute to the inefficient use of land, which is contrary to facilitating structural adjustment to climate change. Exemptions may also pose an impediment to biodiversity conservation if the exemption is lost when the land is converted to conservation (PC 2004b).

The existence of tax-free thresholds may also encourage smaller holdings of land (Gabbitas and Eldridge 1998), as could higher taxes on aggregate land holdings (Treasury 2010a). This could restrain economies of scale and scope, and could potentially impede diversification that might be important for some adaptation decisions.

Reform areas

Reforms to land tax could improve incentives for efficient land use and at the same time be beneficial for adaptation. For instance, broadening the land tax base, combined with a lowering of the land tax rate, would improve the overall efficiency of the tax (Gabbitas and Eldridge 1998; IPART 2008; PC 2004a; SBTRC 2001). This would help facilitate adaptation as it would remove a potential impediment to structural change, particularly in the agricultural sector.

The extension of land tax to owner-occupied land, and to a lesser extent agricultural land, is a highly contentious area. The Commission's 2004 inquiry into first home ownership discussed some of these issues at length. These principally related to payment difficulties for landowners who have high-value landholdings but limited cash flows (the 'asset-rich income-poor') but also included a number of implications for tax administration and compliance (PC 2004a). *Australia's Future Tax System Review* outlined a number of instruments that could be used to address these issues, including loans, deferred tax liabilities, or reverse mortgage facilities.

6.3 Government transfers

Governments often use transfers (financial assistance) to achieve equity objectives, or to address the adverse effects of adjustment on particular groups — these effects can originate from market-related influences, or as a consequence of changes in government policy (for example, climate change mitigation policy). Assistance to ameliorate adverse effects is sometimes warranted, particularly for economically or socially disadvantaged individuals or communities (chapter 3). However, if not provided appropriately, transfers can reduce incentives to adjust to changing circumstances, such as climate change. Reform to transfers — to ensure incentives for adjustment and innovation are maintained — has the potential to increase the wellbeing of the community. These reforms would also help to facilitate adjustment to climate change, strengthening the general case for reform.

Example: drought assistance

Climate change is expected to increase the frequency of drought in Australia (chapter 2). This will place pressure on many farming businesses. While the agriculture sector has a strong record of coping with drought and other changes, Australian governments have for many decades provided support to farmers in drought-affected regions. The existing structure of drought support reduces the

incentives for agricultural businesses to adapt to both the current climate and future climate.

In 2009, the Commission undertook an economic assessment of drought support measures as part of the National Drought Policy Review. This analysis found that government support was diminishing incentives for farmers to manage and prepare for drought (PC 2009). The Commission's recommendations concentrated on refocusing drought policy on risk management and climate change adaptation more broadly, so that support could be better directed at improving farmers' self-reliance and preparedness (box 6.2).

Box 6.2 The Commission's inquiry into drought support

The Commission's inquiry into drought support measures was conducted as part of a trio of assessments for the National Drought Policy Review in 2009. In addition to the Commission's inquiry, the review included a climatic assessment and an assessment of the social impacts of drought on farm families and rural communities. The inquiry delivered a number of findings and recommendations, including that:

- the National Drought Policy's exceptional circumstance declarations and related drought assistance programs do not help farmers improve their self-reliance, preparedness and climate change management
- a number of Exceptional Circumstances associated programs should be terminated, including interest rate subsidies, farm exit support packages, and small business income support, as should state-based transport subsidies in drought declared areas
- all farm households in hardship — regardless of cause or location — should have access to an income support scheme that is designed for farming circumstances, available on a time-limited basis, and involves a 'mutual responsibility contract' — specifying actions to be taken to improve self-reliance. In most cases, this would involve a household or farm financial plan
- significant public funding be directed to training and advice to assist farmers to prepare for, manage and recover from the impacts of climate variability and change.

Source: PC (2009).

In coming to these recommendations, the Commission found that long-term government support encourages dependency. This reduces incentives for self-reliance and preparedness, perpetuates many of the social problems associated with drought, and generally impedes adjustment in the sector (PC 2009). This clearly influences farming businesses' capacity to adapt to the effects of climate change.

Following the release of the Commission’s draft report and other reports of the National Drought Policy Review, ministers with responsibility for primary industries agreed to a number of principles for national drought assistance reform. These principles included abolition of the ‘exceptional circumstance’ trigger for drought assistance and the development of farm income support on the basis of mutual responsibility (box 6.2) (PIMF 2008). The Australian Government conducted a pilot of drought-reform measures in parts of Western Australia in conjunction with the Western Australian Government. The pilot concluded on 30 June 2012 — it was initially scheduled to run from 1 July 2010 to 30 June 2011 but was extended for an additional year. The Western Australian pilot adopted many of the recommendations in the National Drought Policy Review and was aimed at moving towards a ‘risk management’ approach to managing drought. The reform measures are therefore highly relevant to building adaptive capacity in the agricultural sector. An initial review of the pilot program in 2011 was generally supportive of the reforms but made a number of recommendations for change, some of which echo the Commission’s recommendations in its 2009 inquiry (Keogh, Granger and Middleton 2011).

In April 2012, the Council of Australian Governments tasked the Primary Industries Standing Committee with responsibility for developing a new drought support package for consideration by COAG in October 2012. The new arrangements will be introduced from 1 July 2014 and will not include the exceptional circumstances interest rate subsidy or exit grants (COAG Standing Council on Primary Industries 2012).

6.4 Regulation

Regulations are necessary to ensure a properly functioning society and economy. However, in some cases, regulations can impose costs where they fail to achieve their objectives or achieve objectives at greater than the minimum cost. Reforms to these regulations could increase the wellbeing of the community by improving the allocation of resources and reducing compliance costs for households and businesses.

Example: water sector regulation

Climate change will place further pressure on Australia’s water resources. There will be changes in both the availability and demand for water. Adaptation to climate change reinforces the imperative to use scarce water resources efficiently and undertake water supply augmentation options in the most cost-effective way.

Australian governments have come a long way in improving the flexibility and efficiency of water markets. The 2004 National Water Initiative, and its predecessor, the 1994 Council of Australian Governments Water Reform Framework, succeeded in achieving reforms in many areas, including the establishment of secure and tradable water rights, agreement on the removal of barriers to water trading in the rural water sector, and various other pricing and institutional reforms in the urban water sector. These reforms, although yet to be fully implemented, have enabled users to respond to changes in water availability and mitigate the impact of drought on agricultural production (NWC 2011b). They have therefore been highly beneficial in responding to climatic variability and are likely to be valuable for adaptation to future climate change.

Reform areas

Despite substantial progress there is still scope for further water policy reform, and climate change strengthens the case for reform. Potential areas of reform include the removal of remaining barriers to trade in the Murray–Darling Basin, the establishment of new water markets, more cost-reflective water pricing, and improvements in the way water supply is procured and allocated in the urban water sector (box 6.3). These reforms would help to build adaptive capacity by enabling water resources to be allocated to their highest-value use.

The establishment of new water markets provides additional water sources for farmers and other water-dependent businesses during times of drought and low water availability, thus enabling them to adapt to the effects of climate change on water. Reforms to make water prices better reflect the costs of supplying water can signal the need for investment in new supply capacity during times of high demand and low water availability. More cost-reflective pricing also provides a signal to consumers about the cost of their consumption decisions. This can guide behaviour, leading to a more efficient allocation of scarce water resources.

There are a number of challenges associated with implementing these remaining reforms. Not least of these challenges is the need for political commitment to promoting the use of water resources and water infrastructure in a manner that maximises the net benefit to the community. There is also a need to address the tension between providing water for consumptive uses and environmental uses. Nevertheless, the case for continuing reforms is made stronger by climate change. It is opportune to implement reform now while there is less concern about water-supply security in most parts of Australia than there has been in recent years when much of Australia was subject to drought conditions (PC 2011a).

Box 6.3 Further reforms to Australia's water sector

The Commission has previously considered the case for economic reform in Australia's urban and rural water sectors (PC 2010b, 2011a). Several of the high-priority reforms identified in these reports are discussed below.

Urban water sector reforms

- *Policy, governance and institutions* — there is a need to establish clear objectives, clarify the roles and responsibilities of water-related institutions and to ensure that best-practice institutional and governance processes are adopted to make regulators, utilities and policymakers responsible and accountable for their actions.
- *Procurement of supply and water allocation* — water-supply security at a lower expected cost could be achieved by governments removing 'policy bans' on supply augmentation from certain sources, such as rural–urban trade and water recycling. Employing a real options approach to selecting supply options would also assist in reducing costs to the community.
- *Water restrictions and pricing* — water restrictions are costly to the community and should only be used in emergency situations. Consumers should be offered a range of tariff/service options (based on the marginal cost of supply) that allow consumers to express preferences on security of supply and price stability.

Rural water sector reforms

- *Removal of barriers to trade in the Murray–Darling Basin* — annual caps on the trade of water entitlements out of an irrigation district distort trade and should be eliminated. In this context, the Commission endorses the trading rules set out in the proposed Murray–Darling Basin plan that allows water to be traded free of any restrictions.

A number of these reforms have been supported by the National Water Commission (for example NWC (2011b)). In addition, the National Water Commission has outlined several other areas of reform. These include improvements to the efficiency of existing markets, such as improving price information for water trades in the Murray–Darling Basin, and the facilitation of new water markets for both surface water and ground water in areas outside the Murray–Darling Basin (NWC 2011a). These reforms also offer benefits for climate change adaptation.

Sources: NWC (2011a, 2011b); PC (2010b, 2011a).

Example: electricity price regulation

The price of electricity can influence climate change adaptation decisions. For example, some households may use air-conditioners to manage increased temperatures (and thus face a higher electricity bill) while others may install double glazed windows or window blinds.

Where electricity prices are not fully reflective of the true costs of electricity supply, adaptation decisions may be distorted. Governments currently impose a number of constraints on electricity prices. For example, despite the widespread introduction of smart meters, the Victorian Government has introduced a moratorium on time-of-use pricing. In all other jurisdictions, retail price caps persist (though the Tasmanian Government has announced full retail competition from 1 January 2014). This is despite agreement by all governments for the removal of price caps where competition was found to be effective (PC 2012b).

In addition to distorting price signals to consumers, price caps may discourage competition, innovation, and time-of-use pricing (PC 2012a). The Commission has previously recommended that retail price regulation in fully contestable energy markets be removed (PC 2008b). The Commission also recommended that ensuring disadvantaged consumers have access to affordable utility services should be pursued through transparent community service obligations or other targeted mechanisms that are monitored regularly for effectiveness.

Example: regulations affecting business

A broad range of regulatory reform priorities have been identified in the COAG *National Partnership Agreement to Deliver a Seamless National Economy* (box 6.4). These reforms are intended to provide businesses with greater flexibility in shifting resources between jurisdictions, provide smaller firms with greater access to interstate markets, and ultimately reduce the cost of doing business (PC 2012d). While such reforms are beneficial in their own right, they could also facilitate effective climate change adaptation. Businesses that are flexible, less bound by regulation and more competitive should be better able to respond to current and future changes in the environment in which they operate, including climate change.

More broadly, appropriate regulatory reform facilitates adaptation by improving the efficiency and competitiveness of the economy and by reducing the costs of goods and services. For example, streamlining and harmonising construction codes for building and plumbing, combined with a more flexible compliance regime, could lower the cost of compliance for construction businesses operating across jurisdictions and could therefore lower the cost of construction (PC 2012c). This could potentially have flow-on benefits for building owners who wish to undertake construction works to protect their property from the effects of climate change. (Chapters 9 and 10 discuss planning and building issues in more detail.)

Box 6.4 **COAG competition and regulatory reform**

The *National Partnership Agreement to Deliver a Seamless National Economy* outlines 27 priorities for deregulation, 8 areas for competition reform and ongoing reforms to improve processes for regulation making and review. The reforms focus on addressing regulatory and other barriers that impede competition and economic efficiency and add to costs. Many reforms are aimed at reducing the regulatory burden imposed on businesses which operate in multiple jurisdictions.

The 27 areas identified for reform involve:

- developing national regulatory systems (for example, trade licensing, registration of business names and construction codes)
- establishing nationally uniform occupational health and safety systems
- establishing nationally consistent systems (for example, payroll tax administration, mine safety and directors' liability)
- improving and/or reducing the burden that regulation places on business (for example, development-assessment processes, food regulation, oil and gas regulation and standard business reporting).

Competition reforms include:

- rationalisation of occupational licensing
- changes to the national access regime for infrastructure
- implementing previously agreed reforms in the areas of energy, transport and infrastructure.

Timetables for implementing the reforms are outlined in the implementation plan attached to the National Partnership. The Commission has assessed the costs and benefits of 17 of the Seamless National Economy Reforms. Modelling suggests that if full implementation of reforms ultimately occurs and business and consumers respond in accordance with expectations, the reforms assessed could raise GDP by around 0.4 per cent in the longer run (over \$6 billion) (PC 2012d).

Sources: PC (2010a, 2012c, 2012d).

Another example is national licensing of occupations — this could make it easier for workers to take advantage of employment opportunities in other states and territories. Similarly, a national system for registering business names could make it easier for businesses to trade in different jurisdictions. Such flexibility contributes to building Australia's adaptive capacity.

RECOMMENDATION 6.1

Australian governments should implement policies that help the community deal with the current climate by improving the flexibility of the economy. This would also build adaptive capacity to deal with future climate change. This includes reforms to:

- *taxes that influence the way resources are used, such as land tax exemptions and conveyancing duty, which could inhibit the mobility of labour or capital*
- *government transfers that reduce incentives to adjust to changing circumstances, such as reforms to drought support as outlined in the Productivity Commission's 2009 inquiry*
- *regulations that impose unnecessary costs or inhibit competition or flexibility and could impede climate change adaptation by reducing the ability of businesses, households or other entities to respond to changing circumstances, such as restrictions to water trading.*

7 Information provision

Key points

- Information is essential for effective climate change adaptation. Individuals, businesses, governments and community organisations require information to raise awareness of the need to adapt, to help inform them how to adapt effectively and to enable the appropriate management of climate risks.
- Basic information on current climate risks and climate change tends to be funded by governments because it is required by governments to undertake their own functions, including the maintenance of public assets and the provision of public goods and services. Unless there are overriding reasons for non-disclosure, this information should be made publicly available.
- Where market failures lead to the underprovision of information, governments may also fund information for the wider community. In the absence of market failures, specific or customised information should be acquired privately.
- Better provision of information by government could include improving weather forecasting capacity, better aligning adaptation research with the needs of users and providing regional-scale projections of climate change.
- The consistency, quality and dissemination of risk information related to natural hazards in the current climate also need to be improved. The Australian Government initiative to improve the quality, coordination and sharing of flood-risk information is an important first step. Over time it should be expanded to encompass other natural hazards and take into account climate change.
- In other areas, arrangements are already in place to facilitate the sharing of information by governments. In some cases, such as coastal information, there could be scope to build on these arrangements.
- Even if information is produced and shared effectively, individuals may not make effective use of the information. In some circumstances, further tailoring of information and/or public engagement may be necessary to support effective adaptation.
- Where state and territory governments require local governments to provide information to property owners on current and future climate risks, they must ensure local governments are adequately resourced to provide accurate information and that they have sufficient guidance to ensure consistent outcomes.

7.1 Information for adaptation

Information is crucial both to manage risks in the current climate and to effectively adapt to climate change. Information can increase awareness of climate risks and recognition of the need to adapt. It can also inform risk management decisions about when and how to best adapt, and allow adaptation actions to be prioritised.

Individuals, businesses, governments and the wider community may be affected by climate change in a variety of ways. Consequently, demands for climate change information are considerable and diverse. Individuals need information to help ensure their personal safety, protect their property and their livelihoods, and maintain their wellbeing. Businesses need information to make investments, develop new products, manage their assets and protect their employees. Governments need information to provide public goods and services, protect public assets and make decisions about planning and land use.

Who should provide information to support adaptation?

Basic climate information (and underlying research), such as national and regional projections of climate change, is often funded by governments. There are two overlapping reasons why governments may fund the provision of basic information. First, market failures may lead to basic climate information being underprovided by the private market. Where the benefits of doing so exceed the costs, there is a case for governments to fund the provision of this information. Second, governments may fund the provision of information if it is necessary to maintain or improve government functions (box 7.1).

In the absence of market failures, it is the responsibility of individuals and businesses to fund the provision of more customised information for their specific circumstances. For the most part, individuals and businesses bear the costs of the climate change related risks that they face and therefore individuals and businesses have incentives to seek out and acquire the information that best suits their needs.

Public funding decisions for adaptation information and research will need to be made on a case-by-case basis and informed by the best available evidence (qualitative or quantitative) of the costs and benefits of each project. In assessing the costs and benefits of projects and determining priorities for funding, it is important to take account of the long time frames and uncertainties related to climate change impacts (chapter 5). In many instances, information about current climate risks may have larger benefits to the community than information specific to future climate risks. For example, information on bushfire preparedness may

foster effective adaptation by better equipping households to cope with the risk of bushfire under the current climate.

Box 7.1 Why do governments produce adaptation information?

Improving government functioning

Climate change has the potential to affect a wide variety of government functions, including the maintenance of public assets, the provision of healthcare and emergency services, and the protection of the environment. Governments may fund the production of a range of climate change related information to assist in carrying out these functions. For example, to inform decisions about the protection of public assets, the Australian Government has commissioned vulnerability assessments of Australia's national parks, nature reserves and World Heritage properties (DCCEE 2012c).

Correcting market failures

Governments may also provide information to the public to address underprovision by the private market. In relation to information for climate change adaptation, market underprovision mainly occurs because information has public-good characteristics. However, there may also be cases where government provision could be justified on the basis of significant positive spillovers (when the benefits of information use to the community exceed the benefits to the individual user) or information asymmetry (chapter 4).

Public good information

Information can be considered a public good when the same piece of information can be used by more than one person and it is difficult to exclude others from using the information. A wide range of climate change adaptation related information may be produced by governments as public goods. For example, the Climate Commission, established by the Australian Government, has produced a number of reports which provide synthesised evidence of the expected regional impacts of climate change on Australia (Climate Commission 2011a).

Current arrangements for government information provision

A wide variety of information is already provided by governments to manage current climate risks and support adaptation (box 7.2). In some cases, information is produced directly by government departments and agencies. In other cases, governments fund other organisations and businesses to produce climate change information on their behalf.

Box 7.2 Examples of information provided by governments

Climate change trends and projections

- The Bureau of Meteorology produces information on climate trends including monthly, seasonal and annual climate statements. Together with the CSIRO, the Bureau has also released *State of the Climate* publications to outline long-term trends in Australia's climate and provide analysis of the factors that influence it.
- The CSIRO and the Bureau of Meteorology have also produced national and regional climate change projections covering a wide range of variables.

Climate change impacts and vulnerability assessments

- The Department of Climate Change and Energy Efficiency has commissioned vulnerability assessments across a range of areas including investigation of climate change impacts on Australia's coasts, biodiversity and World Heritage properties.
- The Australian Bureau of Agricultural and Resource Economics and Sciences has produced publications on the impacts of climate change on agriculture, fisheries and forestry.
- The Great Barrier Reef Marine Park Authority has produced a Great Barrier Reef vulnerability assessment and a report on the Reef's outlook.
- Government-funded research through universities and other research bodies produces information on climate change impacts and options for adaptation.
- Geoscience Australia develops, manages and distributes a range of national data products that underpin vulnerability assessments. For example, the National Coastal Geomorphic Database underpins the assessment of responses to future sea-level rise.
- The Climate Commission provides general information on climate trends, projections and impacts to raise public awareness of climate change.

Natural hazard risk information, advice and guidance

- State and local governments produce maps of natural hazard risks (such as floods and bushfires) to inform land-use planning and emergency management.
- Geoscience Australia develops models, information and tools to analyse natural hazard risks and impacts in the current climate and possible future climates.
- Government agencies involved in emergency management produce information to assist the wider community to prepare for natural hazards. For example, the Victorian Country Fire Authority provides Fire Ready Kits with information on how to prepare for a bushfire, and operates the Victorian Bushfire Information Line to provide advice on reducing bushfire risks as well as information on current bushfire incidents.

Sources: ABARES (2012); BOM (2012b); CFA (2012b); CSIRO (2007); DCCEE (2012d); GBRMPA (2012); Geoscience Australia (sub. DR167; 2011); Victorian Department of Sustainability and Environment (2011).

Frequently, information is an outcome of government-funded research. For example, projections of climate change produced by the CSIRO and Bureau of Meteorology (2007) build on a large body of research funded through government programs such as the Australian Climate Change Science Program. In other cases, governments may rely on research indirectly, for example, synthesising research findings to produce information suitable for a specific task or to make it accessible to the general public.

Governments also sometimes partner with industry to fund the provision of research and information jointly where some, but not all, of the benefits can be captured privately. For example, the Australian Government and the agricultural industry jointly fund the Managing Climate Variability program, which undertakes research to improve climate forecasting and provides farmers with tools and information to manage climate risks (GRDC 2011b).

Governments may also fund the provision and dissemination of information by non-government organisations. For instance, the Australian and Queensland Governments have provided funding to Green Cross Australia to operate the ‘Harden Up’ website which uses ‘social networking tools and Australia’s best climate research’ to encourage Queenslanders to assess their vulnerability to natural hazards and take adaptive actions (Green Cross Australia 2012).

7.2 Barriers to information provision

Despite the wide variety of climate change related information produced by governments, a lack of information is one of the most commonly cited barriers to adaptation. The view expressed by the Australian Local Government Association (sub. 25, p. 5) is typical.

... [T]he greatest barrier to market based solutions in the area of adaptation is a lack of information and consistent and reliable knowledge.

In some cases there may be good reasons for a lack of information. First, there are scientific uncertainties that limit our understanding of the impacts of climate change (chapter 2). Second, acquiring information is costly. When considering acquiring information, users need to trade off the benefits of more complete information against the costs of acquisition.

A lack of information can only be considered a barrier to effective climate change adaptation when the quantity or quality of information available is less than that required to generate the greatest net benefit to the community as a whole. This may occur when governments fail to address market failures in the provision of

information or fail to fund the provision of information needed to undertake government functions (box 7.1). It may also occur if governments fail to publicly release information that could be useful to the wider community.

The remainder of this section highlights areas where there appears to be scope to improve the provision of information by governments, both to improve government functioning and to support adaptation by the wider community.

Weather forecasting

Recent natural disasters, such as the 2010–11 Queensland Floods and Cyclone Yasi, have highlighted the importance of weather forecasts to provide early warning of extreme weather events. Timely and accurate forecasts by the Bureau of Meteorology (box 7.3) can reduce the costs of natural disasters in a variety of ways, including by providing residents with time to evacuate and allowing emergency management agencies to effectively deploy resources. As climate change is expected to increase the frequency and intensity of many extreme weather events, the value of being able to provide early warning of these events is likely to increase with time.

As the value of weather forecasting increases, there may be significant benefits to improving and expanding the range of forecasting services provided by the Bureau of Meteorology. A recent review of the Bureau's capacity to respond to extreme weather events (the Munro Review) recommended a number of priority actions to sustain the Bureau's current services and identified options to provide enhanced services (box 7.4).

Improving supercomputing capacity

One option, suggested in the Munro Review, is to upgrade the Bureau's supercomputing capacity. The Bureau of Meteorology (sub. DR166) argued that an upgrade of supercomputing capacity would enable the use of weather forecasting models that can run more frequently, over longer time periods, and at finer scales. This would allow for earlier and more frequently updated warnings of extreme weather events, and forecasts with greater relevance to local decision makers. It may also enable models to be run many times over, allowing forecasters to improve the reliability of forecasts by attaching probabilities to a range of possible outcomes.

The Bureau's current supercomputer is due for replacement in 2012-13. The Munro Review estimated that a 'step change' in supercomputing capacity would cost at least \$44 million more than replacing the Bureau's current supercomputer with one

of similar capacity. While the potential benefits appear to be significant, given the level of funding required, the Australian Government will need to undertake a cost–benefit analysis to assess the supercomputer replacement options presented in the Munro Review.

Box 7.3 The Bureau of Meteorology

The Bureau of Meteorology is Australia’s national weather, climate and water agency. It produces a wide range of information useful for managing current climate risks and adapting to climate change.

Weather and climate information

In addition to regular weather monitoring and forecasting services, the Bureau of Meteorology (sub. DR166, p. 2) ‘provides alerts, warnings and forecasts for cyclones, fire weather, floods, high winds, thunderstorms, hail, tsunamis, ocean waves, tidal surges, air turbulence, visibility, volcanic ash, solar disturbances and ultraviolet radiation’. The Bureau also publishes seasonal outlooks and analyses of historical climate conditions.

Water information

Under the *Water Act 2007* (Cwlth), the Bureau is responsible for collecting and disseminating information about the availability, distribution, quantity, quality and use of water in Australia. Information products include real-time water availability forecasts, an annual assessment of Australian water resources and ‘design rainfall data’ (which are used to inform engineering requirements for infrastructure such as drains, bridges and dams).

Other environmental information

Together with the Department of Sustainability, Environment, Water, Population and Communities, the Bureau is implementing the National Plan for Environmental Information Initiative. The aim of the initiative is to improve the quality and accessibility of environmental information (such as information on the health of marine ecosystems). The first stage of the initiative involves reviewing existing arrangements for the governance of environmental information, identifying priorities for further information development and introducing legislation to establish the Bureau as the Australian Government’s central coordinating authority for environmental information.

Sources: BOM (sub. DR166, 2012a).

Enhancing extreme weather services

The quality of forecasting services is not only about computing capacity. It also depends on skilled staff and high-quality observations and data. In addition to upgrading supercomputing capacity, the Munro Review (2011, p. 74) suggested a

number of options to improve the Bureau's level of capability 'in anticipation of demand driven by the rising trend in frequency and impact of severe weather events'. These include:

- an increase in the number of regional extreme weather experts to improve the Bureau's ability to handle events on multiple fronts
- new systems and tools to boost the observation network
- national extreme weather centres for cyclones, fires, severe storms and marine weather to provide greater specialist capability to handle extreme events and allow for specialist training and innovation
- an 'integrated all-hazards decision system' to provide for 'more specific rapid update briefings' to governments, emergency managers and the public on extreme weather events (Munro 2011, p. 75).

Box 7.4 The Munro Review

In July 2011, the Department of Sustainability, Environment, Water, Population and Communities commissioned an independent review of the Bureau of Meteorology's capacity to respond to future extreme weather and natural disaster events, and to provide seasonal forecasting services. A report of the Review's findings was presented to the Department in December 2011 and released publicly on 8 June 2012.

The Munro Review's (2011) findings reflected its focus on the sustainability of the Bureau as an enterprise. Key findings included that:

- there is a strong demand for enhanced products and higher levels of service, but limited capacity to meet this demand
- the Bureau can be 'stretched to the limits of its capacity by long running or simultaneous events' as demonstrated by recent experience during extreme weather events (Munro 2011, p. iv)
- there are ambiguities and inconsistencies in the roles and responsibilities of the Bureau and other agencies involved in flood management.

The Review recommended a range of 'priority actions' to maintain the sustainability of the Bureau, including increasing the number of frontline meteorologists and hydrologists, upgrading the Bureau's flood-monitoring system and several measures to 'build organisational resilience' (such as improved governance of information technology). The Review also put forward a number of options for future consideration to improve the Bureau's fiscal position and to 'provide enhanced services where there is proven demand' (Munro 2011, p. 53).

The Government's initial response to the Review's findings included funding for the recruitment and training of additional meteorologists and hydrologists. The Government also pledged to consider the rest of the Review's findings (Farrell 2012).

As with improvements in supercomputing capacity, these options could have significant benefits in terms of improving the quality of extreme weather services, regardless of how future climate change unfolds. These options could also be important adaptation measures as extreme weather events change in intensity and frequency, the likelihood of concurrent extreme weather events increases, and historical observations alone become a less reliable means of predicting extreme weather events (Bureau of Meteorology, sub. DR166; CSIRO, sub. DR136; Ian Carruthers, sub. DR84). In conjunction with an assessment of upgrading the Bureau's supercomputing capacity, the Australian Government could also investigate implementing the options noted above, taking into account their benefits for adaptation.

Climate change projections and impact assessments

Just as better weather forecasting could improve the ability of governments and the community to manage current climate risks, better projections of climate change and assessments of expected impacts could improve the ability of governments and the wider community to plan for future climate risks. For example, the Australian Building Codes Board Chairman (sub. DR134) submitted that to review building standards in light of climate change it would be helpful to have better data on the likelihood of extreme weather events such as cyclones, floods, bushfires, hail and intense rainfall.

Many inquiry participants also highlighted the need for projections and impact assessments at finer scales. BuildingSMART Australasia (sub. 78) and the Investor Group on Climate Change (sub. 73) considered that a lack of fine-scale projections prevents the impacts of climate change being fully taken into account in infrastructure planning and property development investment decisions.

Similarly, the Municipal Association of Victoria (sub. 79, p. 10) noted that:

While the available climate projections are usually sufficient to undertake high-level, broad scope risk assessments, there is rarely sufficient detail to accurately assess the inappropriateness of existing plans, to develop alternative plans or to quantify the impacts of climate change on assets.

The Great Barrier Reef Marine Park Authority (sub. DR92, p. 2) also considered that fine-scale projections:

... could be extremely valuable when exploring geographic overlays of current and projected climate hazards, ecosystem resilience, likely flow on effects for linked human communities, and what this may mean for effective and sustainable management of [environmental assets such as the Great Barrier Reef].

In some instances, a lack of fine-scale projections and impact assessments may not be useful due to scientific uncertainty. For example, finer-scale projections are not necessarily useful if national-level projections are already subject to a high degree of uncertainty.

Nonetheless, there may be cases where government funding of the provision of more locally appropriate information is warranted. In particular, more fine-scale projections of climate change via a process known as ‘downscaling’ may be worthy of funding as they can sometimes improve the ability of governments and the wider community to plan for climate change at a local level.

Downscaling climate change projections

At a national and regional level, a great deal of information is publicly available about projections of Australia’s future climate. In 2007, the CSIRO and the Bureau of Meteorology (2007) developed regional projections covering a wide range of climate variables, including temperature, precipitation, humidity, snowfall, wind and solar radiation. The projections were developed using a range of climate models, based on six scenarios for future emissions developed by the Intergovernmental Panel on Climate Change, and extend out until 2100. The results of these projections are publicly available on the *Climate Change in Australia* website. Through the *OzClim* website, users can also freely explore regional climate change projections using different emissions scenarios and climate models.

However, these large scale projections (with grid spaces of around 200 by 200 km) may not always provide sufficient detail to inform adaptation decisions. For example, there is significant small-scale spatial variability in rainfall due to factors such as topography, which large-scale projections do not capture (Frost 2007). Reflecting this, in some areas efforts have been made at regional levels to ‘downscale’ high-level climate change projections.

A prominent recent example is the Climate Futures for Tasmania project managed by the Antarctic Climate and Ecosystems Cooperative Research Centre and jointly funded by the Australian and Tasmanian Governments, and private sector partners (Tasmanian DPaC 2011a). The Climate Futures for Tasmania project used dynamic downscaling (box 7.5) to produce fine-scale projections (with grid spaces of approximately 10 by 10 km) for the whole of Tasmania. Projected variables included average daily minimum and maximum temperatures, total annual and seasonal rainfall, average wind speeds, cloud cover, relative humidity, and the frequency and intensity of extreme weather events (such as heatwaves and extreme rainfall).

Box 7.5 Downscaling climate change projections

‘Downscaling’ refers to generating locally relevant data from global climate models. There are two main approaches: statistical downscaling and dynamic downscaling. Each approach has drawbacks and the potential to introduce biases into results.

Statistical downscaling

Statistical downscaling involves the use of statistical methods to project climate changes at scales of kilometres. This is done by identifying relationships between local climate conditions and factors that drive the climate at large scales. The drawbacks of statistical techniques for downscaling are that they assume relationships between local climate conditions and the wider climate are unchanged when the wider climate is altered, they cannot take into account regional feedbacks, and they require historical data over long time periods for testing and adjustment.

Dynamic downscaling

Dynamic downscaling involves fitting output from global climate models to regional climate models so as to make high-resolution regional projections with scales of tens of kilometres. Drawbacks of dynamic models include the high costs involved (doubling the resolution equates to an eightfold increase in computation and storage requirements) and the lack of regional feedback.

Sources: Corney et al. (2010); IPCC (2007c); Wilby et al. (2009).

The results of these projections were used for a variety of purposes, including:

- generating new flood inundation maps that take into account possible changes in extreme rainfall due to climate change
- providing detailed analysis of potential impacts of climate change on agriculture
- projecting changes to river flows and catchment inflows
- assessing the potential impacts of climate change on infrastructure for local governments.

The Climate Futures for Tasmania project is not unique. Similar projects include the South Eastern Australian Climate Initiative (which has produced downscaled projections for the Murray–Darling Basin) and the recently commenced ‘NARClim’ project (to produce downscaled projections for New South Wales and the ACT). However, most regions of Australia have not undertaken exercises in dynamic downscaling of climate change projections of similar scope and application.

In some cases, not undertaking downscaling exercises may be justified. Downscaling is not a ‘magic bullet’ — it cannot resolve many of the key uncertainties of climate change (Government of South Australia, sub. DR88). Its

benefits depend on a range of factors, including local topography and the purpose of the projections, and sometimes downscaling may not produce information more accurate or useful than the regional results of national projections.

Nonetheless, where circumstances are appropriate, the broader use of downscaling of climate change projections could usefully expand the information available for effective climate change adaptation by both governments and the private sector. Given the value of downscaled results for a range of uses, this remains an important area for ongoing research (City of Mandurah, sub. DR104; Dr Bob Webb, sub. DR141; Great Barrier Reef Marine Park Authority, sub. DR92; Investor Group on Climate Change, sub. DR145).

Adaptation research

Numerous government bodies and other organisations receive public funding to undertake research related to climate change adaptation (appendix B). In general, the research undertaken by these bodies is directed towards furthering understanding in areas where governments have a direct interest and to improving the ability of governments to undertake their own functions.

Adaptation-related research includes basic climate science such as climate observation and projections of future climate change (primarily the domain of universities and government research bodies such as the CSIRO and the Bureau of Meteorology) as well as applied adaptation research (mainly undertaken by the CSIRO Climate Adaptation Flagship (box 7.6) and the National Climate Change Adaptation Research Facility (NCCARF) (box 7.7)).

Other bodies also undertake adaptation research, sometimes incidentally. These include:

- the Queensland Climate Change Centre of Excellence
- the Victorian Centre for Climate Change Adaptation Research
- other CSIRO National Research Flagships (particularly the Water for a Healthy Country Flagship and the Wealth from Oceans Flagship)
- several Cooperative Research Centres (such as the Bushfire Cooperative Research Centre)
- Rural Research and Development Corporations (for example, through the Managing Climate Variability Research and Development program)
- some Australian Research Council Centres of Excellence (such as the Centre of Excellence for Coral Reef Studies)

- the South Australian Research and Development Institute (through its Climate Applications science program)
- the Great Barrier Reef Marine Park Authority
- Geoscience Australia.

Box 7.6 CSIRO Climate Adaptation Flagship

The CSIRO Climate Adaptation Flagship is a multidisciplinary research partnership between the CSIRO and other research institutions (Australian and international). The focus of the Flagship is on practical research in national priority areas across four themes.

- *Pathways to Adaptation* — supporting decision making by improving vulnerability assessment, delivery of climate change projections and understanding of interactions between climate change and other future drivers of change.
- *Sustainable Cities and Coasts* — developing practical options for urban and coastal communities to adapt to climate change through new planning, design, infrastructure management and governance solutions.
- *Managing Species and Natural Ecosystems* — improving knowledge of climate change impacts on species and ecosystems, and developing adaptation options.
- *Adaptive Primary Industries, Enterprises and Communities* — assessing vulnerability and adaptation options, developing adaptation technologies and practices, and assessing adaptation–mitigation interactions for mining, agriculture, fisheries and forestry industries.

In 2011-12, the total budget for the Flagship was \$45.1 million composed of \$27.5 million in funding from the Australian Government and \$17.6 million in revenue from external sources. External revenue sources included Australian, state and local governments, rural research and development corporations, businesses and public education institutions.

Sources: CSIRO (2011a, pers. comm., 13 August 2012).

Aligning adaptation research with user needs

For research to support effective adaptation, it must meet the needs of users. Inquiry participants provided mixed evidence that the current arrangements for generating applied adaptation research are effective in doing so. On the one hand, Lake Macquarie City Council (sub. DR107, p. 2) said that it had:

... relied heavily on information and advice from organisations such as CSIRO, [the Antarctic Climate and Ecosystems Cooperative Research Centre] and NCCARF in developing assessments of hazard and risk, and ways to manage and reduce risk.

Box 7.7 **The National Climate Change Adaptation Research Facility**

The National Climate Change Adaptation Research Facility (NCCARF) was established in 2008 under the National Climate Change Adaptation Framework agreed to by the Council of Australian Governments. NCCARF is a partnership between the Department of Climate Change and Energy Efficiency and Griffith University, with a consortium of other Australian universities as funding partners.

NCCARF's (2011, p. 1) mission is to generate the 'information needed by decision makers in government, and in vulnerable sectors and communities, to manage the risks of climate change impacts, by leading the research community in a national interdisciplinary effort'.

NCCARF has developed National Adaptation Research Plans that identify gaps in the information available to decision makers. These plans have been developed for nine priority themes covering biodiversity, health, settlements and infrastructure, emergency management, primary industries, indigenous communities and 'social, economic and institutional dimensions'. Funding for research in accordance with these plans is provided by NCCARF under the Adaptation Research Grants Program.

NCCARF has also set up Adaptation Research Networks across these priority research themes. These Networks are designed to facilitate collaborative climate change adaptation research, the open exchange of information and sharing of climate change adaptation resources.

NCCARF is also responsible for a program of research, conducted with consortium partners, that synthesises and integrates existing and emerging international climate change adaptation knowledge.

Over the five-year period from 2008-09, NCCARF has received \$46.9 million in Australian Government funding. Of this total, \$28.3 million has gone to funding projects under the Adaptation Research Grants Program, \$10.2 million to fund Adaptation Research Networks and \$8.4 million to fund NCCARF's operational activities including outreach and communications. Australian Government funding has been supplemented with \$12.5 million in cash contributions and approximately \$66.8 million in in-kind contributions from other sources (mainly partner universities, research institutions hosting Adaptation Research Networks, and Adaptation Research Grants Program applicants).

Sources: NCCARF (2011, pers. comm., 22 August 2012, sub. 49).

Similarly, the South East Councils Climate Change Alliance (sub. DR100, p. 4) noted that:

NCCARF through its research hubs is performing much needed support for the adaptation work in which [the South East Councils Climate Change Alliance] is involved. The strength of their approach is the close links with local government as end-users of the research where the evidence base for adaptation responses is built.

The Australian Institute of Landscape Architects (sub. DR129, p. 3) also considered that the CSIRO, NCCARF and other adaptation research organisations produce ‘high-quality research and advice on climate adaptation and policy development relevant to the needs of landscape architects and urban design professionals’.

However, some inquiry participants also suggested that the research being produced was not as relevant as it could be. For example, the Australian Local Government Association (sub. 25, p. 5) noted that:

... research projects ... while generally worthy appeared too often to be researcher driven, with an imperative for international publication in order to attract Australian research grants, and not necessarily designed to address practical issues of priority concern to councils and the diverse communities and stakeholders they seek to serve.

Similar concerns were raised by the Queensland Farmers’ Federation (sub. 55, p. 5).

Despite considerable investment in climate change research for primary industries, the major research programs do not produce information that is relevant for a large number of industries.

These concerns come despite extensive efforts by major adaptation research organisations to engage with end users to produce relevant research. For example, NCCARF’s efforts at end-user engagement include:

- requiring that all NCCARF-funded projects have a plan for end-user communication and engagement
- running over 150 workshops, meetings, roadshows, seminars and other events since 2009 that include end users as presenters and participants, including an annual conference on climate change adaptation research and knowledge
- establishing a forum with representatives from state and territory governments that meets every four to six months to exchange ideas and share research
- building adaptation research networks with a total membership of over 5000 researchers, policy makers, practitioners and community members to contribute to research plans and promote information exchange.

To the extent that the needs of end users for adaptation research are not currently being met, this may be partly because NCCARF (which was specifically designed to serve as a bridge between adaptation researchers and stakeholders) is still relatively new. Implementation plans for research by most of NCCARF’s Adaptation Research Networks were only developed in early 2011 and much of the output from NCCARF’s ‘first phase’ of research will not be delivered until early 2013 (NCCARF, sub. DR118).

Where the research already produced by major adaptation research organisations is not as relevant for end users as it could be, it may also reflect funding arrangements. Most funding for applied adaptation research projects comes either directly from the Australian Government or from universities. While it may not always be possible for end users to have a financial stake in research, heavy reliance on Australian Government funding does raise the risk that incentives for publication may sometimes override end-user needs. This could mean the needs of users identified in research plans do not always flow through to research outcomes, preventing research from generating information with benefits to end users. A greater focus on funding from sources other than the Australian Government could lead to a more focused research effort that better meets the needs of end users.

The Australian Government's Climate Change Adaptation Program, which includes funding for NCCARF, was recently subject to review. However, the findings of this review are not yet publicly available. These findings will be an important input into determining the future funding and organisation of adaptation research.

Changes to funding arrangements could help to improve the alignment of research with end-user needs. For instance, the board of NCCARF (sub. DR118, p. 39) has noted that for its second phase, beginning in 2013-14, it intends to alter its funding model:

... to ensure that research effort can be specifically targeted at the needs of end-users and delivered within required timeframes. The Board is seeking a substantial funding contribution from a wider range of partners including Commonwealth, States and Territories, Universities, Business and Industry. This will change the balance of funding to be different from the First Phase and will be reflected in the governance and the operational activities of a future Facility.

To support effective adaptation, research also needs to be well-communicated to end users. While much of NCCARF's research will be delivered in early 2013, NCCARF's first phase of funding is due to expire in June 2013 (Australian Government 2012b). This leaves little time to communicate findings.

If the Australian Government decides not to provide sufficient support for NCCARF to continue in its current form, it may consider providing a relatively small amount of time-limited funding for a transitional period to allow the findings of research already funded to be disseminated to end users. The Government could also consider arrangements that allow for ongoing support to be provided to promising adaptation research networks established by NCCARF.

Sharing and disseminating climate information

Information produced primarily for government use is frequently of value to the wider community. For example, governments may produce information about bushfire risk in a particular region to inform emergency management and land-use planning decisions. This information could also be useful to individuals to inform preventive measures to protect their homes against fire, to businesses to inform investment decisions (for example, whether to invest in a timber plantation) or to insurance firms to help accurately price bushfire insurance. The sharing and dissemination of government-funded climate information is therefore a crucial aspect of effective adaptation.

While the costs of producing information can be high, the costs of reproducing and disseminating information to an additional user tend to be low (and approaching zero for internet publication) (PC 2001a). Where governments have produced adaptation-related information to satisfy government functions, such information should be made publicly available unless there are overriding reasons for non-disclosure (such as privacy concerns or national security). Furthermore, unless there are significant costs involved in dissemination, analysis or other incremental activities, such information should be available to the public free of charge. Provided information is accurate and relevant, the impact of information on property values, for example, should not be regarded as a justification for non-disclosure.

A national repository of information

Many inquiry participants, before and after the release of the Commission's draft report, suggested or supported some form of national repository of adaptation-related information and research to improve government information dissemination and sharing (Australian Coastal Society, sub. 15; Australian Industry Greenhouse Network, sub. 29; Australian Institute of Architects, sub. DR133; Investor Group on Climate Change, sub. DR145; NSW Young Lawyers, sub. 72; Property Council of Australia, sub. 48; Regional Development Australia — Northern Rivers, sub. DR115; Yarra Ranges Council, sub. DR144). Submissions varied considerably on what form a repository should take, what information it should contain and to whom it should be accessible. Some participants called for a generic national repository of data, research and information; others for a concentration on coastal information or information for local governments.

Given the wide variety of audiences and applications for climate change information, a generic national repository is likely to be unwieldy and it is not clear that it would provide significant benefits over present arrangements. To raise public

awareness, the Climate Commission already disseminates high-level information on climate change science, impacts and policy. The University of Southern Queensland also hosts a searchable database of climate research called iClimate (box 7.8).

Box 7.8 iClimate research database

iClimate is a searchable database of Australian climate change research, with a focus on research published after the release of the Intergovernmental Panel on Climate Change's Fourth Assessment Report in 2007. The database includes user-friendly 'statements' which summarise recent research on a range of topics including ecosystems, health, built environments, industry and infrastructure. The iClimate project was funded by the National Climate Change Adaptation Research Facility in partnership with the CSIRO Climate Adaptation Flagship, the University of Southern Queensland and the University of the Sunshine Coast.

Source: Poloczanska et al. (2012).

For local governments, NCCARF hosts an online portal to disseminate information about relevant adaptation research. If NCCARF does not continue to receive sufficient funding to operate this portal, the Australian Government will need to work with local government associations to consider alternative arrangements for disseminating research and other information to local governments.

With regard to coastal information there are some existing arrangements.

- The *Coastal Research Web Portal*, hosted by the CSIRO, provides a user-friendly means of access to current and past coastal research projects.
- The *OzCoasts* website, hosted by Geoscience Australia, disseminates information on Australia's coast, including the impacts of climate change.

The Australian Coastal Society (sub. 15, DR123) has argued that there is a need to go further and develop a national coastal information system. The Commission notes that there are some promising projects underway designed to act as 'building blocks' for a national coastal information system, including:

- eReefs — implemented by the Bureau of Meteorology to improve monitoring data and produce reporting tools for the Great Barrier Reef
- the Australian Coastal Ecosystems Facility — run by the CSIRO in collaboration with a range of partners to provide long-term collection and distribution of key coastal datasets useful for coastal management and policy development.

An assessment of the effectiveness of these projects will provide some basis for judging whether there is a case for proceeding with a more comprehensive national coastal information system.

Improving the coordination and sharing of hazard information

Another area where there is scope for improvement is the mapping of natural hazards (box 7.9). Recent inquiries into natural disasters raised concerns about the quality and consistency of hazard mapping across Australia. For example, the Victorian Bushfires Royal Commission (2010, pp. 215–17) noted that:

There are deficiencies in the mapping of bushfire risk throughout Victoria ... [M]apping and [bushfire risk] designation processes differ between the building and planning systems ... [T]he 2009 fires burnt across large areas that were not designated [as bushfire prone areas for planning or building control purposes].

Similarly, the Queensland Floods Commission of Inquiry (2012, p. 62) noted that:

There is currently a lack of flood mapping in Queensland planning schemes. A recent report ... established that 80 out of the 127 [local government] planning schemes reviewed (63 per cent) contained no flood-related mapping. Of the remaining 47 planning schemes with maps, only 23.6 per cent were completed in accordance with [state planning policy guidelines].

Box 7.9 What is hazard mapping?

Hazard mapping is used to produce and convey information about the potential risk posed to a particular location from a given type of natural hazard (such as floods (inland and coastal), bushfires, cyclones, earthquakes and landslides). Hazard maps are typically produced by state or local governments to inform land-use planning, building regulations and emergency management. The exact information they convey varies by natural hazard and the purpose of the mapping.

Hazard mapping (or risk information gained from hazard mapping exercises) may also inform risk management decisions by households such as where to live and what insurance products to purchase. Hazard maps can also affect the price and availability of insurance (chapter 16).

The quality and extent of hazard mapping tends to improve following such inquiries. For example, the Victorian Government is producing a statewide bushfire hazard map (Victorian Department of Sustainability and Environment 2011). However, it would be preferable if each state and territory did not have to experience a major natural disaster and subsequent inquiry for hazard mapping to advance.

Reflecting concerns about the extent, quality and consistency of flood mapping across the country, the Australian Government recently accepted a recommendation of the Natural Disaster Insurance Review (NDIR 2011) for national coordination and dissemination.

The Government will establish a flood risk information portal, hosted by Geoscience Australia, to provide a single access point to flood mapping data. Initially, this will serve as a repository for existing flood mapping data ... [T]he portal will be complemented by the development of guidelines for the collection, comparability and reporting of flood risk information. The guidelines will contribute to an improvement of the quality and consistency of flood data over time. (Attorney-General's Department, sub. 64, p. 19)

This is an important initiative. Better coordination of flood mapping across Australia will allow for improved management of flood risk in the current climate. It will also provide a stronger basis for future measures to adapt to changes in flood risk due to climate change.

As similar concerns about quality and consistency have been expressed about bushfire hazard mapping, the Commission considers that this initiative should also be expanded over time to encompass other natural hazards (particularly bushfires). A single source for natural hazard information would make it easier to assess the quality and consistency of existing information and identify areas for improvement.

The development of a national hazard information portal should proceed in the most cost-effective way. Risk Frontiers (sub. DR168), a non-profit research centre within Macquarie University, already maintains a National Flood Information Database (as well as databases covering a range of other natural hazard risks) for the insurance industry. The Australian Government should consider whether acquiring information from this database, or otherwise collaborating with Risk Frontiers or other private information providers, would reduce the cost of the proposed portal.

The importance of consistent and up-to-date hazard mapping will only increase over time as climate change alters the intensity, frequency and location of natural hazards. Consequently, climate change will also reduce the reliability of information based on historical experience alone. It will be important that the guidelines developed take into account climate change where feasible and that they are regularly reviewed and updated.

RECOMMENDATION 7.1

The Australian Government initiative to improve the coordination and dissemination of flood-risk information should proceed in the most cost-effective way, be regularly updated and be expanded over time to encompass other natural hazards. Guidelines to improve the quality and consistency of risk information should also be regularly updated and take climate change into account where feasible.

7.3 Barriers to information use

Not all information-related barriers to effective climate change adaptation relate to the provision of information. Even if information is produced, coordinated and shared appropriately, individuals may not necessarily use information in ways that support effective adaptation. This could be due to capacity constraints (a lack of skills or resources) or cognitive constraints.

Capacity constraints

Factors that constrain the ability of an individual, community or organisation to use adaptation information are the same as those that limit the capacity to adapt more broadly (chapter 3). For example, information on options for adaptation is unlikely to be useful if implementing those options requires skills or financial resources that are deficient.

Capacity constraints apply to governments as well as individuals. Several participants highlighted a lack of guidance provided to local governments that do not have the capacity to interpret or use information on climate change impacts and adaptation options (Australian Local Government Association, sub. 25; Ku-ring-gai Council, sub. 1; Mornington Peninsula Shire, sub. 16). Local government capacity constraints are discussed in chapter 8.

Cognitive constraints

Making decisions is a costly process. It takes time and effort to gather, process and analyse information. Psychologists and behavioural economists have demonstrated that often, to reduce the costs of mental processing, people apply heuristics. Heuristics are mental shortcuts, such as rules of thumb, which make decision

making faster and less effortful while resulting in decisions that are ‘good enough’ rather than ‘optimal’. In other words, people trade off the best possible decision to save on the mental processing costs of fully evaluating a decision (Reeson and Dunstall 2009).

Using heuristics often produces good results. When decisions are highly complex, optimising costs and benefits can be ‘simply impractical’ (Reeson and Dunstall 2009, p. 11). However, choices between using heuristics and carefully weighing costs and benefits tend to be made unconsciously. Consequently, using heuristics can lead to biases and anomalies in decision making. A wide range of cognitive biases and anomalies have been identified and some common examples are provided in box 7.10.

Participants noted that cognitive biases may inhibit the use of information and pose barriers to effective climate change adaptation (Australian Psychological Society, sub. 35, DR87). For example, status quo bias may lead people to adapt less than they would otherwise prefer, present bias may lead people to unduly discount the future benefits of adaptation, and choice overload may cause people to avoid adapting due to the large number of complex adaptation choices.

However, heuristics are not necessarily invariable across a population or over time. While many of the biases noted in box 7.10 have been shown to affect wide cross-sections of the community, not everyone experiences every cognitive bias and, those that do, do so to varying degrees. Furthermore, people can (to some extent) adapt and change heuristics over time in response to feedback (Reeson and Dunstall 2009), and reliance on heuristics can vary based on experience and circumstance. For example, List (2003) demonstrated that the status quo bias tends to disappear in markets as traders gain experience.

Moreover, there are questions regarding whether evidence from laboratory experiments and surveys can easily be generalised to everyday experience (PC 2008b). Some economists argue that, over time, the behaviour of markets can compensate for individual biases. Where individuals are aware of their biases, firms can profit by helping individuals to correct them, because biases lead to benefits forgone (Ergas 2007; PC 2008b). Furthermore, in many instances, markets may lead to close to optimal outcomes even in the presence of biases due to the potential for arbitrage and the possibility that offsetting biases cancel out (Epstein 2006).

Heavy-handed approaches that attempt to overcome cognitive biases by mandating or regulating the way individuals adapt are unlikely to be successful and may do more harm than good. But there are certain circumstances where targeted interventions may improve outcomes. Some non-regulatory interventions can

change the way choices are presented in order to overcome biases without restricting individual choice — for example, requiring drivers to make a choice about organ donation when renewing their licence, rather than having to ‘opt in’ (Thaler and Sunstein 2008). Furthermore, governments may prioritise messages and tailor the presentation of information in ways that take cognitive constraints into account.

Box 7.10 Examples of cognitive biases and anomalies

Availability bias — people tend to estimate the likelihood of an event based on the ease with which past examples come to mind. For example, one may overestimate the rate of divorce in a population by recalling the large number of acquaintances who have recently divorced (Tversky and Kahneman 1973).

Anchoring — people tend to make estimates by ‘anchoring’ to an initial reference point and then adjusting. These adjustments are often insufficient (especially in novel situations) so the anchor value influences the final estimate even when it is completely irrelevant (Tversky and Kahneman 1974). For example, comparing two equally valued properties, one may be inclined to offer a higher price for the property with the higher asking price.

Choice overload — people tend to be more inclined to put off making decisions when the number of available choices is very large. For example, in one experiment, people were more inclined to purchase jam when 6 varieties were presented than when 24 or 30 were presented (Iyengar and Lepper 2000).

Dealing with low-probability events — people have difficulty making rational decisions where low-probability events are involved. For example, people tend to buy insurance only when the probability of a risk exceeds a certain threshold, even when the insurance is heavily subsidised (Camerer and Kunreuther 1989).

Framing — people’s decisions can be influenced by the way a choice is framed (Tversky and Kahneman 1986). For example, people may be more inclined to undergo surgery if the risk of death is framed as a ‘95 per cent survival rate’ rather than a ‘5 per cent mortality rate’.

Present bias (hyperbolic discounting) — people tend to prefer a small reward now to a large reward later, but will tend to wait for the large reward if both the small and large rewards are far into the future (Thaler 1981). For example, one may prefer \$10 today to \$12 next week, but \$12 in 52 weeks to \$10 in 51 weeks.

Loss aversion and status quo bias — people tend to prefer avoiding losses to making gains. Consequently, people can be reluctant to change the status quo because the disadvantages of changing loom larger than the advantages (Kahneman, Knetsch and Thaler 1991). For example, rates of volunteering for organ donation tend to be substantially higher in countries where donation is ‘opt out’ rather than ‘opt in’ (Johnson and Goldstein 2004).

Tailoring information provision to public needs

In addition to making government information freely and publicly available, there may be circumstances where further tailoring or wider communication of information by governments would support effective adaptation by the community. However, these measures should only be pursued where it can be demonstrated that there are benefits that clearly exceed the costs.

In many cases, the long time frames of climate change mean individuals and firms have opportunities to learn from others and adjust their responses over time without relying heavily on government-funded information. Governments should therefore prioritise the wider dissemination of information on *current* climate risks, and information to support adaptation-related decisions that are costly to reverse or not regularly repeated (chapter 5).

In communicating this information, governments need to ensure it is accurate, timely, specific, consistent and explicit about uncertainties, but also tempered by the public desire for clear and simple messages (Australian Psychological Society, sub. 35). If information is too complex, it may be misinterpreted or lead to decision paralysis due to ‘choice overload’. However, if information is too simple, it may gloss over important complexities (DEFRA 2011c). In either case, there is a risk of poor decision making by users, and users consequently losing trust in governments and ignoring further advice (Suarez and Patt 2004). To limit these risks, governments may be best advised to present information simply, while providing links to further information for more sophisticated or motivated users (Reeson and Dunstall 2009).

Disclosing natural hazard risks

Natural hazards can pose significant risks to life and property. Residents and business owners in areas exposed to natural hazards are more likely to take action to reduce their vulnerability if they are well-informed about the risks they face. While primary responsibility for staying informed about the risks posed by natural hazards rests with individuals, there can be benefits from government involvement.

For instance, if information provision translates into greater preparation by individuals, this may reduce the costs of providing emergency services in the event of a natural disaster (chapter 13). Furthermore, if property owners are fully informed of the risks they face upon purchase of a property, claims for government compensation in the event of a natural disaster are greatly weakened. This is an important consideration, as climate change alters the frequency, intensity and likely location of natural hazards.

Governments can tailor and disseminate information about natural hazard risks in many ways, from community signposting to smart-phone applications (Australian Emergency Management Institute 2011; Insurance Council of Australia, sub. DR132). At the level of individual properties, risk information may also be disseminated via property title documents, planning certificates, rates notices or rental contracts.

Inquiry participants noted that, in some areas, information about natural hazard risks is already available at the level of individual properties as a result of planning and building controls. For example, in New South Wales, local governments are charged with the responsibility of producing maps of bushfire-prone land. When land is sold, vendors are required to obtain a Section 149 planning certificate from their council to attach to the contract of sale, which stipulates whether the land is in a bushfire-prone area. Developments in bushfire-prone areas must then comply with a range of building and planning restrictions. Across the states and territories, requirements for vendors to disclose natural hazard risks vary widely (table 7.1).

Table 7.1 State and territory vendor disclosure requirements

<i>State/territory</i>	<i>Vendor disclosure requirements</i>
New South Wales	Risks for a range of natural hazards must be disclosed, including flood, landslide (including landslip and subsidence) and bushfire
Victoria	Flood, bushfire and landslide risks must be disclosed
Queensland	No requirements
South Australia	No requirements
Western Australia	No requirements but a comprehensive voluntary hazard disclosure framework is in place
Tasmania	No requirements
Northern Territory	Flood and storm-surge risk must be disclosed
Australian Capital Territory	No requirements

Source: PlanDev Business Solutions (2012).

Many local governments also provide natural hazard information beyond these requirements. For example, Sunshine Coast Council (sub. DR149) has public flood maps on its website to show the extent of a 1-in-100 year flood, and offers a flood search certificate (for a fee) with more detailed information about flood depth and historical flood levels. The Council also operates disaster awareness programs with a focus on flooding and inundation.

There are, however, potential pitfalls in mandating the provision of natural hazard risk information at the property level. For example, where vendors are required to disclose hazard risks on planning certificates or property titles, this may impact property values. This is not a problem in itself, as the exposure of a property to a natural hazard is a relevant consideration for potential buyers. However, if this

information is of questionable accuracy it is of limited use to buyers, may unduly impact property values, and may render local councils at risk of actions of negligence (Australian Local Government Association, sub. DR159; Housing Industry Association, sub. DR151).

Furthermore, where state and territory governments issue guidance on the provision of natural hazard information which is open to interpretation, it may be applied inconsistently between local governments, raising the risk of community backlash. For example, Gosford City Council attracted media coverage and protest when it identified land at risk of sea-level rise on planning certificates in 2010. The Council recently decided to withdraw sea-level rise notifications until the New South Wales Government's policy is clearly defined for all affected councils (Campion 2012; Gosford City Council, trans., p. 56).

State and territory governments should carefully consider the costs and benefits before imposing any requirements on local governments to disseminate natural hazard risk information at the level of individual properties. Where state and territory governments do require that local governments provide this information, they must be explicit about what local governments should provide and how they should provide it to ensure consistent outcomes.

State and territory governments also need to make sure local governments are adequately resourced to fulfil any vendor disclosure requirements they impose. As climate change alters the intensity, frequency and location of extreme weather events, state and territory governments will also need to ensure that natural hazard risk information is regularly updated and that local governments apply consistent approaches when taking climate change into account.

Improving public awareness and understanding of climate change

Another crucial aspect of adaptation is improving basic community understanding of climate change. While studies consistently show that most Australians believe the climate is changing, knowledge about climate change and its impacts tends to be moderate to low (Ashworth et al. 2011; Leviston et al. 2011; Reser et al. 2012). As highlighted by several participants, a failure to appreciate the basic threats posed by climate change can inhibit adaptation (Australian Psychological Society, sub. 35; CSIRO Climate Adaptation Flagship, sub. 40; Matt Mushalik, sub. DR113; Nick Abel, sub. DR156; Richard Weller, sub. DR165).

Measures are already in place to inform the wider community about the nature of climate change, including the formation in 2011 of the Climate Commission (box 7.11). Reflecting the complexities of climate science and the extended

timeframes of climate change impacts, improving community understanding is likely to be a long-term process. Improving community understanding requires clear and ongoing communication by organisations such as the Climate Commission and the CSIRO.

With regard to the effects of climate change on specific regions or sectors, a ‘report card’ may be a useful device for conveying information in a manner that is easy to understand and can be regularly updated. This approach is used in Queensland to convey information about the health of waterways and the Great Barrier Reef, but could be applied more broadly (Healthy Waterways 2009; Queensland Government 2011b).

Box 7.11 The Climate Commission

The Climate Commission was established by the Australian Government as an independent body to provide expert advice and information to the community on the science of climate change, climate change impacts and climate change mitigation policy. The Commission has produced a range of reports to raise awareness about climate change, including summaries of the impacts of climate change for a range of regions across Australia. The Commission also holds public outreach events across the country to explain these impacts.

Source: Climate Commission (2011a).

Providing adaptation options and decision-support tools

To take adaptation actions, decision makers may need more than just information on climate change impacts. They may also need information on options to adapt and tools to help inform their decisions and choose between options. An example is the *Climate Kelpie* website, hosted by the Grains Research and Development Corporation, which provides links to a range of tools to support climate-related decisions by farmers, organised by region and commodity (GRDC 2011a).

Providing decision makers with adaptation options and decision-support tools may be particularly fruitful for motivating adaptation, as behavioural research has shown that information provision tends to be more effective when accompanied by details on how to take action (Reeson and Dunstall 2009).

However, it is important to recognise that there are fundamental limits to the scope of information on adaptation options that governments can and should provide. While market failures may mean that provision of basic climate information is best funded by governments, individuals and businesses generally have strong incentives

to seek and acquire highly customised information. This information is best funded privately.

Some businesses are already making use of publicly funded information and research to provide customised information and advice. For example, Risk Frontiers (sub. DR168), uses government data on natural hazard risks to develop tools and databases that enable insurers and reinsurers to more accurately price risks associated with natural disasters.

Another example is the work of the Insurance Council of Australia's Australian Resilience Taskforce. Working with Climate Risk (sub. 38) and Edge Environment, the Taskforce has developed a web-based building assessment tool, which draws on flood mapping data produced by governments and material resilience data to create a rating for the resilience of domestic buildings, which is specific to each building's geographic location.

The South Australian Research and Development Institute's Climate Applications unit also adopts an approach that leaves room for businesses to provide customised information. Funded by the South Australian Government, it works closely with end users undertaking agriculture-related adaptation research, but then disseminates its research findings to groups, such as private consultants, who can offer more specific information directly to farmers (Government of South Australia, sub. DR88).

The volume of privately provided information and advice useful for adaptation can be expected to expand in the future as climate change impacts become more apparent and demand from individuals and businesses increases. Governments can aid the development of private markets for adaptation advice by ensuring basic information, research and data are publicly available and easily accessible.

Engaging information users

Inquiry participants noted that information alone may not be sufficient to inspire action (City of Mandurah, sub. DR104; Government of South Australia, sub. DR88). For example, the South East Councils Climate Change Alliance (sub. DR100, p. 3) argued that:

... merely presenting information is no guarantee that it will be understood let alone that it will prompt constructive and appropriate responses. Education and engagement leading to behaviour change is needed.

While community engagement may improve the diffusion of climate change information and encourage adaptation, it also has costs. Community engagement strategies are likely to yield the highest returns when focused on activities that relate

to climate risks where the consequences of inaction are very significant. For example, there may be value in engaging communities highly vulnerable to natural hazards to make sure they are informed of the risks they face and aware of ways to manage these risks. Such approaches are already being implemented by emergency services agencies across Australia through programs such as the Victorian Country Fire Authority's bushfire preparedness program 'Community Fireguard' (CFA 2012a). Community engagement is also likely to be an important strategy for engaging residents of existing settlements in areas at high risk of sea-level rise due to climate change (chapter 11).

8 Local government

Key points

- Local governments play an important role in managing the risks of climate change in local communities.
- Local governments are responsible for a broad range of assets and services, many of which will likely be affected by climate change, including:
 - the provision and protection of public infrastructure (including some disaster mitigation) and the delivery of local services, such as emergency management
 - regulatory roles in the areas of development and planning, public health, and environmental management.
- Some local governments have undertaken climate change risk assessments, developed adaptation action plans and implemented adaptation measures. Others have not undertaken any adaptation planning.
 - The identification by state and territory governments of good practice examples of risk assessments and adaptation options could help to provide guidance and reduce costs for councils.
- A number of barriers exist that could be limiting local governments' ability to plan for and implement adaptation measures. These are not unique to adaptation and inhibit service delivery by local government in the current climate.
 - There is a lack of clarity regarding the roles and responsibilities of local government in relation to adaptation, including in the areas of existing settlements and emergency management.
 - Many councils do not have the capacity to effectively plan for and implement adaptation responses — many face financial constraints and shortages of professional and technical expertise.
 - Legal liability concerns are hindering adaptation for many councils. State and territory governments should clarify the legal liability of councils and the processes required to manage that liability.
- Coordination and collaboration among local governments can address some of the capacity constraints they face. This may occur through the establishment of regional organisations of councils, or alliances, to undertake common activities, or joint activities such as resource sharing.
- More broadly, state and territory governments need to ensure that local governments have the capacity to effectively carry out their responsibilities, including, but not limited to, climate change adaptation.

8.1 Adaptation at the local government level

Local governments play an important role in managing the risks of climate change in communities. They are responsible for a broad range of local functions and are likely to face significant exposure to risk as a result of climate change. For example, increased frequency and/or intensity of storm activity could damage coastal assets, such as jetties and marinas, and render some services inoperable, including ferries and barges. It could also result in flash flooding, which could increase the demand for council emergency services and also threaten wetlands and creeks.

The diverse nature of local governments (box 8.1) means that the effects of climate change will be experienced differently. Councils in coastal areas face a different set of climate risks (including sea-level rise and storm surge) from inland councils (such as bushfires and riverine flooding).

Climate change is just one of the many issues that local governments need to manage. Other factors, such as demographic changes and economic growth and development, also present challenges for councils. It is therefore important that climate change adaptation is incorporated into councils' broader risk management strategies.

Box 8.1 Diversity of local governments

Local governments are established through state and territory government legislation and are responsible for a range of community services, such as infrastructure, recreational facilities, and local economic development (including tourism). (The ACT does not have a system of local government.) Local governments also have a range of regulatory responsibilities conferred on them by state and territory governments, which include development and planning, public health, and environmental management.

Each local government is characterised by a unique set of geographical, environmental, economic and social circumstances. For example, there is significant variation in the population served by individual councils (ranging from 57 people to 1.1 million people), the land area covered by individual councils (ranging from less than 1 km² to over 370 000 km²), and the median average income of residents in each council area (ranging from around \$27 000 to \$105 000 per year) (PC 2012e). This influences the services they provide.

When developing strategies to manage climate change risks, councils will need to consult with their local communities about how risks should be managed and the level of risk the community is willing to bear. This includes a consideration of whether and how to manage climate change in new and existing areas of settlement that are at risk (chapters 9 and 11). These decisions will often need to take into

account diverse community opinions and preferences, for example, about protecting the environmental and recreational aspects of some areas, and protecting private and public assets at risk.

Local government barriers to climate change adaptation

To manage the risks of climate change on local government assets and services, councils need to identify risks, develop options to mitigate those risks, and then implement adaptation options that provide a net benefit to the local community. A range of potential barriers to managing risks were cited by participants, including:

- poorly defined roles and responsibilities for adaptation
- local government capacity constraints, including financial constraints, lack of information and guidance (or conflicting information and guidance), and skill shortages
- legal liability concerns of local governments.

These barriers can apply to all stages of climate change risk management. However, for many councils they mainly affect the implementation of adaptation options.

Identifying climate change risks and adaptation options

Climate change risk assessment involves assessing how the climate is projected to change in the future, assessing how this will affect local government assets and services, and developing options to manage identified risks. A number of councils have undertaken climate change risk assessments and developed adaptation action plans as a first step to managing the risks of climate change. For example, several councils submitted details of risk assessments or adaptation strategies developed for their areas (Clarence City Council, sub. 10; Mornington Peninsula Shire, sub. 16; Redland City Council, sub. 36) (box 8.2).

Many other councils have not undertaken any adaptation planning. If councils are unable to develop risk assessments or adaptation plans due to capacity constraints or other reasons, such as behavioural barriers (chapter 4) or councillors' attitudes to climate change, then a barrier to adaptation may exist. (Capacity constraints are discussed in section 8.3.)

Box 8.2 Case study: Redland City Council risk assessment and adaptation plan

In 2009, Redland City Council (south-east Queensland) engaged consultants to undertake a climate change risk assessment to explore the ways in which climate change may impact on Council assets and services. The risk assessment was based on the Australian Government's *Climate Change Impacts and Risk Management* guide for business and government (AGO 2006). A total of 31 council services were considered subject to climate change risks, including the provision of infrastructure (such as coastal infrastructure, transport, and buildings), planning and development, environmental management, community and social planning (such as aged care, emergency services and recreation services), and corporate services (such as workplace health and safety, and legal and financial services).

Risks were assessed over three time periods (current to 2010, 2030, and 2070) using scales for consequences (insignificant to catastrophic) and likelihood (rare to almost certain), and a matrix for risk evaluation encompassing all 31 services at potential risk. Risks were assessed against climate change scenarios based on CSIRO projections for coastal regions of south-east Queensland, using a range of climate variables, including temperature, rainfall, wind speed, sea-level rise and storm surge.

A total of 48 risks were identified, of which 21 were classified as 'high priority'. None were considered extreme, though almost all risks in the medium to high category were associated with infrastructure, such as low-lying public infrastructure susceptible to flooding. A substantial number of risks to environmental management were also identified, such as increased algal blooms, and harm to animal or plant populations, or ecosystem health from storms and flooding. Risks to community and social planning included threats to public safety from increased storms and flooding.

To address these risks, the Redland City Council developed a *Climate Change and Energy Action Plan 2010–2015*, which identifies adaptation and mitigation actions to be taken in this five-year period. These include:

- further research and analysis of risks, such as determining the location of infrastructure and assets at risk by comparing spatial data on storm tides and flooding with data on location of roads and coastal structures
- reviews and updates of existing plans, such as bushfire management plans and bushfire risk mapping, every five years
- investigating cost-effective options to manage risks, including for defending or retreating from sea-level rise impacts and conducting a cost–benefit analysis of major design-criteria changes for new buildings.

Sources: Marsden Jacob Associates and Broadleaf Capital International (2009); Redland City Council (2010).

The Australian Government has provided guidance and financial assistance to some local governments to undertake climate change risk assessments and to develop adaptation options. The main Australian Government programs in this area are:

- the *Local Adaptation Pathways Program* (LAPP) (now closed). The LAPP provided \$2.4 million in funding from 2008 to 2010 for 39 projects covering 94 councils (DCCEE 2012i)
- the *Coastal Adaptation Decision Pathways Program* (CAPP). The CAPP has provided \$4.5 million to councils and alliances of councils for research and development to demonstrate effective approaches to adaptation in the coastal zone (DCCEE 2012e)
- guidance for identifying risks and incorporating these into local government operations, including the *Climate Change Impacts and Risk Management* guide for business and government (AGO 2006) (appendix B).

Some state governments and local government associations have also provided assistance to councils to undertake adaptation planning in the form of grants and guidance material (appendix B).

While many councils have been supportive of these programs, some expressed concern that risk assessments and adaptation plans developed under the LAPP have been generic and not detailed enough to result in concrete action (Pillora 2010). Others suggested that the LAPP has not involved a coordinated or strategic approach to developing local government adaptation responses across Australia. For example, the one-off and competitive nature of the LAPP was thought to disadvantage smaller, less well-resourced councils (Local Government Association of Queensland, sub. 41; Sunshine Coast Council, sub. 53).

Identification of 'good practice' adaptation risk assessments and options

One way to build on the experience of the LAPP and the CAPP would be to identify 'good practice' examples of risk assessments and adaptation plans. This would help councils to draw on the experience and work of others when developing their own responses, especially those councils that have not yet undertaken any adaptation planning. Indeed, one of the objectives of the CAPP is to develop leading-practice approaches to managing climate change risks in the coastal zone (DCCEE 2012e).

Good-practice examples are those that follow good-practice risk management and regulatory principles and that appropriately take into account the uncertainty posed by climate change (chapters 2 and 5).

One option could be for state and territory governments to draw on the risk assessments and adaptation plans that have been developed to date, and to identify best-practice examples that can be distributed to other local governments. While this could provide guidance and reduce the costs of adaptation planning for some councils, it is unlikely to overcome persistent capacity constraints (section 8.3).

Local government associations and regional organisations of councils can also play a role in identifying good-practice examples and disseminating these to councils in their jurisdictions. Some already appear to be taking action in this area, including the Municipal Association of Victoria (sub. 79) and the Local Government and Shires Association of New South Wales through its *Climate Change Action Pack* (appendix B). (Collaboration and coordination between councils is discussed later in this chapter.)

Governments also have a responsibility for evaluating the outcomes of programs they fund, which could help to identify good-practice risk management approaches and adaptation plans. Some of the recommendations outlined in an evaluation of the LAPP could facilitate this. These recommendations include:

- the development of a range of case studies that illustrate climate change risk assessments and adaptation strategies that can be presented to local governments
- the development of networks of council officers involved in adaptation planning
- forums to provide opportunities for councils to learn from the LAPP experience (*DCCEE 2012i*).

The evaluation also includes a number of recommendations focused on improving any future rounds of the LAPP. These include: the development of a standardised list of climate change risks; the development of more detailed guidance to consultants (who often undertake risk assessments on behalf of local governments) on definitions and terminology, the risk assessment process, the focus and format of reports, and adaptation strategies for local government; and greater consideration of the variable level of preparedness of different jurisdictions (*DCCEE 2012i*).

While there has been no formal response to the evaluation of the LAPP by the Department of Climate Change and Energy Efficiency, the Commission understands that the Department has commissioned a report that analyses and synthesises the outcomes of the LAPP. This report is intended to be used as a resource by councils that are considering the risks of climate change for their activities.

8.2 Roles and responsibilities for adaptation

Clearly defined roles and responsibilities are necessary to ensure that the most appropriate level of government or the community is responsible for managing the risks of climate change. Without appropriately defined roles and responsibilities for adaptation, some local governments may fail to take action to manage the risks of climate change due to uncertainty about whether and how they should act. Councils stated that roles and responsibilities are not well defined in respect to climate change adaptation in general, and also in relation to some specific areas.

- *Existing settlements.* Councils reported uncertainty about roles and responsibilities in the management of climate risks in existing areas of settlement, particularly in coastal areas. This uncertainty related to:
 - who has responsibility for funding and managing coastal protection works (state or local governments, or private or public land owners) (Clarence City Council, sub. 10; Municipal Association of Victoria, sub. 79; Sunshine Coast Council, sub. 53; Yarra Ranges Council, sub. DR144) (chapters 11 and 13)
 - whether and how councils should manage the risks of climate change in high-risk coastal areas (Sunshine Coast Council, sub. 53). These issues also extend to managing risks in new developments (Local Government Association of Queensland, sub. 41) and to inland areas, where other hazards can pose high risks, such as bushfires or riverine floods (chapters 9 and 11)
 - determining the appropriate balance between protecting public and private property, and protecting the environmental and amenity aspects of coastal areas (Victorian Local Governance Association, sub. 3) (chapter 11).
- *Emergency management.* There is uncertainty about the roles and responsibilities of the Australian, state, territory and local governments in preparing for and responding to natural disasters (chapter 13).

Some of the uncertainty about roles and responsibilities appears to partly stem from a lack of clarity about the policy and regulatory frameworks within which councils operate, particularly regarding land-use planning (chapter 9), as well as legal liability concerns (discussed later in this chapter). Clarification of these matters may address some of councils' concerns. Nonetheless, there is scope to clarify the roles and responsibilities for adaptation by local governments in some areas, particularly those relating to managing risks in existing settlements (chapter 11).

When should local government be responsible for adaptation?

The principle of subsidiarity — that responsibility for a particular function should reside with the lowest level of government competent to deal with the issue — can help guide the assignment of responsibilities. Local governments have specific knowledge and expertise relevant to their communities. Where council actions are confined to their local area they are likely to be the most appropriate level of government to manage the risks of climate change.

Local government may not be the most appropriate level of government to undertake adaptation in cases where there are adaptation issues of regional or national significance, there are spillovers or economies of scale from adaptation, or where diversity in approaches between local governments would impose costs that exceed the benefits (chapter 3). In these instances, regional, state or territory, or national approaches may be preferable. An example is the South Australian Government's (2010a, sub. DR88) proposed regional climate change agreements and integrated vulnerability assessments.

When determining whether local government is the most appropriate level of government to be responsible for adaptation, it is important to consider whether the local government has the capacity to effectively deliver outcomes. This includes access to financial resources, suitably qualified staff, and appropriate information and guidance from state and territory governments (section 8.3).

Given the diversity of local government functions, it will be necessary to assess roles and responsibilities on a case-by-case basis — a 'one size fits all' approach will not be appropriate. In examining this issue in a recent report into the role of local governments as regulators, the Commission found that state governments should consider the spread of costs and benefits for any given policy area or regulatory activity, and determine which level of government is best positioned to undertake that activity (PC 2012e).

Poor definition of the roles and responsibilities of local governments appears to be a systemic issue and is not specific to climate change adaptation *per se*. There is scope to improve the transparency and accountability of local government regulation. Across all jurisdictions, numerous state and territory Acts and associated regulation delegate regulatory responsibilities to local government. However, over the course of the Commission's study into the role of local government as regulator, all jurisdictions struggled to provide the Commission with a comprehensive list of legislation that created a regulatory role for local government (PC 2012e). Consequently, there is uncertainty as to exactly what functions local governments undertake, and what they are required to do under state and territory law.

Development and maintenance by each state and the Northern Territory government of a list or register of the laws that require local governments to play a role would:

- provide clarity to state, territory and local governments of the regulatory roles of local governments
- assist state, territory and local governments in discussing and setting priorities
- provide a clearer understanding of whether local governments are adequately resourced to fulfil their regulatory roles (PC 2012e).

While this may not entirely clarify roles and responsibilities for adaptation — further guidance and clarification of legal liability is also required — it is likely to be a low-cost and necessary first step in the process.

In addition to this, local governments and local government organisations suggested that it is also necessary to clarify the roles and responsibilities for adaptation of the Australian and state and territory governments (for example, City of Mandurah, sub. DR104; Local Government Association of Queensland, sub. DR116; Moreton Bay Regional Council, sub. DR143; Sunshine Coast Council, sub. DR149; Western Australian Local Government Association, sub. DR111). Chapter 3 discusses the assignment of responsibilities for adaptation between each level of government and the community at a broad level. This provides a basis for a more detailed consideration of roles and responsibilities in specific policy areas, especially where cooperation between levels of government is required. In these instances, it may be necessary for roles and responsibilities to be clarified by all levels of government. Examples include roles and responsibilities for addressing climate risks in existing settlements (chapter 11) and emergency management arrangements (chapter 13).

RECOMMENDATION 8.1

To help clarify roles and responsibilities of local government for climate change adaptation, the state and Northern Territory governments should publish and maintain a comprehensive list of laws that delegate regulatory roles to local governments. This would assist both state and local governments to assess whether local governments have the capacity to discharge their roles effectively.

8.3 Inadequate local government capacity

The capacity of local governments to implement adaptation options is limited by financial constraints, access to information and guidance to support adaptation decisions, and the knowledge and expertise of staff. As noted by the Australian Local Government Association (sub. 25, p. 3):

... the capacity to address these [climate change] impacts will also vary, reflecting differences in the availability of information, expertise, and resources available at the local government organisation level.

The capacity constraints facing local governments are not unique to climate change adaptation. Local governments face resourcing constraints in relation to the broad range of areas in which they have regulatory responsibilities (PC 2008a). It is beyond the scope of this inquiry to comprehensively consider local government capacity issues. Nonetheless, some specific constraints have been identified that are limiting councils' adaptive capacity.

Financial constraints

The most common capacity issue raised by stakeholders related to councils having insufficient financial resources to implement climate change adaptation actions (for example, Barry Pullen, sub. 27; Council of Capital City Lord Mayors, sub. 67; Local Government Association of South Australia, sub. DR139; Redland City Council, sub. 36; Sunshine Coast Council, sub. 53; Western Suburbs Regional Organisation of Councils, sub. DR119). Specific financial constraints were cited for funding capital works to protect against the effects of sea-level rise or extreme weather events, potentially acquiring property in high-risk areas, and preparing for and responding to natural disasters.

The implementation of identified adaptation options often requires considerable financial resources and expertise. For example, the Sunshine Coast Council (sub. 53) has identified 150 adaptation options (at an estimated cost of \$13 million to develop and \$12.5 million per year to maintain). These options cover a broad range of areas, from preparing for the potential health impacts of changes in vector, food, and water-borne diseases to developing guidelines relating to the provision of new, and retrofitting existing, infrastructure.

In the Commission's 2008 inquiry into the revenue raising capacity of local governments, councils indicated that their revenue levels were inadequate to meet many of their functions, including maintaining and upgrading infrastructure and

funding additional services provided to their communities on behalf of other levels of government (PC 2008a). This clearly has implications for adaptation.

Funding infrastructure construction and maintenance is already a major financial challenge for local government, requiring long-term planning and resourcing. Climate change is likely to reduce the lifespan of infrastructure and increase maintenance costs and repair costs ... since many councils struggle to finance baseline capital expenditure requirements, the additional cost of climate-proofing infrastructure is too much. (Municipal Association of Victoria, sub. 79, pp. 18–19)

Local government revenue sources

Local governments' revenue raising capacity will affect their ability to take adaptation actions and could pose a barrier to adaptation where revenue cannot be raised. As noted by the Victorian Local Governance Association (sub. 3, pp. 10–11):

Local governments are often expected to respond to many of the immediate, locally felt climate impacts on communities without having the capacity to do so. Many of the most disadvantaged rural and regional communities are also the most vulnerable to climate change impacts ... These exacerbate other vulnerabilities, such as declines in agricultural yields ... The rural local governments in these areas are the most exposed to a combination of high cost-to-revenue ratios due to large road lengths to maintain and ageing built infrastructure, combined with a diminished capacity for rate-based revenue increase and (often) declining populations.

Local governments receive revenue from a range of sources, including own sources (municipal rates, user fees and charges, fines, and developer contributions) and recurrent grants from the Australian, state and territory governments. Grants from the Australian Government are generally passed through the state and territory governments, and include financial assistance grants (general purpose payments and local roads grants) and specific-purpose grants, including natural-disaster-mitigation funding (chapter 13). State and territory government grants are directed to a wide variety of purposes, including housing and community services, transport, public order and safety, and recreation and culture (DITRDLG 2010).

There is considerable variation in the proportion of revenue each local government receives from own sources, which reflects population density and demographics, natural endowments, and economic activity (PC 2012e). Councils have a choice about which revenue sources they use to fund council services (with the exception of government grants that are tied to specific purposes). In making this decision, councils need to determine whether the service or activity is a public good, private good, or likely to result in costs or benefits to others in the community (box 8.3).

Box 8.3 Funding council services through own revenue sources

Municipal rates

Municipal rates are generally levied on land (and in some cases capital-improved) values and therefore do not influence how land is used. They represent an appropriate means of financing local public goods where those that benefit from the service cannot be identified or excluded. Rates are also an appropriate means of funding services that provide wider community or 'flow-on' benefits, where those that receive the benefits cannot be identified.

User fees and charges

If the local government service provides benefits to identifiable individuals or groups, then the costs of that service should be allocated to those that receive the benefit. Examples include developer charges or contributions from property owners.

Borrowings

If the council service provides benefits to the community over a considerable period of time (as is the case for some infrastructure), then it may be appropriate to finance the service through borrowing, with the cost of debt serviced through rates or user charges. This enables the cost of the asset to be matched with the benefits from the consumption of the service over the life of the asset, promoting intergenerational equity.

It may also be appropriate to use a combination of rates, user fees and charges, and borrowing. For some councils, concerns about ability to pay may result in some services being subsidised from rates revenues or higher prices for some groups. Where this is the case, transparency in the level of any subsidy is important to enhance accountability. The exact mix of cost-recovery mechanisms is a choice for individual councils depending on their circumstances.

Source: PC (2008a).

There is scope for some councils to raise additional revenue through own sources, particularly municipal rates, though this varies between councils. However, some rural and remote councils are highly dependent on grant money, and have limited capacity to raise additional own-source revenue (PC 2008a).

User charges, such as developer charges or infrastructure levies, could also be used to fund adaptation where local governments provide adaptation responses (such as seawalls) that deliver private benefits. Indeed, some councils have used special levies to fund coastal protection measures (chapter 13). Some have also enacted policies or laws that require binding agreements to be put in place with property owners to cover the future costs of protection measures (chapters 9 and 13). For example, under the *New South Wales Coastal Protection Act 1979*, landowners who

construct coastal protection infrastructure are legally obliged to cover the costs of maintaining the infrastructure, or alternatively, can enter into an agreement to pay the relevant council a coastal protection service charge.

In some cases, there are legislated restrictions on the fees that local governments can charge for the provision of goods and services (PC 2012e). This includes developer charges, which in the case of New South Wales and Queensland, are capped by state governments, though in New South Wales, councils can apply to the Independent Pricing and Regulatory Tribunal for a contribution above the capped amount. This could affect the ability of councils to raise revenue to fund some adaptation responses, especially if charges are set at a level below the cost of service provision (PC 2008a).

In addition to own sources of revenue and recurrent grants from the Australian, state and territory governments, local governments can access funding from a number of competitive grant programs. Some of these are adaptation specific, though they have mostly focused on planning for adaptation. Other grants could also be used to fund adaptation responses (box 8.4). There are also various competitive funding arrangements in place to support local government emergency management services (chapter 13).

While some councils may be successful in securing funding through competitive arrangements, these types of funding arrangements may not be effective in addressing more systemic resourcing constraints. A number of inquiry participants noted that competitive funding programs are resource intensive and disadvantage smaller councils that have fewer professional staff to prepare grant applications and to implement funded programs (Local Government Association of Queensland, sub. 41; Sunshine Coast Council, sub. 53). This issue was also raised in the context of securing funding for disaster-mitigation infrastructure (chapter 13).

Local government funding is an issue that goes beyond the scope of this inquiry — councils have competing funding priorities for the broad range of services they deliver and climate change is only one of the risks that must be managed. Nonetheless, funding has clear implications for adaptation and is a barrier for some councils. As noted by the Mornington Peninsula Shire in Victoria (sub. 16, p. 9):

... a barrier to adaptation will be the ability of local government to access funding in a timely and affordable manner. Consideration should be given to examining the regulatory tools available to local governments to raise finance in an economical and equitable way. For example, it may be appropriate to consider how developer contribution schemes are formulated and implemented and how government expenditure in coastal (and flooding) protection works can be recovered from the beneficiaries of any public works.

Box 8.4 Funding available to local governments for adaptation

Adaptation-specific funding has been provided to local governments by the Australian Government to undertake climate change adaptation risk assessments and adaptation plans, primarily through the *Local Adaptation Pathways Program*, the *Coastal Adaptation Decision Pathways Program* and the *Integrated Assessment Human Settlements* sub-program. This latter sub-program funded five projects aimed at building the capacity of local governments to identify climate change challenges and responses (DCCEE 2012f). Some adaptation-specific funding is also available from state and territory governments. For example, the Tasmanian Government's *ClimateConnect* program offers grants of up to \$20 000 for councils to develop and implement adaptation options (Tasmanian Climate Change Office 2012). The Victorian Government's *Local Sustainability Accord* includes funding for local governments to adapt to the effects of climate change. In the most recent round (2011), this included funding to the Loddon Shire Council to implement 15 priority actions identified in its adaptation plan (Victorian Government 2012c).

Local governments can also access other funding that could potentially be used for adaptation. From the Australian Government, these include the *Regional Development Australia Fund*, the *Local Government Reform Fund*, and *Caring for Our Country* grants. One project being supported by the Regional Development Australia Fund is for coastal protection infrastructure for the Torres Strait Islands Regional Council (DRALGAS 2012b). At the state level, examples include:

- in Victoria, the *Local Government Infrastructure Program*, which provides funding to councils to build, or renew, infrastructure, including roads, bridges and new community assets (Victorian Government 2012a)
- in Queensland, the *Local Government Grants and Subsidies Program*, which provides financial support to local governments that demonstrate limited capacity to self-fund an identified priority project. In 2011-12, this program included funding for 21 cyclone and flood warning projects in 11 councils (Queensland DLGP 2012). This program also incorporates the *Climate Ready Infrastructure* initiative, which requires councils to consider climate change adaptation in applications for state government grants for new infrastructure (Queensland Government 2011a)
- the *South Australian Local Government Research and Development Scheme*, which provided financial support to the South Australian Local Government Association to develop a financial model and tool to guide decision makers about the financial implications of climate change impacts on asset management and investment (LGASA 2012).

Given the diversity in revenue sources, revenue-raising capacity, and the adaptation requirements of individual councils, it is likely that financial constraints will vary substantially across local governments. Moreover, as outlined in section 8.2, there may be instances where local governments are providing adaptation responses that have costs or benefits to the community more broadly — for example, council activities to preserve beach amenity typically have benefits for residents outside the

council area — or are provided on behalf of other levels of government. In these instances, it will be necessary for state and territory governments, or the Australian Government, to ensure that local governments have appropriate access to financial resources.

Inadequate guidance and information

Inadequate guidance on managing climate risks

There is currently a large volume of guidance material available to local governments that could be used to support adaptation decisions (appendix B annex). However, this does not appear to be meeting the requirements of councils. This is particularly the case with respect to state government guidance to support land-use planning and development decisions in coastal areas, but also extends to undertaking risk assessments and implementing adaptation options in a range of areas. For instance, the Mornington Peninsula Shire (sub. 16, p. 8) stated that:

There is an urgent need to provide guidance on when and how to conduct a reliable assessment of coastal vulnerability when decision makers are being asked to determine development applications on a given site along the coast.

The Municipal Association of Victoria (sub. 79) recommended that coastal adaptation guidance be developed specifically to meet local governments' needs. Some participants also suggested that there needed to be more tailored guidance on methodologies for undertaking risk management and cost–benefit analyses (Australian Local Government Association, sub. DR159; Yarra Ranges Council, sub. DR144).

More broadly, the Local Government Association of Queensland (sub. 41, p. 2) suggested that councils need clearer guidance across most activities, ranging from:

... understanding social and economic vulnerability, determining acceptable levels of risk and how and when to respond to reduce these risks within their communities, to the particularities of determining when a development application should be refused without exposing their organisations to legal and financial risks.

Some councils also suggested that a profusion of adaptation planning tools, approaches and methodologies is leading to confusion and uncertainty about what adaptation actions should be taken (Environmental Defenders Office of NSW 2011; Northern Alliance for Greenhouse Action, sub. 6).

It is not clear to what extent local governments' concerns relate to unclear roles, responsibilities and legal liability, to a lack of appropriately targeted guidance, or a combination of these. It may be that councils are seeking guidance on exactly when

and how to respond to the expected impacts of climate change, including how to prioritise and implement adaptation actions (Gold Coast City Council, sub. 17; Pillora 2010). Without more specific guidance from higher levels of government, some councils appear to be reluctant to take action on climate change (Gippsland Coastal Board, sub. 65). Moreover, it is likely that for some councils, clarification of roles and responsibilities and the legal liability they face, particularly in the area of land-use planning (chapter 9) and for managing risks in existing areas of settlement (chapter 11), may address some of their guidance concerns.

Regardless, this may reveal a need for different or additional guidance to local governments from state and territory governments and/or local government associations, than is currently being provided. This needs to be provided in a manner that allows councils to take their own circumstances and the diversity of services they provide into account in their adaptation decisions. The identification of good-practice risk assessments and adaptation options (section 8.1) may go some way to addressing this at the adaptation planning stage, but this may be insufficient to guide councils in implementing specific adaptation responses.

Inadequate information on climate change risks

Information on climate change risks is often unavailable at a scale useful for local government. The Municipal Association of Victoria (sub. 79) and the Yarra Ranges Council (sub. DR144) reported that climate change projections are usually sufficient to undertake high-level, broad-scope risk assessments, but there is rarely sufficient localised detail to incorporate risks into specific plans (or to develop new plans) or to quantify the impacts on assets.

While some locally-scaled data are being provided in a number of states, for example as part of the *Tasmanian Climate Futures Project* and Victoria's *Future Coasts Program*, it appears that even in these circumstances further data are required to meet the specific needs of councils. The Mornington Peninsula Shire (sub. 16) acknowledged the work carried out for the Western Port Bay under the *Future Coasts Program*, but suggested that similar information was required for Port Phillip Bay.

To address information gaps, several inquiry participants argued that there needs to be a move to a central data source, in particular to support land-use planning decisions, but more broadly to act as a 'clearing house' for information about adaptation and responses (Redland City Council, sub. 36; Victorian Local Governance Association, sub. 3). Some measures have been introduced which attempt to provide a single point of information to councils on particular climate change impacts and adaptation (chapter 7 and appendix B). If information is not

appropriately utilised to make decisions, this could constitute a barrier to effective adaptation. That is, where the Australian, state or territory governments do not have appropriate processes to ensure that local governments can utilise the information provided to them, or do not have access to the information they need to make decisions or cannot make that information public, then decisions by councils may not effectively take into account climate change. Chapter 7 discusses reforms to improve the preparation and dissemination of climate-related data, including the coordination and provision of locally-scaled data.

Skills and knowledge

Even when climate change information and guidance material are available to local governments, they may not have the professional or technical expertise to determine how these should best be used. The Coasts and Climate Change Council (sub. 30, p. 3) stated that:

At the local level, decision makers have varying capacity to acquire the data they need to understand risks under different climate change scenarios, and can lack the know-how to integrate that information into planning and investment decisions.

Gaps in expertise may be limited to specific areas. These can be as narrow as skills in geomorphology and coastal processes (City of Mandurah, sub. DR104; South East Councils Climate Change Alliance, sub. 12) or in applying new planning options in an Australian context (such as rolling easements and planned retreat (chapter 9)) (Sunshine Coast Council, sub. 53). Some councils do not have the interdisciplinary skills required to incorporate the complexity and uncertainty of climate change into decision-making frameworks across all local government disciplines (Ku-ring-gai Council, sub. 1). They may also lack technical expertise to assess climate change impacts or to respond to climate change information provided to them (Housing Industry Association, sub. 69; Municipal Association of Victoria, sub. 79).

Some stakeholders indicated that training may be required for councils to apply risk-management techniques (Victorian Centre for Climate Change Adaptation Research, sub. 56) and to develop local and regional adaptation action plans (Australian Climate Change Adaptation Research Network for Settlements and Infrastructure, sub. 19).

More broadly, strong competition for workers from other levels of government, as well as the private sector, has meant that local governments are often subject to a shortage of suitably qualified workers, particularly with respect to development assessment planners, strategic planners, building inspectors and surveyors

(PC 2012e). This has implications for councils' ability to consider adaptation issues, particularly with respect to land-use planning decisions. However, a number of options are available to address skill shortages, including contracting out services, training, and assistance from state and territory governments.

There may be circumstances where expertise is available for adaptation, but local governments would have to offer higher wages in order to attract skilled staff to their local area, particularly in remote areas. This may be beyond the resources of some councils, especially if the expertise is only needed infrequently. One option to address this is for councils to outsource some functions to a private organisation. This would provide flexibility for councils to commission work as required and enable them to access expertise they may not otherwise be able to afford to employ on a permanent basis (PC 2012e). In the context of adaptation, the suitability of such arrangements depends on whether private organisations have the required climate change adaptation expertise and knowledge of local issues.

State and territory governments also have a role to play in ensuring an appropriately trained local government workforce, particularly when state or territory governments change, or impose additional responsibilities, on local governments (PC 2012e). In this regard, there have been some initiatives put in place by state governments to address workforce shortages within local governments. For example, the Victorian Government has established the 'Regional and Rural Planning Flying Squad', which provides short-term planning assistance to rural and regional councils to undertake their regulatory planning functions. This includes 'specialist expert and technical assistance on issues such as major projects and developments, long-term land-use issues, strategic plans as well as immediate support with planning permit and amendment work' (Victorian DPCD 2012a). While still in its early stages of operation (the program was launched in November 2011), the Regional and Rural Planning Flying Squad could be an example of how to address some of the barriers that arise from skill shortages.

Local government associations also have a role to play in providing training for their members. An example of this is the training package provided by the Municipal Association of Victoria on behalf of the Department of Sustainability and Environment's *Future Coasts Program*. This training package includes a half-day session for local government councillors and executive staff on climate change and coastal adaptation planning, as well as a more technical full-day session for coastal managers (Municipal Association of Victoria, sub. 79).

Local government coordination and collaboration

Coordination and collaboration among local governments can address some of the capacity constraints they face. This can occur through the establishment of regional organisations of councils, alliances, or committees to undertake joint activities such as resource sharing or undertaking projects together (box 8.5). These arrangements allow local governments to benefit from the skills and knowledge within the local government network. They can also reduce costs for councils and minimise inconsistency in approaches to regulatory activities such as land-use planning, and help to moderate financial constraints.

Box 8.5 Examples of local government collaboration on adaptation

- The South East Councils Climate Change Alliance undertook a project to examine climate change impacts in the Western Port Region and potential adaptation responses by councils. This included involvement from the CSIRO Climate Adaptation Flagship, and funding from the Australian and Victorian Governments (South East Councils Climate Change Alliance, sub. 12).
- The Local Government Association of Queensland has formed a Coastal Councils Adaptation Taskforce with 21 Queensland councils. The Taskforce aims to improve the ability of councils to adapt to climate change and provide expert guidance to councils on planning issues (LGAQ 2011). The Association is also working with Townsville City Council and the Queensland Government to develop a coastal adaptation strategy for Townsville. This project will include an assessment of adaptation options for coastal areas of Townsville, which will be applicable more widely (Queensland DEHP 2012).
- The Southern Tasmanian Councils Authority (representing 12 councils) undertook the Regional Councils Climate Adaptation Project in partnership with the Local Government Association of Tasmania and the Tasmanian Government (with additional funding from the Australian Government). The project developed climate change scenarios at local scales, adaptation plans for individual councils and a toolkit for adaptation planning (STCA 2012; Tasmanian DPaC 2011b).
- The Western Australian Local Government Association and Western Australian Government have formed the Climate Change in Local Government Partnership Agreement. This aims to improve the capacity of councils to address climate change issues. A Climate Change Management Toolkit and Adaptation Planning Checklist have also been developed to assist councils (WALGA 2012).
- Central NSW Councils (representing 17 councils) undertook a Water Security Study to develop 50-year water demand and supply projections — factoring in potential climate change impacts — and identify options to ensure adequate water availability (water supply is a local government responsibility in parts of New South Wales) (Central NSW Councils 2009).

Some of these collaborative arrangements have a climate change specific focus (appendix B), including the Northern Alliance for Greenhouse Action (sub. 6), the South East Councils Climate Change Alliance (sub. 12), the Coastal Councils Adaptation Taskforce (Gold Coast City Council, sub. 17) and the National Sea Change Taskforce (sub. 75). Some local government collaborative bodies with a broader focus also consider climate change adaptation, such as the Victorian Local Governance Association and Central NSW Councils.

Some state and Australian Government assistance is provided to local governments to coordinate or collaborate. For example, the Queensland Government's *Local Government Grants and Subsidies Program* provides funding assistance 'to promote collaboration between neighbouring local governments to deliver regional priorities' (Queensland DLGP 2012, p. 1). The Australian Government's *Local Government Reform Fund* provided financial assistance to the Tasmanian Government and the Southern Tasmanian Councils Authority to develop a regional approach to climate change adaptation (DRALGAS 2012a). Adaptation-specific funding through the LAPP and the CAPP was also provided for joint risk assessments and other adaptation projects undertaken by alliances of councils.

8.4 Legal liability as a barrier to adaptation

The unclear legal liability of local governments when implementing adaptation measures was consistently identified as a barrier to effective climate change adaptation (Baker and McKenzie 2011; Blake Dawson 2011; Cairns Regional Council, sub. DR108; Clarence City Council, sub. 10; Local Government Association of Queensland, sub. 41; Municipal Association of Victoria, sub. 79; Shire of Busselton, sub. 50) (box 8.6). Councils are concerned about liability in circumstances both where they take action in response to climate change and in circumstances where they fail to take action. As noted by the Gold Coast City Council (sub. 17, p. 2):

In the absence of guidance on how and when to respond to the potential impacts of climate change, [Local Government Authorities] may be vulnerable to liability for both action and inaction and will continue to struggle with the question of what constitutes a reasonable response.

Box 8.6 Examples of legal liability concerns in Queensland and New South Wales

Queensland

Liability concerns were raised in the context of how changes in planning systems impact on 'existing use rights'. In particular, Queensland's 'injurious affection' provisions under the *Sustainable Planning Act 2009* (Qld) provide for compensation to owners of interests in land when they are adversely affected by changes to the planning framework — for example, from rezoning land from high density to low density or from future urban to open space (Gold Coast City Council, sub. 17). Similar provisions exist in Western Australia and Tasmania, although in these jurisdictions 'injurious affection' only applies where the relevant land is set aside for a public purpose under a planning scheme (Blake Dawson 2011). The Sunshine Coast Council (sub. 53) stated that the injurious affection provisions in Queensland have meant that local governments are unwilling to change planning systems to address coastal hazards.

New South Wales

In New South Wales, under the *Civil Liability Act 2003* (NSW), an authority is only liable if something it does (or fails to do) is found to be so unreasonable that no other authority with the same functions would consider it reasonable (England 2008). Councils in New South Wales are also protected from liability for negligence when acting in 'good faith' (under the *Local Government Act 1979* (NSW)), which is widely assumed to mean compliance with the relevant state government planning manual. Currently, New South Wales is the only state with such legal arrangements (SCCCWEA 2009). Even in states and territories without 'injurious affection' provisions (including New South Wales), there are concerns about legal liability. For example, Clarence Valley Council (sub. DR98) stated that the NSW legal exemption does not preclude legal action being taken against councils. They suggest that responsibility for managing risks that arise from climate change should not rest with councils and instead responses should be determined by the state and the Australian governments.

Examples of local governments' concerns about liability include instances where councils:

- release or do not release information relating to climate change impacts. For example, councils may face legal challenge from those who unknowingly purchased a property at risk, where risks were not disclosed by the council, or by those whose property values have fallen due to the publication of climate risks (Gold Coast City Council, sub. 17)
- approve or refuse applications for developments susceptible to climate change risks where decisions quarantine land from development or exacerbate future risk (Local Government Association of Queensland, sub. 41)

-
- make changes to planning instruments that affect existing developments by incorporating climate change considerations (such as rezoning land to reduce intensification in high-risk areas). This may require councils to compensate affected landowners (Sunshine Coast Council, sub. 53)
 - install, do not install, or do not appropriately maintain protective structures. For example, councils may be liable if they construct a seawall that fails to adequately protect property or that has unintended consequences for nearby properties (Clarence City Council, sub. 10, att. 2).

Uncertainty about the circumstances in which councils are liable affects local government decisions — in particular, the extent to which adaptation considerations are incorporated into land-use planning and development practices. Several participants suggested that the prospect of legal challenge has prevented councils from acting proactively, and has resulted in the adoption of conservative approaches to development approvals (Gold Coast City Council, sub. 17; Housing Industry Association, sub. DR151; Sunshine Coast Council, sub. 53; Urban Development Institute of Australia, sub. DR137).

How can legal liability be addressed?

Arguably, concerns regarding liability partly stem from poorly defined land-use planning policy and regulatory frameworks, and uncertainty about when and how councils should manage the risks of climate change, particularly in existing settlements. Addressing these issues may resolve some of the uncertainty about liability. (This is discussed further in chapters 9 and 11.)

In some cases, it may be the *perception* of liability that is hindering effective adaptation and not the legal arrangements themselves. If this is the case, state or Australian Government leadership to clarify where liability lies and the provision of information to councils about this could effectively address this barrier.

Beyond this, there is little agreement on an appropriate government response. Some participants expressed a view that changes to legislation are required, though there were varying views on whether legislated legal protection (as is currently in place in New South Wales (box 8.6)) could fully address liability concerns.

Lake Macquarie City Council (sub. DR107) stated that protection from liability afforded in New South Wales was a significant factor in the willingness of the council to make decisions to manage the risks of sea-level rise and flooding. Other participants supported a similar application of legal protection to other jurisdictions (Australian Local Government Association, sub. DR159; Clarence City Council,

sub. 10; Gold Coast City Council, sub. 17; Housing Industry Association, sub. DR151; South East Councils Climate Change Alliance, sub. DR100).

However, legal protection has the potential to diminish incentives for sound decision making. Suncorp Group (sub. DR127, p. 9) submitted that:

... it would be difficult to limit liability enough to enable action without reducing the incentive for sound decision making. For this reason, Suncorp suggests that any change to local government liability only apply for past decisions. Decisions made into the future should be made with due consideration of the risks associated with climate change and legal liability should apply.

Similarly, the Australian Network of Environmental Defender's Offices (sub. DR106, p. 4) suggested that legal provisions like those in place in New South Wales, 'are likely to protect councils which fail to act appropriately in relation to climate change risks just as much as they are likely to protect councils that are proactive in this regard'.

Regardless of any provisions introduced by state governments to provide local governments with 'indemnity', there is still a risk of legal challenge (Clarence Valley Council, sub. DR98). This has been the experience of the Byron Shire Council in New South Wales, which has faced various legal challenges from residents affected by the Council's 'planned retreat' strategy (chapter 9).

Common law evolves as new case law emerges and courts consider how existing principles apply to novel circumstances. Thus:

... protection from liability can never be guaranteed and will only be established after the event. Any path the Council decides to pursue therefore necessarily carries some risk, even though it believes itself to have exercised reasonable care throughout. (Clarence City Council, sub. 10, attachment 2, p. 19)

It is important that councils adopt sound decision-making processes and that incentives for managing risks are maintained. To inform their decisions, and to help mitigate liability, local governments need to have access to up-to-date information and appropriate guidance (Australian Local Government Association, sub. DR159; Western Australian Government, sub. DR81). This should include clarity on liability, information on the circumstances in which liability may apply, and the actions that can be taken to manage that liability.

RECOMMENDATION 8.2

Local governments' uncertainty about their legal liability is a barrier to effective climate change adaptation. State governments should clarify the legal liability of councils with respect to climate change adaptation matters and the processes required to manage that liability.

9 Land-use planning

Key points

- Planning regulation in Australia has traditionally been based solely on historical information.
 - As data have become more reliable, some predicted climate change impacts are being considered. However, this is not occurring in a systematic or coordinated way within or across regulatory frameworks.
 - In recent years, land-use planning has increasingly taken into account projected changes to coastal processes, including sea-level rise and erosion.
 - Inquiries into recent natural disasters have improved the consideration of natural hazards in planning frameworks more generally, leading to climate change adaptation benefits.
- State, territory and local governments should incorporate consideration of the impacts of climate change in land-use planning decisions. Land-use planning regulation should:
 - facilitate a risk management approach that promotes planning decisions that are robust across a range of climate change outcomes and are proportionate to the risks involved
 - moderate activities which retard adaptation by the community
 - facilitate the provision of public goods.
- In addition, transparent and rigorous community consultation processes are essential to ensure that communities' 'acceptable levels of risk' are incorporated in land-use planning decisions.
- In updating and reviewing state and territory land-use planning regulations, governments should focus on ensuring that risk management approaches are explicitly supported and that appropriate guidance is provided to local governments to implement these approaches.
- Improvements to land-use planning systems to ensure that they are consistently applied within state and territory frameworks and regularly updated will have benefits in current and future climates.

Climate change poses a range of risks to the built environment. These include risks from new hazards that have not previously been recognised in land-use planning frameworks, such as sea-level rise. There is also the potential for changes in the frequency and intensity of more familiar hazards from a land-use planning perspective, such as bushfires, cyclones and floods. Consequently, government

policy regarding where we live and the types of dwellings we live in should reflect these changing risks (see also chapter 10 which examines how building regulation incorporates climate change considerations).

Land-use planning systems are frameworks to guide and facilitate the future growth and development of Australian settlements. They are also used to preserve the environment, provide and coordinate community services and facilities, and promote and coordinate the orderly and economic use and development of land (PC 2011e) (box 9.1). Land-use planning regulation includes various regulatory bodies, the rules which define their powers and roles, and the plans and planning instruments under which decisions are made and put into force (PC 2011e). Consequently, land-use planning regulation encompasses a very wide range of instruments, generally organised in a hierarchy, incorporating state planning Acts and regulation, strategic regional and metropolitan plans, and local government planning schemes.

Planning regulation in Australia has in the past been based solely on historical information — for example, ‘1-in-100 year’ events are often used as a benchmark for planning decisions. In recent years, as data have become more reliable, some predicted climate change impacts are being considered. However, this is not occurring in a particularly systematic or coordinated way across Australia.

Box 9.1 Why do governments regulate planning?

Government intervention in private property markets is justified as private markets fail to maximise community wellbeing in the absence of suitable regulation. There are several types of market failure.

- Spillovers
 - For example, where an area is cleared for development, biodiversity may be affected, or the natural beauty of an area may be diminished.
 - The co-location of different types of developments can introduce problems or create benefits. Where industrial facilities are placed close to residential areas, residents can be negatively affected by noise or pollution. Conversely, it may be advantageous for complementary retail businesses to be co-located.
- Public goods
 - For example, governments can ensure the coordination and provision of community services and facilities such as parks in land-use planning.

Sources: PC (2004c, 2011e).

9.1 Planning regulation incorporates climate change risks to varying extents

Generally, the overarching land-use planning legislation in each state and territory does not contain specific requirements to take climate change into account in planning decisions. In some cases, other legislation may indirectly impose climate change requirements, for example, the Victorian *Climate Change Act 2010* requires decision makers, including planners, to have regard to climate change.

Specific directions to incorporate climate change considerations in planning decisions are generally contained in state and territory planning policy documents and guidance material. Policy approaches and recommended treatment of climate change risks generally differ by type of hazard.

Coastal management

Most jurisdictions have specific coastal management legislation which establishes a policy framework in coastal areas that also covers land-use planning. In some cases, these Acts (such as the *Coastal Protection Act 1979* (NSW)) explicitly identify climate change induced sea-level rise as an environmental hazard to be considered.

Coastal management is also addressed in state planning policies which generally specify high-level principles for managing coastal erosion and inundation in local planning schemes. For example, Victoria and New South Wales require the use of the precautionary principle in local government planning decisions, and most states recommend that development in inundation- and erosion-prone areas should be avoided where possible (box 9.2).

Most states (except Tasmania) set a benchmark for the expected sea-level rise by 2100 based on projections from the Intergovernmental Panel on Climate Change's (IPCC) Fourth Assessment Report (table 9.1). Until recently, New South Wales also used a sea-level rise benchmark (box 9.2) (Hartcher 2012). These benchmarks differ by state due to the choice of base years and IPCC scenarios. Further, Western Australia takes into account regional variations in sea-level rise based on work by the CSIRO (Western Australian Planning Commission 2010). These benchmarks are used by local governments when making planning decisions, and in assessing whether an area is at risk of coastal hazards, including inundation and erosion. In addition, Queensland's benchmark also specifies an increase in cyclone intensity that must be considered and Western Australia's draft State Coastal Planning Policy requires an allowance for some storm inundation plus predicted sea-level rise.

Box 9.2 Principles in statutory coastal planning policies — examples

Victoria

Victoria's State Planning Provisions (section 13.01) outline principles for managing coastal inundation and erosion. These include: planning for a sea-level rise of at least 0.8 metres by 2100 (with an interim benchmark of 0.2 metres by 2040 for infill development); applying the precautionary principle to planning decisions when considering climate change risks; ensuring that new development is located and designed to take into account the impacts of climate change on coastal hazards; ensuring that land subject to coastal hazards is identified; and avoiding development in areas subject to inundation and erosion.

New South Wales

New South Wales' Coastal Policy 1997 recommends that the precautionary principle be used when planning for climate change risks. In addition, the NSW Coastal Planning Guideline outlines six principles for coastal planning: assess and evaluate coastal risks, taking into account the NSW sea-level rise benchmark (as set out in the NSW sea-level rise policy statement 2009); advise the public of coastal risks; avoid intensifying land use in coastal risk areas; consider options to reduce land use in coastal areas; minimise the exposure of developments to coastal risks; and implement appropriate responses to manage climate change risks and adaptation strategies. However, the NSW Government has recently announced that it will undertake comprehensive reforms to its coastal policies, including removing compulsory application of sea-level rise benchmarks.

Queensland

Queensland's State Planning Policy for Coastal Protection specifies that areas prone to coastal hazards are to be identified based on a benchmark of a sea-level rise of 0.8 metres and an increase in cyclone intensity of 10 per cent by 2100. The policy restricts development in these areas unless it is temporary or relocatable, or is development that cannot be easily located elsewhere. The policy also notes that beach nourishment is the preferred option for controlling erosion. Coastal protection works should only be considered where retreat from the location is not a feasible option.

Finally, section 5.1 of the *Sustainable Planning Act 2009* (Qld) requires local governments to apply the precautionary principle in planning decisions.

Sources: Hartcher (2012); NSW DECCW (2009); NSW Department of Planning (2010); NSW Government (1997); Queensland DERM (2012).

Table 9.1 Sea-level rise benchmarks^a

<i>State/territory</i>	<i>2050 benchmark</i>	<i>2100 benchmark</i>
	cm	cm
New South Wales ^b
Victoria	20 ^c	80
Queensland ^d	..	80
South Australia	30 ^e	100
Western Australia	..	90 ^f
Tasmania
Northern Territory

^a The base year for the benchmarks is 1990, except for Western Australia, which uses 2010 as its base year. ^b The New South Wales' Sea Level Rise Policy Statement outlines sea-level rise benchmarks of 40 cm for 2050 and 90 cm for 2100. However, in September 2012 the NSW Minister for the Central Coast announced that New South Wales will remove compulsory application of sea-level rise benchmarks. ^c The 20 cm benchmark is for 2040 and applies only to infill development in established areas. ^d The Queensland State Planning Policy: Coastal Protection also includes a benchmark of a 10 per cent increase in cyclone intensity by 2100. ^e Most development is required to address the 30 cm sea-level rise benchmark only (provided that there are 'reasonably practical means of addressing the further 70 cm rise to 2100') (Government of South Australia, sub. DR88, p. 19). ^f This benchmark is for 2110. .. Not applicable.

Sources: Baillieu (2012); Government of South Australia, sub. DR88; Hartcher (2012); NSW DECCW (2009); Queensland DERM (2012); SA DPLG (2011); Victorian Department of Planning and Community Development (2012b); Western Australian Planning Commission (2010, 2012a).

States and territories provide some guidance on how to apply state planning principles and sea-level rise benchmarks. These may impose regulatory requirements that local governments should include in their planning schemes. For example, for developments in specified coastal areas:

- New South Wales' State Environmental Policy No. 71 (coastal protection) requires a development plan approved by the minister, which includes consideration of coastal processes and hazards
- Western Australia's draft State Coastal Planning Policy requires a coastal foreshore reserve to be identified at the commencement of a project. This reserve must be available at the end of the planning timeframe. The foreshore reserve will be determined on a case-by-case basis taking into account a range of factors, including significant natural features such as coastal habitats (for example, for their biodiversity, ecological heritage and visual landscape values), likely impacts of coastal hazards, safety to lives and property, and opportunities for public access. Coastal physical processes are to be contained within the foreshore reserve and development is to be landward of the foreshore reserve (Western Australian Planning Commission 2012a).

Other environmental hazards

Local governments are required to consider specific environmental hazards — such as floods, bushfires, cyclones and landslides — in local planning processes. In particular, state planning policies often incorporate requirements or restrictions on development in areas that are classed as at risk of environmental hazards. For example, Victoria requires a permit for development in bushfire-prone areas, which includes conditions on water access and defensible space.

Only a limited number of state and territory planning frameworks and associated policy documents mention management of environmental hazards in the context of climate change. For example:

- Western Australian planning policy (State Planning Policy 3.4 Natural Hazards and Disasters) notes that changes in risk driven by climate change should be taken into account by local governments
- the Queensland Government provides advice on identifying climate change impacts in its planning framework (though the guidance notes that incorporating climate change into bushfire risk assessments would be impractical). Further, the Queensland Inland Flood Review (Queensland Government 2010) recommended that a climate change factor be taken into account for flood planning
- the NSW Government provides guidance on taking climate change into account when identifying flood risks (NSW DECC 2007).

A number of state and territory policies for managing environmental hazards are currently under review. In addition, recent inquiries into natural disasters, such as the Victorian Bushfires Royal Commission and the Queensland Floods Commission of Inquiry, have considered planning frameworks. While these reviews do not generally focus on climate change, to the extent that they improve the consideration of natural hazards in planning frameworks, they have climate change adaptation benefits.

Some states are also undertaking research to better integrate climate change into natural hazard planning frameworks. For example, the NSW Government is currently undertaking work to update data on the impact of climate change on flood and bushfire risks (Roger and Dunford 2011). Adjusting planning maps for climate change impacts is discussed further in chapter 7.

9.2 Incorporating climate change adaptation in land-use planning

There is no well-established approach to incorporating climate change into land-use planning decisions (box 9.3). Even where states and territories have explicit frameworks, guidance and tools for incorporating climate change into land-use planning, local governments must still make difficult decisions regarding how to implement and enforce planning systems on the ground. Many local governments have raised concerns about their role in this context. A commonly identified barrier to climate change adaptation is insufficient user-relevant guidance and information from state and territory governments on how to incorporate climate change into land-use planning. A compounding issue is that local governments can have insufficient financial and human resources to undertake this role. While these concerns are often specific to land-use planning, they can also relate to local government functions more broadly (chapter 8).

Box 9.3 Participant views on how planning systems should respond to climate change risks

It is not immediately clear how planning systems should respond to threats of climate change. While some submissions stated that planning systems do not effectively incorporate climate change considerations, little detail was provided regarding how planning schemes should manage climate change risks.

The Australian Climate Change Adaptation Research Network for Settlements and Infrastructure (sub. 19, p. 4) expressed concern that state planning policies were not effective or ‘strong enough’. For example, it cited the Victorian State Planning Policy as being unable to prevent development occurring in vulnerable coastal areas, despite the inclusion of an ‘erosion-prone-areas’ policy.

The Council of Capital City Lord Mayors (sub. 67, p. 4) argued that ‘currently developments and buildings are not always durable and adaptable to changes over time’. It advocated a focus on ensuring longer lifespans for developments. In particular, they noted that site cover and setback requirements need to be reviewed in order to ensure that neighbourhoods have adequate tree cover and sufficient space between buildings.

The Gippsland Coastal Board (Victoria) (sub. 65, p. 7) suggested that ‘numerous state and local government planning policies may need to be reconsidered in light of climate change’. It provided an example of ‘activity centres’ which promote growth and development in particular areas — which may be inappropriate where these areas are susceptible to climate change impacts.

Sources: Australian Climate Change Adaptation Research Network for Settlements and Infrastructure (sub. 19); Council of Capital City Lord Mayors (sub. 67); Gippsland Coastal Board (sub. 65).

Principles for managing climate change risks within land-use planning

In order to effectively take into account climate change risks, planning systems should:

- facilitate a risk management approach
- incorporate transparent and rigorous community consultation processes and take into account the community's acceptable levels of risk for different types of land use
- consider the full costs and benefits of land use from a community-wide perspective.

Risk management approach

A risk management approach enables land-use planning decisions to be made within a framework where the consequences of climate change impacts on land use, the likelihood of occurrence and the costs and benefits of alternative options to manage these impacts are considered (chapter 3). Such an approach promotes land-use planning decisions that are robust across a range of climate change outcomes and are proportionate to the risks involved. A further important element of a risk management approach is that land-use planning frameworks are flexible and responsive to new information. To be effective, a risk management approach to land-use planning needs to be integrated throughout the planning framework and supported through legislation, strategic planning documents, and local government schemes.

Some state planning policies advocate risk management or adaptive management (box 9.4) approaches, for example, the NSW sea-level rise policy (NSW DECCW 2009) and the Western Australian draft State Coastal Planning Policy (Western Australian Planning Commission 2012a). Further, a number of local governments have identified 'risk management' as an important approach in their adaptation plans. For example, Clarence City Council in Tasmania (sub. 10, attachment 1, p. 36) stated that 'risk management responses should be flexible and allow creative solutions to local circumstances' (box 9.5). However, it is not clear to what extent risk management approaches are being implemented by governments more broadly.

Box 9.4 Adaptive management

Adaptive management which takes into account the costs and benefits of different land-use decisions is consistent with a real options approach (chapter 5). Adaptive management aims to ensure that flexibility is incorporated in planning processes to deal with changing risks and uncertainties. This approach requires an understanding of the community's tolerance for risk and a suite of tools or policies that can be implemented where a decision or 'trigger point' is reached. Policy is implemented iteratively over time, in order to maintain levels of risk within tolerable bounds (Victorian Department of Sustainability and Environment 2012). Tol et al. (2008, p. 497) posit that adaptive management also requires 'institutional forms that are capable of "learning by doing"'. Community consultation processes and ongoing monitoring and evaluation of land-use planning approaches are also crucial elements of adaptive management.

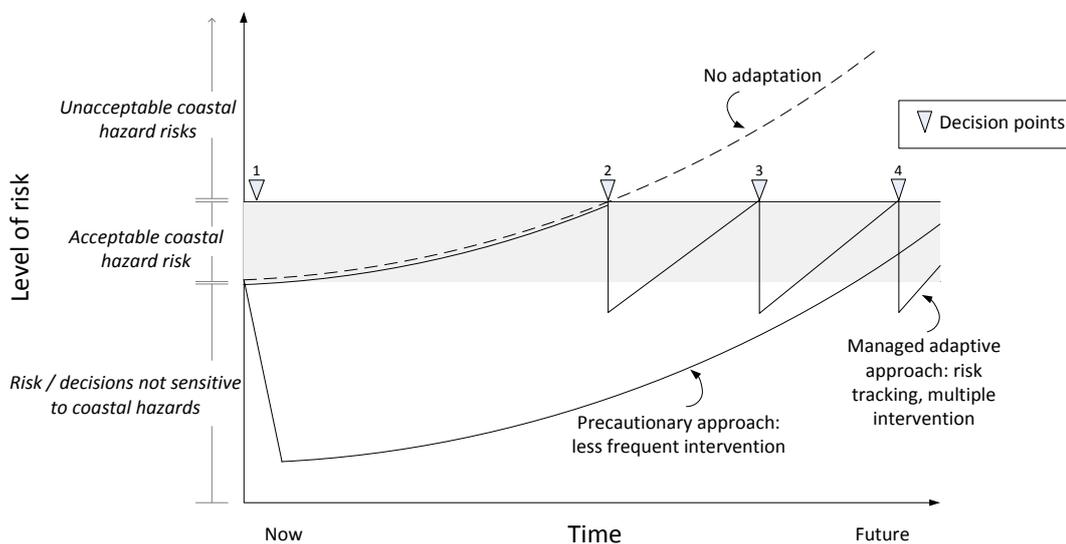


Figure adapted from Victorian Government Department of Sustainability and Environment (2012).

A risk management approach is likely to require provisions for a range of planning instruments to manage risks (box 9.6). For example, Macintosh (2012, pp. 9–10) advocated an approach which embeds alternative land-use and development options in planning instruments 'through real options, financial options, futures contracts, mandatory but conditional regulatory instruments [and] time limited approvals'. For such tools to be implemented effectively at the local government level, appropriate support from state and territory governments is required in recognition of the capacity constraints faced by local governments (chapter 8).

Box 9.5 Risk management and Clarence City Council

In 2007, the Clarence City Council (Tasmania) commissioned a study into climate change impacts in the Clarence coastal area. The report recommended that the emphasis for new development should be on 'performance based responses that maintain acceptable levels of risk over the life of the structure' (sub. 10, attachment 1, p. 32). In this way, areas subject to potential hazards may be used for many years before further adaptation responses are required. Under a performance-based approach, a range of responses could be considered when facing a particular risk as long as they meet a given performance requirement (for example, a dwelling piled to be stable in spite of erosion or capable of withstanding waves).

For existing settlements subject to increasing risks (or new property approved in areas subject to climate change risks), the council proposed to use 'triggers', such that an adaptation response is only required to maintain risk at acceptable agreed levels. In this way the community will respond to actual changes in risk as the sea level rises or erosion progresses, not to events forecast for the distant future. Different triggers will be required for different risks (the council has identified high water tables, inundation and erosion in its report) and hazard maps will be required to monitor each trigger point.

Source: Clarence City Council (sub. 10, attachment 1).

A key characteristic of these types of planning tools is a capacity to match the timeframe of the relevant land use and its associated potential risks. For example, time-limited or 'trigger based' development approvals enable development to be approved for a specified period of time (box 9.6). Both Clarence City Council and Wellington Shire Council (Victoria) have proposed to use 'triggers' in their land-use planning schemes (boxes 9.5 and 9.7). The intention is to take action that manages climate change risks as they develop. Consequently, land subject to potential hazards may be used for many years before further adaptation responses are required. Such tools are appropriate for climate change impacts that manifest slowly over time, but may not be as suitable for unpredictable events such as extreme rainfall or cyclones (DCCEE, sub. DR163).

There was general support in submissions for promoting a risk management approach to land-use planning in Australia (Gippsland Coastal Board, sub. DR140; Local Government Association of South Australia, sub. DR139; National Sea Change Taskforce, sub. DR90; Suncorp, sub. DR127; Urban Development Institute of Australia, sub. DR137; Richard Weller, sub. DR165). However, some submissions also indicated that there are challenges to achieving such an approach in practice. In particular, as the current planning 'culture' favours fixed and certain outcomes (Coastal Zone Management and Planning, sub. DR91, attachment 1; Gary Middle, sub. DR160).

Box 9.6 Planning scheme instruments

A range of instruments could be used to manage climate change risks in land-use planning. Some of the instruments detailed below are already in use in some jurisdictions in Australia, while others, such as rolling easements, have only been used in other countries.

Zones — describe the types of land use that will be encouraged in particular areas and establish permit requirements for both land use and development. These can be used to restrict development in high-risk areas.

Overlays — set other area-specific requirements that regulate the development of land, but do not usually control the use of land, which is managed under the zones.

Rolling easements — are a type of easement placed along the shoreline to prevent property owners from holding back the sea through engineering works, but allow any other type of use and activity on the land. As the sea advances, the easement automatically moves or ‘rolls’ landward (NOAA 2012). These policies do not require a particular line to be drawn on the map and allow landowners to decide how best to use their property up to the point where the land finally erodes (Titus 1998).

Setbacks — require dwellings to be set back a minimum distance from specified areas (such as roads or the line of permanent vegetation or shoreline) or at a minimum elevation above sea level. Elevation setbacks are used to manage coastal flooding, while lateral setbacks address coastal erosion risks.

Time-bound or trigger-bound approvals — approval for development can be given for a specified time period, or until an identified event occurs (a ‘trigger’).

Trigger-based development conditions — require landholders to undertake adaptation measures, such as building protective works, when an identified event occurs.

Hazard risk management plans — require landholders to conduct risk management plans or provide ‘risk disclosure certificates’ that set out information on risks and hazards.

Indemnity statements — approval is dependent on the developer formally acknowledging the climate change risks associated with the property and ‘indemnifying’ local government against future legal actions arising from the effects of climate change.

Adaptation response plans — approval is dependent on the preparation of an adaptation response plan that may include a description of climate change impacts on the land and details of adaptive actions to be taken.

Sources: Macintosh (2012); NOAA (2012); Titus (1998).

Box 9.7 Wellington Shire Council — climate change response plans

The Wellington Planning Scheme identifies sea-level rise and coastal inundation caused by climate change as potential threats to coastal communities. Research is underway to better define the risks in specific locations. This information will be used to develop future planning and development regulations.

In the interim, the council uses climate change response plans to regulate development on land identified as vulnerable to sea-level rise and inundation. A response plan must be prepared by the proponent of a development and include:

- the climate change impacts on the land. Impacts may include short-term inundation caused by storm surges or longer-term inundation caused by sea-level rises
- risks to people, property and the environment. Risks may include drowning, water damage to buildings, pollution, loss of access to a property, and permanent loss of use of a property
- adaptive action to manage the risks. Adaptive action may be incorporated into the design of the development by raising floor heights, using building materials that are not susceptible to water damage, or building removable structures. Alternatively, adaptation action such as evacuating or permanently abandoning the site in certain circumstances may be contingent on future triggers
- triggers for adaptive action. An evacuation trigger can include flood warnings from emergency or weather services. Where the council determines that a risk indicator exceeds a given level, such as where the annual event probability of a severe flood deeper than 300 mm exceeds 10 per cent, abandonment may be triggered.

If the climate change response plan is approved and the development proceeds, the owner of the land is required to enter into an agreement with the council to abide by the plan and register it on the title of the land. Land owners are also required to review and re-register the plan at least every ten years, or sooner if required by the council.

Source: (Wellington Shire Council nd).

For example, depending on interpretation and application, the use of sea-level rise benchmarks could result in planning decisions being based on impacts unlikely to occur until some future time (usually 2100). Such benchmarks can substantially exceed usual safety margins for the majority of the lifespan of a structure (Clarence City Council, sub. 10, attachment 1). Further, Macintosh (2012, p. 8) argued that these benchmarks can ‘induce deterministic decision making, where the prescribed level of [sea-level rise] is treated as a certainty and responses are designed to avoid the associated impacts’ and ‘can leave decision makers without sufficient information on the potential range of threats and, in the worst case, create a false sense of certainty and promote deterministic decision making’ (Macintosh 2012, p. 15).

However, the practical application of these benchmarks can differ. In its Coastal Planning Guideline which emphasises mitigating and managing climate change risks in land-use planning systems over time, the NSW Department of Planning (2010, p. 4) noted that ‘the sea-level rise planning benchmarks are not intended to be used as a blanket prohibition on development of land projected to be affected by sea-level rise’. Further, a recent report by the NSW Chief Scientist and Engineer (2012, p. 6) highlighted the importance of reviewing sea level rise benchmarks at frequent intervals ‘given the rapid pace of advancement in scientific understanding and computational and modelling capacity’.

Some local governments argued that state and territory planning frameworks are not sufficiently flexible and impede local governments’ management of climate change risks. For example, the Gold Coast City Council (Queensland) (sub. 17, p. 2) noted that ‘it appears that the existing legislative and legal framework may restrict [Local Government Authorities] in developing an adequate planning response potentially leaving the community vulnerable to future risk’. A key concern was that legislative frameworks within which local governments operate planning systems do not incorporate policy for all climate change risks (Mornington Peninsula Shire, sub. 16; South East Councils Climate Change Alliance, sub. 12). Further, there is some evidence that there are barriers to councils using more sophisticated and complex planning instruments within state frameworks (Giles and Stevens 2011).

Increased flexibility, or a greater availability of planning tools, may not always lead to more effective adaptation. This could occur as a result of capacity constraints and legal liability concerns faced by local governments (chapter 8). For example, while the recent decision to no longer prescribe state-wide sea-level rise benchmarks for use by local governments in New South Wales will provide them with flexibility to determine their own projections to suit local conditions (NSW Department of Environment and Heritage 2012), it may not necessarily lead to better adaptation decisions.

In particular, the effectiveness of greater flexibility may be limited where local governments do not have appropriate support, information and funding. For instance, a report by the NSW Chief Scientist and Engineer (2012, p. 23) noted that the responsibility for implementing sea-level rise into planning strategies and approvals could put local governments:

under pressure in interpreting what is complex science related to sea levels as well as the complexities of coastal land issues and geomorphology, weather events, structural engineering and the overlaying statistical uncertainty that is associated with projecting events out several decades.

The report recommended that technical support be provided to local governments to assist them to interpret and apply climate science when making land-use planning decisions.

In many cases, state government planning frameworks are currently under review or undergoing modification. However, by and large, existing frameworks do not appear to explicitly or clearly support a range of flexible planning tools. The Queensland Government (sub. DR161, p. 12) submitted that ‘it is currently unclear whether the *Sustainable Planning Act 2009* [Qld] (SPA) allows local governments to approve trigger-bound development’. However, the SPA powers are broad and only limited by the requirement that conditions be ‘relevant and reasonable’ (Queensland Government, sub. DR161, p. 12).

It is not clear to what extent state and territory government land-use planning frameworks impede the use of risk management approaches or simply do not provide sufficient clarity regarding how these approaches can be implemented. In updating and reviewing state and territory regulations, governments should focus on ensuring that risk management approaches are explicitly supported and that appropriate guidance is provided to local governments to implement these approaches.

Understanding risk at the community level

Rigorous and transparent community consultation processes are required in order to establish the community’s ‘acceptable levels of risk’ (box 9.8) and ensure this risk profile is incorporated into land-use planning decisions. Such a process should incorporate information provision and a dialogue with the community about the risks posed by climate change for both proposed and existing areas of settlement (chapter 11).

Box 9.8 Acceptable levels of risk

The international standard for risk management states that risk evaluation is the ‘process of comparing the results of risk analysis with risk criteria to determine whether the risk and/or its magnitude is acceptable or tolerable’ (International Organization for Standardization 2009, p. 6). This is also reflected in the draft Australian Standard on climate change adaptation for settlements and infrastructure, which explicitly incorporates identifying ‘acceptable risks’ through stakeholder consultation as part of the risk assessment process (Standards Australia 2011, p. 46).

In all states and territories, amendments to land-use planning schemes are required to undergo community consultation processes. However, in some cases, specific studies to gauge community views may be required. One example of this is the work conducted by Lake Macquarie City Council in New South Wales, which used a range of consultation methods to canvas how best to manage flood risks in the Lake Macquarie area (box 9.9). Clarence City Council (sub. 10) is another example of a local government that consulted constituents to determine their views on managing climate change risks. Participants emphasised the importance of a broad range of stakeholders being consulted and included in these processes. For example, the Australian Chamber of Commerce and Industry (sub. DR102, p. 6) noted that consultation should extend beyond local residents in order to avoid problems of ‘NIMBY-ism [Not In My Back Yard]’.

Determining acceptable levels of risk for different types of land uses involves recognising that some damage to buildings and assets may not pose significant problems (for example, flooding of a road for a few days each year may not cause significant disruptions or damage). In other cases, even minor impacts may be highly undesirable (for example, impacts on hospitals that lead to power outages or require evacuation of staff and patients).

Ensuring that the community has a good understanding of the risks posed by climate change for areas of settlement is essential to the process of establishing acceptable levels of risk. A common first step to assessing climate change risks within local government areas is to undertake vulnerability assessments (chapter 8) and then make these publicly available. Local governments have also explored a range of options to convey information about climate change risks at the property level. For existing settlements, this can include placing notices on property contracts. For example, Lake Macquarie City Council has both flooding and sea-level rise notifications on contracts for sale (box 9.9) (chapter 11).

One approach to ensuring that property owners are aware of the climate change risks facing proposed property development is to require property owners themselves to conduct risk assessments before development approval is given. This approach has been utilised by the Victorian Government through Coastal Hazard Vulnerability Assessments and as an interim measure in Wellington Shire Council (box 9.7). Such an approach is also proposed as part of Western Australia’s draft State Coastal Planning Policy (Western Australian Planning Commission 2012a). However, requiring private developers to undertake climate change risk assessments has the potential to add to the costs of development approvals, lead to inconsistent application of development restrictions in a given area and result in problems financing projects, obtaining insurance and selling the land (Macintosh 2012; Victorian Coastal Climate Change Advisory Committee 2010).

Box 9.9 Lake Macquarie City Council — Flood Risk Management

Lake Macquarie City Council is currently updating its *Waterway Flood Study*, *Flood Risk Management Study* and *Flood Risk Management Plan* to incorporate recent flood events and the implications of climate change (all of which are required under the NSW Government's flood policy) (WMA Water 2011).

The Council has embarked on a community consultation process before adopting a finalised Management Plan, which has included:

- correspondence with all affected property owners (approximately 7000)
- six community workshops with potentially flood-affected residents
- a survey of residents' views relating to attributes of Lake Macquarie
- a survey of residents' views on proposed flood risk management options
- other opportunities to provide feedback through online surveys and written submissions.

Through the Flood Risk Management Plan, the Council has identified three categories of flood risk. Proposed development restrictions in these areas include requirements for floor heights and setbacks from the lake. In the survey of residents' views of flood management options, 94 per cent of respondents supported imposing development conditions such as raised floor heights and foreshore setbacks (Molino Stewart 2011).

Property certificates (section 149 certificates) are also utilised in Lake Macquarie and the intention is for these to continue to include a 'lake flooding' notation on foreshore properties below 3.0 metres Australian Height Datum, and a 'sea-level rise' notation on properties below 1.0 metre Australian Height Datum (Lake Macquarie City Council 2011). 83 per cent of survey respondents agreed with using section 149 certificates to notify owners about the risk of flooding and sea-level rise (Molino Stewart 2011).

In addition, 'indemnity statements' could be used to promote awareness of climate change risks facing proposed developments (these statements can be also used in order to manage the liability of local governments (chapter 8)). The Commission is aware of only one example of a local government using such a tool. In June 2011, the Lockyer Valley Council in Queensland endorsed an interim measure which required owners reconstructing a dwelling on flooded land to provide an 'indemnity statement' to the council confirming that they were aware of the current minimum habitable floor levels recommended by the council and the risk of rebuilding at a lower level (Lockyer Valley Regional Council 2011b). However, this was rescinded in September 2011 (Queensland Floods Commission of Inquiry 2012).

While participants generally agreed with the importance of information provision and community consultation in land-use planning processes (Coastal Residents Incorporated, sub. DR122), concerns were raised relating to how information provision could impact on property values (Bruce Thom, sub. DR128; Gold Coast

City Council, sub. 17; Suncorp, sub. DR127). Participants also raised concerns regarding the feasibility of establishing acceptable levels of risk on a community-wide basis and implementing policies that reflect this. For example, the South Australian Government (sub. DR88, p. 9) noted that ‘communities have only limited ability to determine their own “acceptable level of risk”. Given a choice, most communities will choose the least cost option now and defer most of the cost to future generations’. Further, the Western Australian Local Government Association (sub. DR111) posited that the communities’ ‘acceptable level of risk’ may differ significantly from the level of risk a local government is willing to accept, when zoning or rezoning land.

Establishing acceptable levels of risk also requires an elucidation of private and public responsibilities in managing these risks. This can be a very contentious issue and debate is already occurring regarding the responsibilities of public and private parties in relation to both new and existing settlements (chapter 11).

Considering the costs and benefits of land-use

The full costs and benefits of land-use planning regulation need to be considered in order to effectively manage the risks of climate change within land-use planning frameworks. This involves a consideration of the spectrum of options for land-use — this could range from avoiding development in a given area altogether, allowing development but with certain conditions to accommodate climate change risks or allowing development for a limited timeframe. Any analysis of the costs and benefits of land-use should be applied in a broad way that accounts for impacts that are not easily quantified (chapter 5). For example, the Great Barrier Reef Marine Park Authority (sub. DR92) emphasised that planning decisions should consider the effects of these decisions on important areas adjacent to the land in question.

There can be significant costs to the community of restricting or allowing development. Consequently it is necessary to consider any forgone benefits of different land uses as well as the costs of land use. For example, the Queensland Government (sub. DR161, p. 12) noted that:

It is not clear whether the discounting of risk due to other short term benefits has been sufficiently examined. For example, for every year that a house on the beach is not subject to storm tide inundation, it is providing benefits without any costs being materialised. How many times a generation, or a decade, or a year is flooding acceptable before it is intolerable and the costs outweigh the benefits?

To ensure the full costs and benefits of planning decisions are considered from a community-wide perspective, land-use planning decisions should not be made in isolation of other relevant policy issues, including building regulation and

environmental policy. Such an approach is intended to address information failures and spillovers created by land markets and climate change without imposing unnecessary costs on the community.

RECOMMENDATION 9.1

As a priority, state and territory governments should ensure that land-use planning systems are sufficiently flexible to enable a risk management approach to incorporating climate change risks into planning decisions at the state, territory, regional and local government levels. Consideration should be given to:

- *transparent and rigorous community consultation processes that enable an understanding of the community's acceptable levels of risk for different types of land use*
- *the timeframe of risks and the expected lifetime of proposed land use*
- *the costs and benefits of land use.*

State and territory governments should provide appropriate guidance to local governments to implement these provisions in local government schemes.

Consistency in planning regulation across different jurisdictions

Current approaches to incorporating climate change in land-use planning systems vary by jurisdiction. This reflects the decentralised nature of Australia's planning system more generally. However, inquiry participants raised concerns that climate change risks are not being consistently managed or monitored in land-use planning regulation and that this could constitute a barrier to effective climate change adaptation.

This issue was raised in the context of inconsistent regulatory approaches at the local government level (Housing Industry Association, sub. 69). For example, the Coasts and Climate Change Council (sub. 30, p. 2) noted that:

State policies provide broad direction on managing climate change risks but are often non-binding and, in giving effect to the state policies in planning decisions, a lot of discretion is exercised at local government level. This can result in very inconsistent consideration of risks at local scales, and in some cases no consideration at all.

Concern was also raised regarding inconsistency across state government policies, most commonly in relation to the different sea-level rise benchmarks developed by the Australian Government and some state governments (Clarence City Council, sub. 10; Council of Capital City Lord Mayors, sub. 67) (table 9.1). For example, the Sunshine Coast Council (sub. 53) felt that the existence of different sea-level rise benchmarks across jurisdictions divided opinions within local governments, led to

significant time and effort being expended to develop local government policy responses, and impeded the process of adaptation to coastal hazards.

A number of participants proposed a national approach to promote consistency and coordination in decision making regarding climate change and land use (Clarence City Council, sub. 10; Local Government Association of Queensland, sub. 41; VCCCAR, sub. 56). For example, the Investor Group on Climate Change (sub. 73, p. 4) argued that:

A consistent national approach is needed which recognises and allows for the different severities and likelihoods of climate risks in different regions, but which at a national level provides:

- clear protections for private property owners and insurers in order to provide greater investment certainty;
- consistency in the overarching framework, definitions and procedural matters to reduce compliance costs and the risk of errors; and
- policies based on the current scientific understanding of the risks, particularly as hazard maps and other forecasting tools become more sophisticated, so as to ensure that adequate adaptation policies are implemented.

Further, the Department of Climate Change and Energy Efficiency (sub. 57, p. 9) noted that ‘a one-size-fits-all definition of sea-level rise ... will not work for Australia, given the climatic differences across the country. But agreed national methodologies would allow the development and delivery of information to support effective adaptation’.

It is not clear what a national approach would entail or the policy areas that it would encompass. For example, a national approach was frequently evoked in conjunction with management of the coastal zone (National Sea Change Taskforce, sub. 75). A consistent approach to coastal zone issues seeks coordination across a range of different policy areas, a non-exhaustive list of which might include: land-use planning, building regulation, environmental regulation and emergency management. Such an approach could also incorporate consideration of the issues facing both new and existing settlements (chapter 11).

Australia’s system of land-use planning regulation is intended to provide planners with the flexibility to account for local circumstances in decisions. This reflects the principle of subsidiarity, where decisions are made by the lowest level of government capable of adequately taking into account all positive and negative impacts on the community (chapter 8). In this context, leading practice involves local governments assessing development which affects the local community, and regional or state bodies making decisions where land use has broader impacts beyond a given local government area (PC 2012e). Thus, it may be appropriate that

state and territory governments adopt different planning frameworks, or use different benchmarks to respond to climate change risks. For example, the South Australian Government (sub. DR88, p. 9) argued that it is reasonable to have variations in sea-level rise benchmarks due to ‘differing appetites for risk’.

Nevertheless, to be effective, planning instruments and policy should be consistent and current (PC 2011e). Consistency in land-use planning is generally managed through a clear hierarchy of planning instruments and policies. For example, local government level schemes must be consistent with state (and other higher level) legislation and planning policies. The currency of planning instruments and policies is important as the factors that underlie planning regulation — such as demographics and social and political goals — are constantly changing (PC 2011e).

In previous work, the Commission has identified general areas of improvement where land-use planning schemes could be updated more regularly and local government land-use regulation made more consistent with state policy (PC 2011e, 2012e). In addition, a large number of inquiry participants have raised concerns regarding the clarity of regulatory frameworks and the level of support from state governments to local governments more generally (chapter 8). Focusing on improvements in these areas is likely to provide significant benefits in terms of strengthening the consideration of climate change risks within land-use planning systems and the consistency of local government schemes with state government policy. Further, improvements in these areas are likely to be beneficial in both current and future climates.

10 Building regulation

Key points

- Building regulation in Australia has been based solely on historical information. However, the Australian Building Codes Board has undertaken work that examines the implications of climate change for the National Construction Code, including:
 - a review of the potential impacts of climate change on buildings, which identifies options to adapt the code to address future hazards
 - consideration of updating wind standards to manage increased cyclone intensity
 - consideration of a standard for buildings in flood-prone areas.
- A number of reports have suggested that the Australian Building Codes Board should incorporate climate change impacts into the National Construction Code, including the Council of Australian Governments' National Adaptation Framework and National Strategy for Disaster Resilience.
- Currently, there is no explicit requirement for the Australian Building Codes Board to consider climate change impacts when reviewing the National Construction Code.
- A formalised program to incorporate climate change impacts into the National Construction Code over time is required.
 - This program should direct the Australian Building Codes Board to monitor projections of climate change risks to buildings and incorporate this information into the National Construction Code where a net benefit to the community is identified.
- The Commission has not identified any barriers preventing the Australian Building Codes Board taking into account climate change when amending the National Construction Code.
 - The current objectives of the National Construction Code do not restrict building regulators incorporating climate change risks into the code.
 - The current process of regulatory impact analysis for changes to the National Construction Code is appropriate.
- It is appropriate that building regulation does not contain requirements to manage natural hazards where these would be better managed by the planning system. However, in these cases it is important to ensure that the risks are appropriately managed by the planning system.

The National Construction Code (NCC), along with state and territory legislation, sets out a range of minimum design characteristics for buildings. The NCC aims to

address market failures relating to the safety of a building's residents, the amenity of buildings and the sustainability of buildings (box 10.1).

The Australian Building Codes Board (ABCB) has recently undertaken work to consider the implications of climate change for the NCC. This included work on assessing the need to update the NCC to reflect the impacts of increased cyclone intensity and floods. The ABCB has indicated that it intends to consider climate change impacts in its future work.

However, there may be potential to improve the transparency of this process. In particular, there is currently no publicly available work plan published by the ABCB explaining how climate change will be incorporated into the NCC, nor is there a formal requirement for the Board to consider climate change in its reviews of the NCC.

Box 10.1 Why do governments regulate building?

There are several types of market failure that may be applicable in the building industry. Where such market failures exist, government intervention has the potential to improve community wellbeing.

- **Spillovers.** For example, buildings, or the construction of buildings, can have negative impacts on inhabitants and the surrounding community through excessive construction noise, inadequate ventilation or poor drainage.
- **Information asymmetries.** Many characteristics of a building are hidden by the time it is completed, leading to a situation where these may be known to the builder, but not the user of the building. This is compounded by the nature of building information. The building process is complex, involving tradeoffs between costs, skills, materials, building designs and processes, which impact on the characteristics of the finished building.

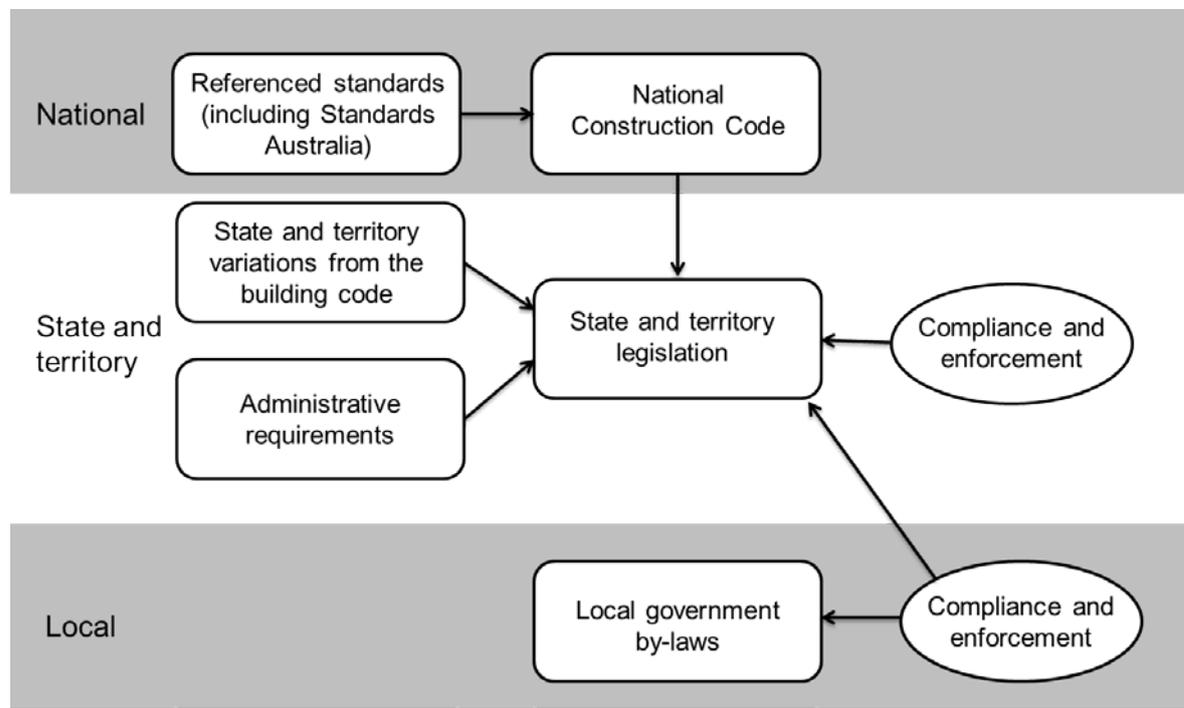
Equity considerations (for example, access to buildings for people with disabilities) is a further rationale for minimum standards relating to building use.

Source: PC (2004c).

10.1 Building regulation in Australia

Under the Australian Constitution, state and territory governments have primary responsibility for building regulation. The ABCB intergovernmental agreement provides a national framework for building regulation (the NCC), applied and enforced at the state, territory and local levels (figure 10.1).

Figure 10.1 Responsibility for building regulation in Australia



The NCC is developed and maintained by the ABCB (box 10.2). The ABCB is a joint initiative of the three levels of government, and reports to the Council of Australian Governments' (COAG) Building Ministers' Forum. The NCC references a range of other standards — for example, bushfire standards developed by Standards Australia. In these cases, the responsibility for maintaining the standard lies with the original standards body — though the ABCB may provide support for this.

The NCC is given legislative force through state and territory legislation. All state and territory governments have building Acts and regulations that reference technical building requirements contained in the NCC. This legislation also incorporates administrative provisions such as facilitating the issuing of building permits and certificates. While states and territories have primary responsibility for enforcing building regulation in Australia, this responsibility is typically delegated to local governments.

In addition, local governments can influence building regulation through:

- by-laws that impose additional building requirements within their local government area (though not all jurisdictions allow local governments to make such laws)
- planning regulation, which can intersect with building regulation (chapter 9 and section 10.4).

This regulatory framework creates the potential for state, territory and local government regulation to incorporate variations from that contained in the NCC. For example, Queensland's Development Code imposes a range of requirements on buildings that go beyond the National Construction Code. However, the ABCB intergovernmental agreement states that variations from the code should be kept to a minimum.

Box 10.2 The National Construction Code

The National Construction Code is intended to incorporate all on-site construction requirements. Currently, the code comprises the Building Code of Australia (BCA) and the Plumbing Code of Australia. A reform program is underway to expand the National Construction Code to incorporate electrical and telecommunications standards.

The BCA covers new commercial, residential and public buildings, but excludes 'non-buildings' or engineering constructions (such as roads and bridges). Existing buildings are not covered unless undergoing significant alterations or changes of use. The code establishes national minimal standards (typically developed by Standards Australia) to ensure buildings are designed and constructed to withstand a range of hazards, including natural hazards, such as cyclones and extreme winds, intense rains, bushfires and (to some extent) floods. The BCA itself is not legally binding — requirements under the BCA only become mandatory once referenced in state and territory legislation.

Information about environmental hazards feeds into two stages of the BCA's standard-setting process. First, these data are used to estimate the intensity and frequency of the weather hazards a building may face in a given location. This determines geographical coverage and the stringency of building standards. Second, data on environmental hazards are used in regulatory impact analyses to estimate the costs and benefits of proposed amendments to the BCA and inform determinations regarding changes to the code.

Source: ABCB (2012).

10.2 Climate change and building regulation

A range of submissions to this inquiry raised the need for changes to building regulation to take into account climate change (for example, Australian Sustainable Built Environment Council, sub. DR157; Bluescope Steel, sub. DR97; Department of Climate Change and Energy Efficiency, sub. 57; Suncorp Group, sub. 28, sub. DR127). For example, in its submission, the Department of Climate Change and Energy Efficiency (sub. 57, p. 10) noted that the Building Code of Australia (BCA) is generally applied through 'prescriptive technical standards that assume an

unchanging climate’ and that ‘without regular review, technical standards for a particular region could become obsolete over time as the climate changes’.

In addition, since 2007 a number of reports have suggested that climate change impacts need to be considered in the NCC (box 10.3).

Box 10.3 Reports considering climate change and building regulation

- A 2007 Australian Government report identified probable impacts on buildings from various environmental hazards. It recommended reviewing the building code and standards, and areas where standards apply, using projected climate impacts (BRANZ 2007).
- The COAG National Adaptation Framework recommended that ‘the Australian Building Codes Board consider climate change as part of periodic reviews’ of the building code. It proposed that ‘information used to determine vulnerability of settlements to climate-related hazards (such as floods, bushfires, cyclones and coastal inundation)’ should be reviewed (COAG 2007b, p. 18).
- A 2009 review for the Australian Government found that ‘standards for building design and construction do not currently reflect the potential impact of climate change’. The review recommended that ‘governments and industry be open to the potential to reflect climate change adaptation risks within the National Construction Code, where such inclusion can be justified in [regulation impact statement] analysis’ (ACG 2009, p. iv).
- The 2011 COAG National Strategy for Disaster Resilience established a priority outcome that ‘building standards and their implementation are regularly reviewed to ensure they are appropriate for the risk environment’ (COAG 2011, p. 12).

What steps have been taken to incorporate climate change into building regulation?

The ABCB has been considering climate change for the past five years (Australian Building Codes Board Chairman, sub. DR134; Department of Industry, Innovation, Science, Research and Tertiary Education, sub. DR121). This has included work in the areas of floods and cyclones.

In 2010, the ABCB conducted a review to assess how well the BCA could address potential environmental hazards under climate change, and found that minimal changes to the BCA were required under a ‘low-emissions’ scenario (Department of Industry, Innovation, Science, Research and Tertiary Education, sub. DR121) (box 10.4). However, the review noted that if the climate changed in accordance with a ‘high-emissions’ scenario, the current BCA is likely to be inadequate. In addition, the review identified possible adaptation options for the BCA to better

manage environmental hazards and proposed areas where further research was needed.

Box 10.4 ABCB review of the BCA under climate change

In 2010, the ABCB reviewed the potential impacts of climate change (including higher temperatures, higher wind speeds, more intense but overall less rainfall, and greater risks of floods and bushfires) on buildings designed and constructed to the existing building code, and identified options to adapt the building code to meet future changes in environmental hazards.

The review found that buildings designed and constructed in accordance with the current standards under the BCA are likely to be 'reasonably adequate' under a 'low-emissions' scenario for the next 50 years. However, if the climate were to change in accordance with a 'high-emissions' scenario, the current BCA is likely to be deficient. The report noted that the latest climate science indicates a high-emissions scenario is likely in the medium to long term (2050 to 2100) and in this case the BCA will need to adapt in response.

The review contained a number of suggestions for potential adaptation options to improve the resilience of buildings, including:

- lessening the impact of higher temperatures by using 'passive solar design'
- improving the chain of fixings from roof to foundation and improving bracing to counter more intense cyclones and storms
- increasing the capacity of gutters and flashings to managing increased rainfall intensity
- increasing the efficiency of plumbing
- avoiding building in flood-prone areas and bushfire-prone areas
- considering the use of hail-resistant materials in high-risk areas.

Sources: Australian Building Codes Board Chairman (sub. DR134); Department of Industry, Innovation, Science, Research and Tertiary Education (sub. DR121).

An ABCB review of Australian wind standards found that there would not be net benefits to amending the NCC to reflect increased cyclone intensity (box 10.5). The analysis included a range of climate change scenarios, and the proposals were tested under these scenarios. As a result of this analysis, no change was made to the NCC.

Finally, the ABCB has recently released a consultation regulation impact statement (RIS) on a proposed flood standard, which suggested that there would be net benefits from such a standard (there is currently no flood standard in the NCC). The standard would impose requirements for the design and construction of buildings in flood-prone areas. The standard has been developed in response to an ABCB review that found an increased risk of damage to buildings due to flooding in low-lying or

coastal areas as a result of climate change (Australian Building Codes Board Chairman, sub. DR134).

Box 10.5 Reviewing wind standards for climate change impacts

The ABCB is currently reviewing the existing Australian wind standards (AS/NZS 1170.2 and AS/NZS 4055) to determine if cyclone regions and standards for construction should be amended to allow for possible increases in cyclone intensity and shifts in cyclone activity due to climate change.

As part of the initial regulation impact statement (RIS) process, a range of scientific information was reviewed (including historical wind data, studies of recent extreme cyclones, and climate change literature on cyclone activity). Five changes to existing wind standards were proposed to manage the evolving risk from cyclone activity.

In an initial RIS, the five proposed changes were subject to cost–benefit analysis. Benefits were calculated as ‘avoided damages’ using an estimate of the ‘annual average cyclone related insured losses’ over the period from the mid-1960s to 2006 (ABCB 2010, p. 13). Benefits (avoided damage) were adjusted for a predicted increase in cyclone peak winds of 5 to 10 per cent by 2070, and southward movement of category 3 intensity cyclones by up to 3 degrees of latitude as a consequence of climate change. Under these conditions, when taking into account costs, all five proposed changes were found likely to deliver a net benefit compared to existing wind standards.

After a consultation period, and as part of the final RIS process, additional research on cyclone activity and climate change impacts was reviewed, and the methodology used in the initial cost–benefit analysis was revised. Benefits were recalculated using estimates of the likelihood of a cyclone affecting a new house (based on historical data on cyclones reaching land in a given area), and the damage to the house per cyclone event (based on damage reports from Cyclones Yasi and Larry). These data were then adjusted to account for a 25 per cent reduction in the likelihood of cyclones by 2100, and a 30 per cent increase in damage (arising from a 5 to 10 per cent increase in cyclone intensity and wind speed by 2100). In contrast with the initial RIS, the final RIS found that the five proposed changes to wind standards were likely to deliver an overall net cost, and therefore no change to the NCC was recommended.

Sources: ABCB (2010, 2011b).

A formal and transparent process

A formal climate change adaptation work program for the ABCB would enhance the framework for monitoring projections of climate change risks to buildings and incorporating these projections in the NCC where they deliver a net benefit to the community. Such an approach is likely to require formal direction from the COAG Building Ministers’ Forum and be incorporated in the ABCB’s annual work plan.

Such a work program should include a requirement for the ABCB to monitor projections of climate change risks to buildings. The ABCB review of climate change in the BCA noted that the BCA is likely to be deficient under high climate change scenarios. However, there is currently no formal requirement for the ABCB to monitor these projections (though there is a requirement for the ABCB to monitor current natural disasters).

The work program should also provide a process for incorporating climate change impacts into the NCC. At this stage, it is not clear that climate change considerations are sufficiently formalised in ABCB processes. For example, while the ABCB's 2012 review of climate change in the BCA outlined a number of potential adaptation options, there has been no formal response to this report and at this stage the ABCB has not committed to the adaptation options outlined in the report (Australian Building Codes Board, trans., p. 141).

By making such a work plan publicly available, this would enhance the transparency of the process of considering climate change in the NCC. The ABCB already has well-established processes for transparency, including releasing RISs for public consultation. Publicly releasing a detailed climate change adaptation work plan would enable further consultation at an earlier stage in the process.

RECOMMENDATION 10.1

The Council of Australian Governments' Building Ministers' Forum should provide formal direction to the Australian Building Codes Board to:

- ***monitor projections of climate change risks to buildings***
- ***revise the standards in the National Construction Code to take into account these projections where this delivers a net benefit to the community.***

This body of work should be transparently and formally incorporated in the Australian Building Codes Board's annual work programs.

10.3 Potential barriers to considering climate change in building regulation

The objectives of the National Construction Code

The ABCB (trans., p. 140) has noted that the current NCC objectives of health, safety, amenity and sustainability are sufficient for it to consider climate change.

... we believe that the objective of sustainability, together with the other objectives, sufficiently enables us to consider adaptation to climate change when we regulate, or propose to regulate.

However, several inquiry participants argued that the lack of a building durability objective means that the ABCB cannot fully consider climate change issues. For example, the Insurance Council of Australia (sub. 42, p. 5) noted that:

... unlike the building codes of some other developed nations, the BCA does not include a specific principle for property durability. The BCA therefore permits the construction of buildings (at a minimum standard) that include no element of durability (property protection), creating a stock of buildings that whilst 'safe' are increasingly brittle to extreme weather events ...

The Commission does not consider that a building durability objective is needed for climate change purposes. The ABCB is already considering climate change issues in its decision-making processes, and the current objectives of the building code are likely to lead to some degree of protection to buildings. Further, the Australian Building Codes Board Chairman (sub. DR134, p. 11) has suggested that a durability requirement would add 'significant upfront costs to construction'.

Private builders and property owners are able to construct buildings to standards in excess of building regulation requirements if they deem durability to be an issue. The private sector is currently developing tools that will assist property owners with assessing the durability of their building — for example, the Building Resilience Rating Tool may help developers to assess the risks to buildings, and ways of minimising these risks (Australian Resilience Taskforce 2012).

Therefore, it is unlikely that introducing a durability objective into the NCC would have net benefits for climate change adaptation.

The regulatory impact statement process

Changes to the NCC must be shown to have net benefits through the COAG RIS process (box 10.6). The Commission considers that best practice regulation

guidelines are an appropriate tool to ensure that reforms achieve net benefits. Adherence to these guidelines should not preclude the consideration of climate change impacts in the BCA.

However, inquiry participants suggested that a strict application of the COAG RIS process by the ABCB has limited the scope for climate change projections to be considered when assessing changes to the BCA. For example:

Practically applying principle 3 of the Guide, ‘adopting the option that generates the greatest net benefit for the community’, has required historical data and demonstrable building failures before any regulatory proposal designed to prevent harm can be justified. (Tasmanian Government, sub. 51, p. 7)

Box 10.6 COAG best practice regulation guidelines

Under the intergovernmental agreement which established the ABCB, amendments to the BCA must meet COAG best practice regulatory principles. These include that potential amendments generate ‘the greatest net benefit for the community’ and be ‘proportional to the issue being addressed’ (COAG 2007a, p. 4). The COAG best practice regulation guide states that a cost–benefit analysis should ‘assess the costs and benefits of all the options supported by an acceptable level of evidence’ (COAG 2007a, p. 11). The intergovernmental agreement imposes the additional requirement that an amendment must be the ‘minimum necessary’ to achieve ... [the BCA’s] objectives efficiently (COAG 2006).

The COAG best practice regulation guide contains guidance for managing uncertainty in the RIS process. The guide suggests that sensitivity analysis should be conducted, which considers the ‘worst-case’ scenario. If the analysis suggests that there are net benefits under this scenario, then there can be more confidence that the actual benefits of the reform will exceed the costs.

The ABCB has also indicated it faces difficulties in amending the BCA to incorporate climate change impacts while still meeting COAG best practice principles. The Australian Building Codes Board Chairman (sub. DR134, p. 10) noted that:

... the actual quantum of changes to hazards and risks, as a result of climate change, are uncertain and the timeframes for such impacts are long. Traditional cost–benefit analysis may be difficult where risks are uncertain but could potentially be catastrophic if they materialise.

Further, the Australian Building Codes Board Chairman (sub. DR134) stated that more reliable data on specific climate impacts will be needed to ensure that standards can be adequately reviewed through the RIS process to take account of the longer-term trends.

To date, the ABCB has utilised climate change projections in only one RIS — its review of wind standards for construction in cyclone affected areas (box 10.5). The Australian Building Codes Board Chairman (sub. DR134, p. 10) stated that the ABCB was able to achieve a high degree of rigour in the cost–benefit analysis for this RIS through:

- identifying alternative climate scenarios with clear assumptions and projections
- incorporating a thorough literature review that established a broad consensus view of the likely change in climate, with quantified projections
- testing the proposals under all scenarios.

While the RIS did not result in a regulatory change, this is appropriate where the expected benefits of a reform option do not exceed the costs.

Uncertainty regarding climate change impacts will complicate the analysis. However, this does not alter the overriding goal for the ABCB to identify and implement reforms to the code that can be confidently expected to increase the wellbeing of the community as a whole. Supplementing traditional cost–benefit analysis with tools, such as those considered in chapter 5, and improving information on climate change impacts (chapter 7), would assist with the consideration of climate change impacts in regulatory impact analysis.

The timeframes of regulatory review

In some cases, long review processes could constitute a barrier to effective adaptation. Some inquiry participants have raised concerns regarding the length of time taken to update the NCC and associated standards (Bluescope Steel, sub. DR97; Water Services Association of Australia, sub. 52).

It is important to strike the right balance between the length and the robustness of review processes. The Commission acknowledges the importance of robust and transparent amendment processes that incorporate up-to-date information. Such processes are likely to take time, particularly where consensus decision making across different levels of government is required. However, it is important that the length of review processes does not unnecessarily impede the ability of the building sector to adapt to climate change.

A number of reviews have examined this issue. The Commission’s 2004 report into building regulation received submissions raising similar concerns.

To some extent, delays are an inevitable consequence of the need to achieve agreement between nine jurisdictions and the need for rigorous and transparent consultation and impact assessment processes. Further, the recent agenda for the [ABCB] has included

reform issues for which acceptable resolutions are inherently more difficult to achieve. (PC 2004c, p. 279)

The Victorian Bushfires Royal Commission (2010) also examined this issue and reported significant delays in Standards Australia developing new bushfire standards. Further, the Royal Commission noted significant delays in a project to update bushfire maps (for use in both planning and building regulation), which commenced in 2002 and was still ongoing in 2009. The Royal Commission noted that this was partly a factor of insufficient resourcing of these processes (box 10.7).

Box 10.7 Timeliness of revisions to the bushfire standard

The Victorian Bushfires Royal Commission — established to investigate the Victorian bushfires on 7 February 2009 — reviewed the length of time required to complete the most recent revision of the bushfire standard AS/NZS 3959: Construction of buildings in bushfire-prone areas.

The Royal Commission noted that the development of the new bushfire standard (AS 3959-2009) took nearly eight years. It found that this was primarily due to the management of the review processes by the ABCB and Standards Australia, and insufficient resourcing of those processes. The Royal Commission noted that:

The lengthy history of the revision of AS 3959-1999 and the eventual publication of AS 3959-2009 reflect poorly on both Standards Australia and building regulators, in particular the ABCB. It is unfortunate that regulation of a matter of public safety should have been allowed to drift for nearly eight years ... (Victorian Bushfires Royal Commission 2010, p. 255)

The Royal Commission recommended reforms to improve the timeliness of future revisions of standards, including:

- a greater commitment of public resources to the review and development of AS 3959 and other bushfire-related standards
- that future proposals for revision and development of bushfire-related standards by Standards Australia specify the scope of the review and include clear project management specifications.

Source: Victorian Bushfires Royal Commission (2010).

Progress has been made in accelerating the standards revision process. For example, Standards Australia has made changes to its project management processes both prior to and following the Victorian Bushfires Royal Commission. A number of changes to the bushfire standard have been completed since the Royal Commission, and the average project delivery time has dropped from 3.3 years to 0.9 years since 2008 (Standards Australia, sub. DR135).

10.4 Interactions between land-use planning and building regulation

In some cases, the vulnerability of people and buildings to climate change impacts will depend on how well building standards (which generally control how to build) and planning regulations (which generally control where to build) are integrated. For example, where planning schemes can identify areas that are bushfire prone and the level of bushfire hazard, building regulation can then specify a construction standard for a building in a given area to better manage bushfire risk. The importance of this crossover is recognised in the National Strategy for Disaster Resilience, which states that:

... the predicted impact of climate change on sea level and the frequency and intensity of extreme weather events must be considered in an integrated approach to natural hazards in land-use planning schemes, building code standards, and state and territory based regulations. (COAG 2011, p. 11)

Under the strategy, a range of work is underway to examine how current planning and building frameworks interact to manage environmental hazards to settlements.

It is appropriate that the NCC does not contain standards to manage some natural hazards where would be better managed by the planning system (for example, the current NCC does not contain standards for storm surge (ABCB 2011a)). The Department of Industry, Innovation, Science, Research and Tertiary Education (sub. DR121, pp. 8–9) stated that:

It is impractical for the BCA to require buildings to resist extreme weather events that would be better and more cost effectively addressed by using land-use planning controls to restrict development in high-risk areas. Conflating building and planning regulations has the risk of imposing excessive construction costs on all buildings, when planning requirements in specific areas could deter much of the damage at a far less cost.

However, in such cases it is important to ensure that the risks are managed by the planning system (for example, by restricting developments on flood plains). Otherwise, this may lead to gaps in the overall regulatory framework where neither system addresses the hazard. A specialised national body to consider these issues may be useful if a lack of coordination between the building and planning systems is an issue.

Where both planning and building frameworks must address a common environmental hazard, they should both use the best available information to determine the extent of the hazard. Inconsistent use of data may lead to gaps in overall risk management. For example, the Victorian Bushfires Royal Commission

noted that bushfire-hazard maps used in the planning and building systems did not match — meaning that houses could be located in a bushfire hazard area under the planning system without meeting the bushfire standards under the NCC (Victorian Bushfires Royal Commission 2010).

In some cases, there can be duplication and overlap in regulation as a result of building and planning interaction (Housing Industry Association, sub. 69). For example, some local governments may impose building regulations through their local planning instruments. In 2004, the Productivity Commission found that ‘local governments, through their planning approval processes, are imposing regulations on building. While this may offer benefits, there are concerns about the resulting regulatory inconsistencies across Australia and a lack of rigorous regulatory assessment’ (PC 2004c, p. xlv).

There have been moves towards delineating the planning and building frameworks. The 2012 ABCB intergovernmental agreement states that:

To strengthen reforms to building and plumbing regulation nationally, the respective governments of the Commonwealth, the States and the Territories commit to: ... seeking commitments ... from their local governments and other local government-like bodies where they have any administrative responsibility for regulating the building and plumbing industry, and as far as practicable implementing a ‘gateway’ model which prevents local governments and other local government-like bodies from setting prescriptive standards for buildings that override performance requirements in the NCC. (COAG 2012, p. 2)

This model is currently adopted by three states (Victoria, Western Australia and Queensland) and the Commission’s study into the Role of Local Government as Regulator suggested this approach was a leading practice (PC 2012e). The use of this approach by the states would limit unnecessary costs imposed by local government planning and building frameworks.

11 Existing settlements

Key points

- Climate change has the potential to increase risks in many areas of existing human settlement.
 - These encompass the built environment such as residences, parks and infrastructure, and many natural areas such as beaches.
- Policy responses to address these risks may be categorised as three broad types: ‘protection’, ‘accommodation’ and ‘retreat’.
- A large number of participants — in particular, local governments — raised concerns regarding the lack of a well-established or comprehensive approach for governments to manage these risks and implement policy responses.
- In assessing the role for governments and determining when a policy response is appropriate, several complex questions arise, including:
 - what are the roles of private individuals, businesses and governments in managing climate change risks to existing settlements?
 - how should the costs of managing risks to existing settlements be allocated across governments and the community?
 - what should be the roles of the different levels of government in any policy response?
- A national framework to support strategic management of these issues may be necessary. However:
 - the costs and benefits of different strategies and roles of different levels of government are yet to be established
 - community views on policy responses and ‘acceptable levels of risk’ for different assets within existing areas of settlement need to be canvassed.
- Addressing these questions and developing a government response will require the involvement of all levels of government and comprehensive community consultation.
 - Given the importance, scale, scope and complexity of the issues involved, the Commission considers that the Council of Australian Governments should commission a dedicated inquiry to review and examine appropriate responses to managing the risks of climate change to existing settlements.
 - The Council of Australian Governments may wish to create an advisory committee with membership from all states and territories and local government representation to work with the independent panel.

Climate change has the potential to expose many areas of existing human settlement to greater or unaccustomed risk. Examples include coastal areas subject to storm surge, riverine areas vulnerable to flood, or areas facing significant bushfire risk. Human settlement in this context is interpreted broadly and encompasses the built environment such as residences, parks and infrastructure, and also in some cases areas of natural environment that are integral components of human settlements, such as beaches.

While most areas of existing human settlement will experience some climate change impacts, adaptation responses may not be required in all cases. This chapter focuses on areas of human settlement that face significant risks — these include settlements susceptible to severe climate change impacts or settlements where the value of potentially affected assets is high.

11.1 Protect, accommodate or retreat

Addressing climate change risks for existing settlements entails a number of complex considerations, including whether and how governments should ‘protect’ cities or towns, implement measures to ‘accommodate’ climate change impacts or relocate existing settlements from high hazard-risk areas (boxes 11.1 and 11.2). While helpful as a way to frame possible adaptation options, the simple typology of protect, accommodate or retreat ‘hides the complexities surrounding the implementation of these options’ (Macintosh 2012, p. 2).

Implementing a chosen mix of protect, accommodate and retreat strategies is likely to cut across several areas of policy. For example, a ‘protect’ strategy that involves building a flood levee may require coordination between emergency management, environmental management and urban planning agencies. Further, a chosen strategy is likely to raise significant issues for all levels of government. For example, a range of Australian, state, territory and local government assets could be affected by climate change, including public infrastructure and areas of important environmental or cultural value to the community.

Coordination across different levels of government is required to ensure that actions by governments or private individuals to manage climate change risks do not result in unintended impacts on other members of the community, or beyond a given community.

Box 11.1 Categories of adaptation strategies

There are three major categories of adaptation strategies that governments can pursue to manage climate change risks to existing settlements — protection, accommodation and retreat (these strategies also apply for new development).

Protection involves the construction of ‘hard’ engineering infrastructure, such as flood levees and seawalls to maintain development in its current location, or ‘soft’ protective works such as replenishment of beaches (where sand lost through longshore drift or erosion is replaced from sources outside the degraded beach).

These responses can be used to protect private and public assets (including private residences, the environment and public infrastructure) from climate change impacts and may be developed and funded by governments or private individuals. Regulatory arrangements differ across Australian jurisdictions regarding the provision and funding of protective works (chapter 13). Private individuals can also initiate and fund protective strategies to protect their own property, although in some cases local government approval must be sought.

Accommodation entails the modification of existing or proposed structures to take into account potential climate change impacts (for example, by strengthening the wind resistance of roofing to improve protection from cyclone events). Accommodation strategies can be undertaken voluntarily by private property owners or may be imposed (through regulation) or facilitated (through provision of information or incentives) by governments. Governments may also fund accommodation measures for publicly owned assets.

Regulatory requirements to undertake accommodation measures for existing private property are not commonly used due to issues of applying retrospective regulation, though such approaches may be legally feasible (De Sousa and Thwaites 2012). For example, all Australian states and territories have laws that require fencing around pools and spas and the installation of smoke alarms in residences.

Retreat provides for the relocation of built assets from a high-risk area to a lower-risk site. Alternatively, at-risk assets may be abandoned. Retreat can involve voluntary or mandatory relocation, be ‘managed’ or ‘unmanaged’, implemented gradually over time (such as in Byron Bay) or en masse after a natural disaster (such as in Grantham).

A ‘managed retreat’ policy involves active intervention by the government. This may involve setting aside undeveloped land for retreat or allowing new development in an area on the condition that it be removed once a trigger point is reached. Managed retreat can also be facilitated through the acquisition of land by governments, either voluntarily or through compulsory measures.

In contrast, an ‘unmanaged’ approach to retreat primarily involves non-intervention by governments and a gradual reduction in the provision of government services, including the provision of various types of infrastructure. Landowners have the option of vacating the land (‘retreating’), or undertaking their own accommodation or defence strategies (where these do not have adverse impacts on others or the environment).

Box 11.2 Examples of managed retreat

Byron Bay, Byron Shire Council (NSW)

In response to concern about coastal erosion and the potential impacts of climate change, Byron Shire Council has adopted a 'planned retreat' policy (for both new and existing areas of human settlement). Local planning regulations require that development must be relocated or removed once the erosion escarpment (the most landward limit of erosion) encroaches within a set distance of the development (Byron Shire Council 2010a). When this happens, development consent lapses, though coastal land may be occupied and used until that time. In addition, new dwellings must meet several criteria, including being single storey, modular and able to be removed within 12 hours if necessary.

Property owners are also largely prohibited from constructing protective structures against the erosion of their land and impacts of other coastal processes. The Council's Development Control Plan specifies that such structures must 'not cause adverse impacts on other lands or on coastal processes' (Byron Shire Council 2010a, p. J7). Where beach protection works are permitted, rock, concrete and other hard material must not be used.

Grantham, Lockyer Valley Regional Council (Queensland)

In response to floods in 2010 and 2011, the Lockyer Valley Regional Council introduced a 'relocation policy' in 2011 (updated in June 2012). This policy allows eligible property owners to voluntarily swap their land for a new parcel of land located in a development area acquired by the council (above the 2011 flood peak). The land is swapped at no cost to the landowner, but landowners are responsible for meeting the cost of building their homes on the new allotments. The relocation policy is staged, with the initial stage open to members of the community who lost family members and suffered property damage during the floods. Parcels are allocated by ballot and later stages allow other lots to be developed and sold to help offset the cost of the program. This program is scheduled to continue until June 2013 or once all lots are allocated.

Wooli village, Clarence Valley Council (NSW)

Clarence Valley Council (sub. DR98) is considering several options (including managed retreat) for managing risks in Wooli village. Work by the council indicates that more than 40 houses (built prior to 1996) are at immediate risk of coastal erosion, and a total of 158 residences will be at risk by 2100 (WorleyParsons 2010). Preliminary estimates for major protection works are in excess of \$30 million, and maintenance costs were estimated at more than \$250 000 annually. The cost of 'buyback' of the front row of 40 existing properties is estimated to be \$50 million. The council has utilised triggers for new development since 1996 (where development close to the erosion escarpment is conditional on the dwelling being constructed so as to allow future retreat).

Sources: Byron Shire Council (2010a, 2010b, nd); Clarence Valley Council (sub. DR98); Lockyer Valley Regional Council (2011a, 2012); McDonald (2007); Moore (2010); Munro (2011); WorleyParsons (2010).

There is currently no well-established or coordinated approach to addressing climate change risks to existing settlements (Australian Academy of Technological Sciences and Engineering, sub. 18; Mornington Peninsula Shire, sub. 16; Suncorp Group, sub. 28). Regulatory frameworks, such as planning and building regulation, do not apply to existing uses of land and structures.⁵ Development approval through land-use planning schemes effectively confers a property right or ‘interest’ that existing use may continue irrespective of future changes in planning instruments (chapter 9). Similarly, existing buildings are not generally required to meet amendments to building regulation, unless undergoing major alterations or additions, changes of use, or subdivision (chapter 10).

Some state policies provide a hierarchy of adaptive responses that could be applied to existing settlements (box 11.3). However, these generally provide little guidance on when a particular response should be implemented (Blake Dawson 2011). Further, while a number of local governments have implemented ‘protect’, ‘accommodate’ or ‘retreat’ policies, this has in some cases created considerable controversy among the community and resulted in local governments being subject to legal action (chapter 8).

This is a key area of concern for local governments. Local governments face difficult decisions regarding choosing between protect, accommodate or retreat policies, how to fund policy responses and how to address situations where policy responses have negative impacts on the broader community (for example, where protective infrastructure leads to worsening environmental outcomes) (box 11.4).

Local governments currently lack a framework — developed at a state or Australian Government level — within which they can implement locally appropriate responses. For example, Lake Macquarie City Council (sub. DR107, p. 4) argued that local governments ‘have little or no support in current policy or legislation, and very few legal precedents to guide them’.

The Commission received a number of submissions from individuals and community groups angered by the approaches taken by local governments to manage climate change risks in their communities (Byron Preservation Association, sub. DR120; Coastal Residents Incorporated, sub. DR122). These submissions often reflected differing views regarding the role of government in protecting private and public assets. These include examples where governments placed restrictions on private protection of property or where the provision of information regarding climate change risks led to the devaluation of private property.

⁵ An exception to this is the ACT, where the ability to use land is controlled through leasing provisions (Maddocks 2011).

Box 11.3 State government policies that support consideration of climate change risks to existing settlements

Western Australia Draft Coastal State Planning Policy 2.6

This policy is intended to provide a framework for coastal hazard risk management and adaptation planning where existing or proposed development is in an area at risk of being affected by coastal hazards. It advocates adaptation options that maintain a wide range of potential future risk management strategies over those that act to limit future options, and provides a hierarchy of adaptation measures (across the broad categories: avoid, retreat, accommodate and protect). In this context, the guidelines state that 'avoiding the placement of sensitive development within areas that are at risk from coastal hazards provides the most resilience to future (uncertain) coastal hazards. Conversely, using protection structures to allow sensitive development within areas that would otherwise be at risk from coastal hazards provides the least resilience to future (uncertain) coastal hazards' (Western Australian Planning Commission 2012b, p. 8). While this policy only imposes formal requirements for new developments (including in-fill development), it is intended to provide a framework for local governments to use where desired for existing settlements.

Victorian Coastal Hazard Strategy

This strategy outlines a five-stage coastal hazard risk management framework based on best practice. In particular, the strategy provides some brief guidance on treating risks in terms of avoiding, reducing, sharing or transferring coastal hazard risks. This incorporates some discussion of protect and retreat strategies.

Queensland Coastal Plan

This plan incorporates some discussion of strategies of protect, accommodate and retreat for existing settlements. In particular, the plan states that for:

areas which are under constant threat of erosion, a strategy of retreat from the erosion prone area is the preferred option. For existing development which has social and economic value, erosion control works should be initiated only as a last resort in an instance when erosion presents an immediate threat to public safety, property, and/or infrastructure that is not expendable. (Department of Environment and Resource Management (Qld) 2012, p. 8)

Sources: Department of Environment and Resource Management (Qld) (2012); Victorian Department of Sustainability and Environment (2012); Western Australian Planning Commission (2012a, 2012b).

Box 11.4 Challenges facing local governments

A number of local governments raised concerns regarding a lack of clarity or a framework for managing climate change risks to existing settlements. For example:

It could be assumed that LGAs [local government authorities] will be expected to protect and defend the foreshore area from erosion, sea-level rise and storm surge, for the purposes of protecting property and community infrastructure ... How long should LGAs be expected to defend coast lines regardless of policy, who should pay for this and will the community accept a retreat option as the only viable option? (Gold Coast City Council, sub. 17, p. 3)

It would seem logical in many circumstances to implement preventative measures where appropriate rather than to rely on emergency response and management when events occur. At present there appears to be no understanding of the economic benefits of protect versus recover in relation to coastal processes. (Clarence City Council, sub. 10, p. 4)

Further, the Sunshine Coast Council (sub. 53, p. 6) queried:

- What are the triggers for implementing a planned retreat ...
- Where and how should affected people be accommodated?
- What tools or mechanisms are available to facilitate the implementation of these options and what are the barriers which prevent their uptake?
- Will the accommodation of these people in a new location create social issues or generate a need for additional infrastructure or services? Is further development required to accommodate the affected people, is this culturally acceptable and who should pay?

It was not only local governments that identified this issue.

There is also uncertainty as to the status of existing property and infrastructure, particularly in relation to any obligation on councils to protect existing assets. (Investor Group on Climate Change, sub. 73, p. 4)

They [local government] don't know what to do. I think they're under pressure and they're giving some [approvals for private property protection] but they just don't know what to do — 'What's the long-term strategy?' They know they're under pressure and to some extent it might be consistent with their scheme to give approval, but they also know that this is not sustainable in the long term — they're under pressure right now. (Dr Garry Middle, trans., p. 198)

11.2 Cross-cutting issues

While protect, accommodate and retreat are three commonly identified policy responses, in reality a combination of these approaches will be required to manage climate change risks to existing settlements. In assessing the role for government and determining when a policy response is appropriate, several key areas of contention commonly arise. These include establishing:

- the roles of private individuals, businesses and governments in managing climate change risks to existing settlements

-
- how the costs of managing risks to existing settlements are allocated across governments and the community
 - the respective roles of the Australian, state, territory and local governments in responding to this issue.

These key themes apply to climate change adaptation more broadly and not just existing settlements. In many cases, the Commission has provided principles in other parts of this report that address these themes (in particular, chapters 3, 8 and 17).

Allocation of public and private risks

There are diverse views within the community regarding the role of government in protecting private and public assets from climate change. These have been reflected in submissions, with some participants arguing that governments are not doing enough, or in some cases are doing too much, to protect either public or private assets from climate change impacts (Byron Preservation Association, sub. DR120; Coastal Residents Incorporated, sub. DR122).

Establishing private and public responsibilities for managing climate change risks is an integral element of determining the role of government in protecting private and public assets from climate change. This issue is particularly contentious for coastal areas where dynamic processes can lead to the degradation or loss of both private and public land due to rising sea levels and storm impacts. An illustration of these issues is provided by the Coasts and Climate Change Council (2011, p. 6).

Investigation is needed on how to balance the rights of public vs private interests. Shoreline positions will change and there will be increasing inundation of low-lying areas and assets, creating conflict between public rights and property holders' interests. This is an emerging issue which is likely to have a significant national impact. There is currently greater emphasis in law on protecting development and property interests than public amenity such as beach access. Legal conflicts have already emerged and will undoubtedly grow.

One approach that has been proposed to help clarify the balance between public and private interests for coastal assets in Australian law is the public trust doctrine (Bruce Thom, sub. DR128). This doctrine recognises that governments at all levels have a duty of care to protect environmental assets for the common benefit of the public. The public trust doctrine has been most commonly applied in the United States in relation to maintaining public access to coastal foreshores and navigable waters. While application of this doctrine has differed between US states, such a legal mechanism could be one way to place responsibilities on governments to protect areas of public significance, such as beaches.

The Commission has outlined, in principle, what it considers to be the roles of private individuals and governments in adapting to climate change (chapter 3). To date, some state and local governments have made statements to manage community expectations regarding the circumstances under which government will be responsible for climate change risks and where they think private responsibility should lie (box 11.5). Further, the Council of Australian Governments' Select Council on Climate Change has also outlined roles in its recent discussion paper (COAG Select Council on Climate Change 2012b).

Box 11.5 Private and public responsibility for climate change risks

To emphasise that land owners must accept private responsibility for risks where they continue to live in hazard-prone areas, some state and local governments have released policy statements that attempt to delineate public and private responsibility for risks for both new and existing settlements. For example, in its Sea Level Rise Policy Statement, the NSW Government states that:

Coastal hazards and flooding are natural processes and the Government considers that the risks to properties from these processes appropriately rest with the property owners, whether they be public or private. This will continue where these risks are increased by sea-level rise. Under both statute and common law, the Government does not have nor does it accept specific future obligations to reduce the impacts of coastal hazards and flooding caused by sea-level rise on private property. (NSW DECCW 2009, pp. 5–6)

Coastal development plans in South Australia incorporate statements such that coastal development requiring protection measures against particular environmental hazards at the time of development, or in the future, should only be undertaken if:

- the measures do not or will not require community resources, including land, to be committed
- binding agreements are in place to cover future construction, operation, maintenance and management of the protection measures (Government of South Australia, sub. DR88).

Clarence City Council (sub. 10, attachment 1, p. vi) stated in its report into climate change impacts that:

As existing owners were not aware of the developing risk and are not in control of the causes of this developing risk, it is proposed that for a period of 25 years, risk reduction and management measures be borne by the wider community. After that time, the cost of further risk management measures would be the responsibility of those that benefit from coastal use or occupation. Risk management works undertaken by the Council could be paid for by a special coastal risk reduction rate [applied to landowners' rates] in affected areas. Funding assistance from higher levels of government would be required during the 25 year transition period.

To be effective, a delineation of public and private responsibility for managing climate change risks to existing settlements must be predicated on a shared

community understanding of the role of government in climate change adaptation. Resolution of this issue is likely to require a whole-of-community discussion regarding ‘acceptable levels of risk’ for both public and private assets and the appropriate distinction between public and private risk management. As noted by Dr Garry Middle from Curtin University (trans., p. 199), ‘this whole debate is fraught with politics and you’ve got to go gently with this, you’ve got to bring the public with you’. Further, the effectiveness of any policy approach will also be reliant on government commitment into the future (Department of Climate Change and Energy Efficiency, sub. DR163) (chapter 5).

Who bears the costs of managing risks to existing settlements?

An understanding of private and public responsibilities for managing climate change risk is integral to determining who should bear the costs of managing risks to existing settlements. For example, governments will be responsible for assessing climate risks to their own assets and infrastructure, and funding adaptation responses.

Private property owners already face incentives to implement adaptation measures at their own cost to manage the risks of climate change to their personal safety and property (chapter 3). The case for government provision of further incentives — for example, financial incentives or information — would require that existing incentives are in some way distorting the risk management decisions. That is, a barrier to effective climate change adaptation exists. Where a barrier is identified, the most appropriate policy response to address the particular barrier would need to be established (chapter 5) (box 11.6).

There may also be a case for government to provide assistance to owners of existing property on the grounds of equity (chapter 3). For example, in many areas of existing human settlement, private property may have been purchased prior to any awareness about climate change risks (Insurance Australia Group, sub. DR110).

There is little case for government to provide financial assistance or to compensate landowners where property was purchased with full knowledge of potential climate change risks or where a disparate or indefinite group of property owners are affected. Claims for government assistance or compensation need to be carefully considered on a case-by-case basis (box 11.7).

Calls for compensation have already been made in the context of the few ‘retreat’ policies underway at the local government level in Australia, for example, in response to Byron Shire Council’s managed retreat policy (box 11.2). Further, local governments have also faced calls for compensation where information has been

provided about climate change risks that have subsequently affected property values. In particular, this has occurred in New South Wales where some local governments have placed information about climate change risks on property certificates (chapters 7 and 9). The NSW Government has recently announced changes to this practice (Hartcher 2012).

Box 11.6 Retrofitting houses in response to climate change risks

Some participants argued that there could be barriers to private property owners modifying housing in response to climate change risks. This was commonly raised in the context of where building regulation is updated in response to new information, but these standards do not apply to existing buildings. Participants suggested that governments could provide information, financial incentives for home modifications or regulate that existing buildings be modified (Australian Conservation Foundation, sub. 47; Australian Institute of Architects, sub. DR133; Australian Sustainable Built Environment Council, sub. DR157; Ku-ring-gai Council, sub. 1). The most appropriate policy response to this issue will depend on the type of barrier — that is, what is preventing property owners from undertaking appropriate risk management actions for their home?

Split incentives

An example involves a divergence in incentives faced by tenants and landlords. For example, both landlord and tenant could benefit from installing insulation in a building if they could agree on a rent adjustment that makes both better off. Yet frequently this does not happen because of difficulties and risks in negotiating the rental adjustment (PC 2005b). The importance of split incentives as a market failure (chapter 4) needs to be kept in perspective. To the extent that the costs of damage to a building are important, it will become worthwhile for both parties to agree to a new contract.

Information

Where property owners have access to appropriate information — about climate change risks and options to manage these risks — they can make their own decisions as to the type of adaptation options they wish to pursue based on their individual risk preferences and the costs and benefits of specific measures. However, where property owners do not have this information there may be a role for governments to provide it (chapter 7). For example, the Victorian Bushfires Royal Commission (2010) recommended greater information provision about ways in which existing buildings in bushfire-prone areas can be modified to incorporate bushfire safety measures.

The roles of different levels of government

The scope of cross-jurisdictional issues involved in managing climate change risks to existing settlements requires a clear allocation of responsibilities across different

levels of government. There is likely to be a role for all levels of Australian government. However, currently there is little agreement regarding how responsibility should be shared.

Box 11.7 Principles for providing compensation for policy change

In the past, the Commission has argued that the need for additional measures (beyond the social security and tax systems) to assist adjustment and moderate adverse distributional impacts arising from policy-induced changes should be assessed on a case-by-case basis (PC 2001b). While claims for compensation on the grounds of equity and fairness can be contentious and are generally difficult to assess, the Commission has developed some principles where the case for compensation is likely to be the strongest. This includes where policy changes:

- impose a clear and sizable burden on a specific group in the community (particularly if the affected group is relatively disadvantaged);
- deliver benefits mainly to relatively advantaged groups in the community; and/or
- are largely unanticipated (they occur with limited notice) and involve material changes to a well-defined and defensible 'property right'. (PC 2001b, pp. 62–5)

The Commission has also noted that while assistance to 'buy-off' opposition to policy changes may have superficial appeal on pragmatic grounds, the provision of such assistance faces fundamental difficulties and carries with it considerable risks.

On the other hand, where adjustment assistance can improve the efficiency of resource use, so as to reduce the costs of structural change (and the costs of intervention are less than the benefits), there is a strong in-principle case for intervening.

It is chiefly local governments that are making policy decisions regarding how to manage these risks (Clarence City Council, sub. 10). While it may be appropriate that local governments be responsible for implementing locally specific policy responses, there is also a need for state and territory governments to ensure that local governments have suitable support to undertake these roles. This includes ensuring that local governments have access to necessary resources, that their roles and responsibilities are clearly defined, and that regulatory and policy frameworks are in place to guide local government policy responses (chapter 8).

Numerous Australian, state, territory and local government assets in existing areas of human settlement are likely to be affected by climate change. In addition, management of climate change risks to existing settlements raises a number of issues of state and national significance. For example, several of the key sectors identified as national priorities for adaptation activity are relevant to this policy issue, including coastal management, infrastructure and natural systems of national significance (Australian Government 2010a).

Coordination across Australian, state, territory and local governments is likely to be necessary where actions by governments or private individuals to manage climate change risks to existing settlements result in unintended impacts beyond a given community.

There was strong support by participants for a nationally-coordinated policy response to managing climate change risks to existing settlements. For example, the Australian Coastal Society (sub. DR123, p. 1) argued that any policy response should entail ongoing Australian Government involvement and would need to match ‘the scale of the problem that the nation confronts’.

A national policy framework was also commonly advocated in the context of management of the coastal zone more generally (encapsulating both new and existing settlements). This issue has been addressed previously in other forums. For example, the House of Representatives Inquiry *Managing our Coastal Zone in a Changing Climate* recommended that governments consider the benefits of adopting a National Coastal Zone Policy and Strategy with principles, objectives and actions for integrated coastal zone management (SCCCWEA 2009). A national approach to coastal adaptation has subsequently been proposed (DCCEE 2010c), but no formal policy approaches have been agreed.

A whole-of-government response

The extent of the cross-jurisdictional issues surrounding the management of climate change risks for existing settlements suggests a whole-of-government approach would be helpful. This would require an articulation of the appropriate roles and responsibilities for different levels of government, the split between private and public responsibility for management of climate change risks and the costs and benefits of different policy approaches. Crucially, it would require a sound understanding of community values regarding the levels of risk the community is willing to accept within existing areas of settlement. Accordingly, any process to formulate a national approach must feature extensive and transparent community consultation.

Given the importance of this issue and the complexity involved, the Commission considers that a dedicated inquiry is required on existing settlements that face climate change risks or where the value of potentially affected assets is high. The necessary focus and depth of involvement of governments and the community was not possible in the context of this inquiry, which had a much broader remit on barriers to effective climate change adaptation.

11.3 An independent public inquiry into managing climate change risks to existing settlements

There was general support in submissions for a process to examine how best to manage climate change risks to existing settlements. For example, the South East Councils Climate Change Alliance (sub. 12, p. 3) stated that:

A response from national and state governments, developed at a high-level and supported with appropriate research, is an absolute requirement. This should include the development of a set of regulatory or legal tools that might be available, economic modelling for the range of possible engineering responses and clear advice on the roles of responsible authorities.

The Gold Coast City Council (sub. 17) recommended a cost-benefit analysis of adaptation options be conducted and a national timeframe for adaptation options in high-risk areas developed. Suncorp Group (sub. DR127) also emphasised the importance of establishing responsibility for decision making and policy responses by governments.

The importance of community consultation was also emphasised. For example, the South East Councils Climate Change Alliance (sub. 12, p. 4) argued for a comprehensive program of community engagement delivered through ‘genuine partnership with those affected’. Lake Macquarie City Council (sub. DR107) also advocated an assessment of this issue with broad involvement of decision makers and affected communities.

The Commission considers it important that any inquiry into this issue involves participation and support from all Australian governments and entails wide-ranging and inclusive public consultation processes. This is required to build consensus around options for managing climate change risks to existing settlements.

Establishing community attitudes to managing climate risks is beyond the scope of this inquiry. The Commission believes that this would best be achieved through a jointly sponsored inquiry by all levels of government commissioned by COAG. The terms of reference of this inquiry should include requirements to:

- canvass the full range of community views and explore acceptable levels of risk and how this might differ for public and private assets
- identify and assess the options and instruments needed to manage climate change risks to existing settlements, including a consideration of the costs and benefits and relevant implementation issues for each approach
- establish clear roles and responsibilities for implementing identified options and policy approaches across each level of government.

The inquiry panel should comprise a selection of independent experts with a variety of experience in both the political arena and across the full range of policy issues concerned. This would include land-use planning regulation, building regulation, coastal policy, natural-hazard management and environmental policy. In recognition of the significant interest, and likely implementation role, of state and territory governments, COAG may wish to create an advisory committee with membership from all state, territory and local governments to work with the independent panel.

At the completion of this inquiry, state and territory governments should assess the implications of its findings and recommendations for their own jurisdictions. This reflects the important role of local governments in any response and the consequential need for state and territory governments to provide clearly defined regulatory frameworks and support for local governments to fulfil their responsibilities (chapter 8). Such an assessment may involve:

- making changes to regulatory frameworks where relevant to assist management of climate change risks to existing settlements
- developing policies to manage climate change risks to state and territory assets in existing settlements
- developing policies for state-level adaptation strategies for existing settlements where necessary
- clarifying the roles and responsibilities of local governments in managing climate change risks to existing settlements
- providing guidelines and support to local governments to implement adaptation strategies at the local government level where appropriate.

RECOMMENDATION 11.1

The Council of Australian Governments should commission an independent public inquiry to develop an appropriate response to managing the risks of climate change to existing settlements. The inquiry should:

- ***explore, via extensive consultation with all levels of government and the community, in a variety of locations, the community's acceptable levels of risk for public and private assets***
- ***identify the options available to manage climate change risks to these assets***
- ***assess the benefits and costs of each option***
- ***establish policy frameworks that can be applied by state, territory and local governments.***

State and territory governments should draw on the findings of the inquiry to:

- *manage risks to their own assets*
- *clarify roles and responsibilities for managing climate change risks for each level of government and the community*
- *provide appropriate support to local governments that face capacity constraints.*

12 Provision and regulation of infrastructure

Key points

- The impacts of climate change on the infrastructure sector are significant because:
 - infrastructure assets tend to be long lived
 - some infrastructure is critical — if it were rendered unavailable for an extended period, there would be a significant impact on the wellbeing of the community
 - infrastructure sectors are interconnected — impacts on one sector are likely to have impacts on other sectors.
- There do not appear to be many policy and regulatory barriers that inhibit the infrastructure sector from adapting to climate change.
 - However, there may be ways for governments to encourage adaptation (for example, through facilitating the provision of information and coordination between sectors).
- Network infrastructure is subject to price regulation. Regulators and regulated entities need to consider the long-term impacts of climate change when making price regulation proposals and decisions.
 - There may be scope in some cases to move to light-handed forms of pricing regulation, such as price monitoring.
- Improving broader infrastructure investment decision-making frameworks could assist with adaptation to climate change.
- In general, public and private infrastructure providers are best placed to consider and respond to climate change risks. It is important that consideration of these risks is embedded within their existing risk management frameworks.
- There is not a strong case for regulatory intervention, such as requiring infrastructure proposals to include consideration of climate change impacts.

Infrastructure refers to the system of structures that provide services to support human settlements. This includes transport, electricity, water and telecommunications (building regulation is discussed in chapter 10 and disaster-mitigation infrastructure is discussed in chapter 13). Climate change may have a number of impacts on Australia's infrastructure network. These include damage to infrastructure caused by natural disasters and coastal inundation, reduced reliability of electricity transmission and distribution networks due to higher temperatures, and the impacts of variable rainfall on the water sector (chapter 2).

Climate change is of particular significance for the infrastructure sector for three reasons.

- Infrastructure assets tend to be long lived. For example, electricity generators are generally designed with operational lives in excess of 30 years. Major bridges have a design life of up to 100 years. Infrastructure investment decisions therefore need to consider the climate over an extended time period.
- Some infrastructure, including electricity and water networks, is classed as ‘critical infrastructure’, which ‘if destroyed, degraded or rendered unavailable for an extended period, would significantly impact on the social or economic wellbeing of the nation or affect Australia’s ability to conduct national defence and ensure national security’ (Australian Government 2010c, p. 8).
- Infrastructure tends to be interconnected — the impact of climate change on one infrastructure asset may be felt across many sectors. For example, the impacts of reduced rainfall would be felt in the water sector, but may also have impacts on the electricity sector (which uses water in the generation process). This may in turn have impacts on transport and telecommunications.

The Commission has not identified significant barriers specific to the infrastructure sector that would prevent it from adapting to climate change (though reforms in areas such as information provision (chapter 7) and emergency management (chapter 13) could facilitate adaptation). In general, adaptation in the infrastructure sector is best facilitated by embedding consideration of climate change risks in infrastructure providers’ standard risk management frameworks (alongside the other risks faced by providers).

12.1 How is infrastructure provided?

Historically, infrastructure in Australia has been provided by governments — as infrastructure often displays public good and natural-monopoly characteristics. However, in more recent times, a growing proportion of infrastructure is being provided by the private sector, including through public–private partnerships.

Governments at all levels provide a range of infrastructure (either directly, or through public corporations) — including transport, electricity, telecommunications, water and sewerage infrastructure. Much of the responsibility for infrastructure provision lies at the state, territory and local government level — the Australian Government’s responsibilities lie primarily in the provision of national road, rail and telecommunications networks and postal, shipping and aviation services (Webb 2008).

Private sector provision of infrastructure has included telecommunications, electricity generation and distribution assets in some states, some water infrastructure and most toll roads. In these cases, governments plan for and monitor the provision of infrastructure, but leave construction and operation to the private sector. Because infrastructure may display natural monopoly characteristics, privately-owned infrastructure is often subject to price regulation.

At the national level, the primary bodies responsible for infrastructure decision making are the Department of Infrastructure and Transport, and Infrastructure Australia. The Department is responsible for the implementation of Australian Government infrastructure programs, such as the Nation Building Program. Infrastructure Australia is a statutory body that provides advice to the Australian Government on Australia's infrastructure needs, and evaluates proposals for investment in nationally significant infrastructure.

Most state and territory governments have infrastructure plans, which identify key projects and priorities for state infrastructure networks. Examples include the *Queensland Infrastructure Plan* (Queensland Government 2011c) and New South Wales' *State Infrastructure Strategy 2008–2018* (NSW Government 2008).

The Australian, state and territory governments provide a range of guidelines to assist with infrastructure investment decisions, or on how to apply for government funds for infrastructure. For example, Infrastructure Australia has issued guidelines for infrastructure funding proposals. These guidelines require robust cost–benefit analysis, which must consider risk and uncertainty through, for example, sensitivity analysis (Infrastructure Australia 2011). Further, the NSW Government has issued guidelines for the economic appraisal of reform and investment proposals by public-sector agencies (NSW Treasury 2007).

Government guidelines and infrastructure decision-making frameworks generally do not require explicit consideration of climate change impacts. Some exceptions include:

- environmental impact statements, which can require consideration of climate change risks through project-specific determinations (for example, the assessment of mining projects in Queensland requires consideration of climate change impacts (Queensland Environmental Protection Agency 2008))
- requirements in Queensland and Tasmania to consider climate change risks in cabinet submissions for government projects. The Queensland *Climate Ready Infrastructure* initiative requires local governments to consider climate change adaptation when applying for Queensland Government grants for infrastructure (Queensland Government 2011a)

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- guidelines in New South Wales that state that climate change impacts on infrastructure should be considered in existing risk management frameworks (NSW Treasury 2010)
 - Council of Australian Governments requirements that state and territory governments have strategic plans (including infrastructure needs) for capital cities. These plans must cover a range of criteria, including climate change adaptation. Infrastructure funding will be linked to meeting these criteria (COAG 2009a).

In addition, some organisations have issued guidelines to assist with managing climate change risks to infrastructure assets.

- Standards Australia (2011) released a draft standard on considering climate change adaptation for infrastructure and buildings. This standard sets out a series of guidelines for managing risk, based on the international standard for risk management.
- The Australian Green Infrastructure Council issued guidelines on managing climate change risks for infrastructure (AGIC 2011). This guidance forms the basis of the adaptation component of the Infrastructure Sustainability rating tool.

Finally, the Australian Government has a strategy in place for managing risks to critical infrastructure, including those posed by climate change (box 12.1). This strategy contains programs aimed at improving the resilience of Australia's critical infrastructure.

Disaster-mitigation infrastructure

Disaster-mitigation infrastructure refers to infrastructure designed to protect settlements from natural hazards. This can include 'hard' engineering works such as seawalls and flood levees, or 'soft' works such as beaches replenishment.

There may be barriers that could limit the provision of disaster-mitigation infrastructure, including inadequate resourcing, unclear roles and responsibilities, legal liability concerns and the impact of government regulation. These issues are considered in chapter 13.

Box 12.1 The Australian Government's strategy for critical infrastructure resilience

The Australian Government's *Critical Infrastructure Resilience Strategy* is aimed at improving the capacity of critical infrastructure, both publicly and privately owned, to deal with disasters, including those affected by climate change. The strategy endorses a non-regulatory approach, recognising that in most cases, '... the owners and operators of critical infrastructure are best placed to manage risks to their operations and determine the most appropriate mitigation strategies' (Australian Government 2010c, p. 14).

As part of this strategy, the Trusted Information Sharing Network (TISN) has been established. The TISN is a forum through which owners and operators of critical infrastructure can work together, share risks and solutions, and bring issues to government that are seen as barriers to critical infrastructure 'resilience'. The TISN consists of seven critical infrastructure sectors (banking and finance, health, food chains, transport, communications, water services, and energy), and two expert advisory groups (IT security and resilience). TISN members include owners and operators of critical infrastructure, government representatives and peak bodies.

A second major component of the strategy is the Critical Infrastructure Program for Modelling and Analysis (CIPMA). CIPMA attempts to model the behaviour and dependencies of critical infrastructure networks in response to disasters and threats (including climate change impacts). This information is provided to owners and operators of critical infrastructure to help them prepare for disasters. It aims to address spillovers relating to interdependencies between critical infrastructure networks.

CIPMA includes a series of 'impact models' which assess the flow-on impacts of disruptions to a critical infrastructure service. The modelling work can provide insights into:

- how the economy and population will be affected
- how long the disruption will last
- which areas will be affected
- how the various systems will behave (CSIRO 2011b).

Five TISN sectors are currently involved in CIPMA (health and food chains are not). The Attorney-General's Department (sub. 64) noted that it is looking to expand the coverage of CIPMA by expanding the geographic and sectoral coverage, developing the transport sector coverage, and developing a national critical infrastructure geospatial database. However, due to confidentiality concerns, the CIPMA data are not made publicly available.

12.2 Potential barriers to climate change adaptation

The Commission has not identified widespread barriers to climate change adaptation specific to the infrastructure sector (though reforms in areas such as information provision (chapter 7) and emergency management (chapter 13) could also facilitate adaptation). Indeed, there is evidence that owners and operators are responding to climate change risks, including via risk assessments, adaptation investments and developing adaptation ‘tools’ (box 12.2). However, some inquiry participants suggested a number of issues that may limit the ability of infrastructure to adapt to climate change. These include potential barriers in the areas of using real options, information and guidance, disaster recovery, coordination, public–private partnerships and government regulation.

Lack of guidance on adaptation of infrastructure

Some inquiry participants suggested that a lack of guidance from governments regarding how adaptation should be taken into account in infrastructure decisions may be leading to a fragmented approach to dealing with climate change adaptation (Australian Green Infrastructure Council, sub. 13; Investor Group on Climate Change, sub. 73; NSW Young Lawyers, sub. 72).

It is unclear whether a lack of guidance represents a barrier to infrastructure owners and operators considering climate change risks. There already appears to be considerable guidance on managing climate change risks to infrastructure that is available or in development (such as by Standards Australia and the Australian Green Infrastructure Council), and programs are in place to assist operators of critical infrastructure to manage climate change risks. Given the financial and human resources of many infrastructure operators, in most cases a shortage of relevant advice from governments is unlikely to prevent them from considering climate change risks in their investments.

Nonetheless, there may be scope to improve the guidance available to local governments, a number of which may not have adequate resources to manage climate change risks to the infrastructure they own and provide (chapter 8).

Box 12.2 **Adaptation and infrastructure investments**

A number of participants noted that infrastructure providers are considering the impacts of climate change on their investments. In some cases this may be in accordance with government regulation and in others it may be voluntary. For example, the Australian Petroleum Production and Exploration Association Limited (sub. 59, p. 2) noted that:

The industry already, in some cases, considers climate-related issues in project and facility design. For example, the Environmental Impact Statement for the Queensland Curtis [liquefied natural gas] Project assesses climate and climate change related issues ...

Further, the Australian Industry Greenhouse Network (sub. 29, p. 2) noted that:

... commensurate with the commercial self-interest that accompanies large capital investment, companies are already factoring in adaptation.

An example of climate change risks being considered in a project is the Brisbane Airport Parallel Runway development. The site for the runway is currently subject to inundation during flood events, which may become more severe as a result of climate change. The development contains a number of adaptation measures, including building tidal channels, building a new seawall along the northern boundary of the airport, and bringing in sand to elevate the site.

Transurban also has a climate change strategy that considers and responds to climate change risks faced by the business. Transurban has undertaken climate change risk assessments for Melbourne's Citylink road network, and intends to do the same for its Sydney assets.

The Water Services Association of Australia noted that many of its members have been considering climate change. In addition, Association members are developing the AdaptWater project, which:

... will deliver a climate change adaptation tool for the Australian urban water industry. AdaptWater will capture and quantify the complexity of modern water utilities' economic, social and environmental performance requirements and integrate the effects of evolving direct and indirect climate change hazards. (Water Services Association of Australia, sub. DR147, p. 3)

Sydney Water is in the process of implementing a climate change adaptation strategy. This strategy involves mapping the key climate change risks to infrastructure owned by Sydney Water, assessing the interdependency of its infrastructure with other infrastructure, and producing prioritised adaptation responses.

Sources: Australian Industry Greenhouse Network (sub. 29); Brisbane Airport Corporation (2007); Sydney Water (2010); Transurban (2011); Water Services Association of Australia (sub. DR147).

A lack of coordination in the built environment

A number of participants to the inquiry considered that there was a need for a national council to better coordinate adaptation responses in the built environment (including building and infrastructure) (Australian Sustainable Built Environment

Council, sub. DR157, attachment 1; Property Council of Australia, trans., pp. 64–5). For example, the Australian Sustainable Built Environment Council’s Climate Change Adaptation Framework states that:

A National Built Environment Adaptation Council with broad representation and a properly resourced and dedicated secretariat could provide the Minister for Climate Change and Energy Efficiency the sounding-board and policy forum needed on adaptation issues, using the framework as the basis for action ...

The Council could share ideas and strategies on the most useful way to deal with the predicted effects of climate change, sponsor research, and communicate about this issue with the broader population. (Australian Sustainable Built Environment Council, sub. DR157, attachment 1, pp. 23–4)

Impacts on infrastructure networks can have significant impacts on other infrastructure sectors. Therefore, a body to facilitate discussion of adaptation within and across the sectors could be of use.

However, the Commission considers that there are already appropriate bodies in place that fulfil this role. In the critical infrastructure sector, the Trusted Information Sharing Network facilitates discussion between industry representatives and governments on a range of issues, including climate change (box 12.1). In the building sector, the Australian Building Codes Board has broad representation (including representatives from industry, and the Australian, state, territory and local governments) and is likely to be best placed to facilitate discussion with stakeholders and consider whether climate change issues need to be incorporated into building regulation (chapter 10).

Lack of information on climate change risks

Information on climate change risks is important for the infrastructure sector. The extent to which information is available on climate change risks for specific locations will influence decisions such as the location of infrastructure and the degree of resilience to build into infrastructure projects.

While there is a role for governments to provide information on the risks associated with climate change, the provision of information is not costless. The costs and benefits of providing information need to be considered and information needs to be provided in a manner that is useful to infrastructure providers.

Several participants suggested that a shortage of appropriate information is a barrier to climate change adaptation. For example, the Water Services Association of Australia (sub. 52, pp. 20–1) noted that:

There is a lack of information regarding climate change scenarios of design events that are permissible or the methodologies to apply them, and as a result organisations are going it alone. This risks inconsistent, and possibly inadequate, adaptation responses.

Further, the Investor Group on Climate Change (sub. DR145, pp. 2–3) stated:

... investors find that it is difficult to discern certain information on the extent of likely local impacts from ... information sources, making investment decisions difficult. [The Investor Group on Climate Change] also notes gaps in the information available, relatively poor usability for non-technical audiences and frequent contradictions in the available information on sector specific adaptation issues.

Improving the provision of information on climate change risks more generally is considered in chapter 7.

Inadequate arrangements for disaster recovery

There are concerns that the Australian Government’s arrangements for disaster recovery — the Natural Disaster Relief and Recovery Arrangements — may be imposing a barrier to effective climate change adaptation in the infrastructure sector. Under these arrangements, the Australian Government may act as an insurer of last resort by reimbursing state and territory governments a certain percentage of expenditure on relevant infrastructure.

These arrangements may lead to ‘moral hazard’ — that is, the arrangements may lead to state, territory or local governments not appropriately considering disaster mitigation in infrastructure investments, or adequately insuring their assets. These issues are considered in chapter 13.

Barriers to using real options

‘Real options’ can be used to manage the uncertainty surrounding climate change, and can be incorporated into existing cost–benefit frameworks (chapter 5). A number of participants have advocated the use of real options to manage climate change risks, including Dr Leo Dobes (sub. 63), the Tasmanian Government (sub. 51), and the Water Services Association of Australia (sub. 52).

However, there may be barriers to the use of real options by governments in the infrastructure sector. For example, in the urban water sector, the use of real options has been limited due to:

- unclear roles of ministers, government departments and water utilities
- inappropriate political involvement in decision making that can lead to an undue level of risk aversion — it may be difficult to convince people that money needs to be spent that does not lead to an output at the time of the investment (PC 2011a).

The institutional and governance reforms recommended in the Commission's 2011 inquiry into the urban water sector — such as clearly outlining the roles and responsibilities between elected representatives, water utilities and regulatory agencies — would help overcome some of these impediments and enable more efficient water supply augmentation decisions to be made (PC 2011a).

In addition to these governance issues, local governments face capacity constraints, which may limit their ability to use techniques such as real options. The issue of local government capacity is considered in chapter 8.

Inappropriate risk allocation and assessment of public–private partnerships

In general, public–private partnership contracts require the government to pay the private sector partner to deliver infrastructure on behalf of the government. It is important that the allocation of risk between the public and private sectors in these contracts is appropriate. Where risks (in particular, the risks posed by natural hazards) are not allocated to the party best able to manage these risks, this may impose a barrier to effective climate change adaptation.

Guidance is available to governments to support consideration of risk allocation in public–private partnerships. The *National Public–Private Partnership Guidelines* apply in all states and territories, and state that:

- the private party must use all reasonable endeavours to minimise the impact of the extreme event
- no financial relief is to be granted as a result of extreme events (that is, the private party bears the financial risk)
- the government bears the risk of not being provided with services (Infrastructure Australia 2008).

A related issue is how governments assess whether to proceed with a public–private partnership contract. The *National Public–Private Partnership Guidelines* suggest that the costs and revenues be forecast over the life of a project. These exclude the costs and revenues incurred after the contract has been completed and control of the asset has been handed back to the government. Using this approach, features of the project that may be aimed at managing climate change risks that occur after the duration of the partnership contract cannot be accounted for in the valuation of the project (Department of Climate Change and Energy Efficiency, sub. 57; Maddocks 2011).

It is not clear that this is a significant issue. Governments should consider the climate change risks for the life of the asset. Where governments consider that there are climate change risks that occur after the project is handed back to governments, they have the option of requesting modifications to the infrastructure to manage these risks (and therefore may need to pay the private provider more in the contract).

Price regulation restricting investment

Infrastructure networks, such as electricity networks and water, are often natural monopolies and therefore subject to price regulation. Some inquiry participants raised concerns that current price-setting arrangements may represent a barrier to adaptation investments, as it may be difficult for infrastructure providers to get adaptation investments approved by the regulator (Attorney-General’s Department, sub. 64; CSIRO, sub. DR136; Water Services Association of Australia, sub. 52, DR147). For example, the Attorney-General’s Department (sub. 64, p. 14) suggested that:

... regulatory bodies tend to work on timeframes of about five years, which in the context of gradual environmental change is a significantly short-term perspective. In these circumstances, it is often difficult for the owners and operators of [critical infrastructure] to mount convincing arguments that their assets should be changed ... moved or duplicated so as to provide adequate security of supply through justifiable investments in redundancy.

In one case, a proposal to include adaptation investments in prices for Victorian distribution companies in 2011–15 was partially rejected by the regulator (box 12.3).

The predominant model used to regulate prices in Australia is a building-block model. This model bases prices on projections of operating costs, capital investment and the required return on capital over a regulatory period (box 12.4). Regulators

monitor investment and operating expenses to ensure that market objectives are met at the lowest cost possible, as the building block model:

- provides limited incentive for the regulated firm to operate efficiently — increases in costs will be recovered
- may provide an incentive for the regulated entity to overinvest in capital if the regulator overestimates the required rate of return on the assets.

Box 12.3 Australian Energy Regulator decision on Victorian distribution networks

In July 2010, the Australian Energy Regulator (AER) published its draft findings on the expenditure pools for Victorian electricity distributors over the 2011–15 period. The distribution companies were proposing a substantial increase over their 2006–10 budgets, partially on climate change grounds.

Victorian distributors proposed a forecast capital expenditure of \$5.4 billion — 66 per cent higher than the 2006–10 period. Part of this increased capital expenditure proposal was based on a climate change report by AECOM. However, the AER (2010, p. 293) suggested that the ‘reports do not demonstrate any material shifts in asset ageing or deterioration nor in operating condition sufficient to materially alter the expected future demand or power system capability in the forthcoming regulatory control period’. The AER considered that the impacts of climate change will emerge progressively over time, and as such the large proposed step-change increase in capital expenditures was unjustified. Due to a range of factors, including the AER’s view of the climate change related investments, the capital allowance approved in the draft findings was \$3.4 billion — a 38 per cent reduction on the proposal.

In addition, the distributors proposed operating and maintenance expenditure of around \$3 billion, a 38 per cent increase over the previous period. Of this increase, \$47 million was related to the projected impacts of climate change. These impacts included more hot days, bushfire risks, increased termite damage, and the need for reviews of climate change risk.

To be satisfied that the proposed operating expenditures were needed, the AER required evidence that the impact of climate change was likely to be more significant than for the 2009 base year. However, the AER noted that consultant projections for the number of extreme heat and wind days in 2015 were less than the actual number of extreme heat and wind days in 2009. As such, the AER did not allow the proposed increase in climate change related operating expenditure.

Source: AER (2010).

Regulated companies must submit proposals for forecast capital and operating expenditure over a regulatory period. If the regulator does not deem these expenses

to be appropriate, they can prevent these expenses from being considered in the pricing decision.

While the regulatory framework generally specifies that regulators determine prices over a set timeframe, this does not prevent regulators from approving adaptation investments. Given the long-lived nature of infrastructure assets, regulators need to consider the costs and benefits of investments over the lives of the assets when determining whether a capital investment made during the regulatory period can be reflected in higher prices. The same holds true for adaptation investments.

Box 12.4 Regulation of natural monopolies

Natural monopolies in Australia are regulated in various ways.

- **Electricity transmission and distribution** in the National Electricity Market is regulated by the Australian Energy Regulator. The regulator limits the amount of revenue a transmission or distribution company can receive. The revenue cap is based on the provider's weighted average cost of capital for its existing assets, and the expected investments and operating costs over a five year period. The regulator can refuse to allow network companies to pass through capital or operating costs if it is not deemed to be the most efficient way to meet network objectives.
 - Most states also regulate **electricity retail prices** (chapter 6). For example, the Independent Pricing and Regulatory Tribunal in New South Wales regulates the retail prices for small retail consumers.
- **Water** prices are regulated by state and territory governments. For example:
 - in Victoria, the Essential Services Commission regulates water prices, based on the utility earning a reasonable rate of return on its assets, and being able to recover operational and investment expenditure. The Water Industry Regulatory Order 2003 notes that expenditure forecasts must represent the efficient delivery of the service, and must take into account a planning horizon that extends beyond the regulatory period
 - in New South Wales, the Independent Pricing and Regulatory Tribunal uses a building-block model to calculate tariffs for water retailers.
- The Australian Competition and Consumer Commission has the power to make access determinations for parts of the **telecommunications network**, and sets the default price for access to networks. For example, in July 2011 the Australian Competition and Consumer Commission released the access determination for fixed-line services, with prices for the network based on similar principles to those used to regulate electricity distribution and transmission.

In general, the onus is on the infrastructure operator to provide evidence that an investment is necessary. The regulator is required to consider the evidence, and determine whether the expenditure is consistent with the objectives of regulation. If an infrastructure operator can provide evidence as to why a climate change

adaptation investment is required to meet the objectives of the market (for example, in the National Electricity Market, the investment would need to improve the efficiency, security or reliability of supply), the regulatory framework appears able to accommodate this investment.

However, there may be potential for the broader regulatory framework to be improved, which may facilitate adaptation responses. This is discussed in section 12.3.

Consideration of climate change in technical standards

There is a range of technical design standards applying to infrastructure. These standards are created by both government and non-government bodies. In some cases, these standards are referenced in legislation, and therefore have legislative force.

The current process for updating standards to incorporate climate change impacts is likely to be appropriate. The peak organisation responsible for technical standards in Australia is Standards Australia. Standards Australia has an established process in place for creating and reviewing standards. New standards must pass a net-benefit test, and draft standards are made available for community consultation (box 12.5) (Standards Australia, sub. DR135). Other organisations that are accredited to produce Australian Standards must also follow this process.

There appears to be some progress in updating standards to consider the impacts of climate change. For example, the Australian Rainfall and Runoff guidelines are in the process of being revised to consider climate change impacts. In addition, Standards Australia is producing an Australian Standard for considering climate change adaptation in infrastructure (section 12.1).

12.3 Can investment and regulatory practices be improved?

While the Commission has not identified significant barriers to effective climate change adaptation in the infrastructure sector, there may be ways in which broader infrastructure investment and regulatory practices can be improved.

Investment practices

There may be a number of improvements that could be made to broader investment practices, that could facilitate climate change adaptation. For example, the Commission has previously recommended changes to infrastructure investment frameworks (box 12.6). Such measures are ‘no regrets’ — they would have net benefits regardless of the impacts of climate change. Climate change strengthens the case for such reforms.

Of particular importance for infrastructure is the timeframe of investments. Infrastructure assets tend to be long lived, with some infrastructure having a design life of up to 100 years. Therefore, infrastructure investment decisions should consider potential climate change scenarios, and the impact these may have on the asset over the long term.

Box 12.5 Standards Australia’s process

Selecting projects

Standards projects can be initiated by a request from an individual, organisation or government, or via the Standards Australia review process (standards are reviewed every five years). Requests are reviewed by Standards Australia to ensure that the project would achieve net benefits for the community — taking into account factors such as public health and safety, social and community impacts, environmental impacts, competition, and economic impacts (Standards Australia, sub. DR135).

Project development

Once the project is started, a technical committee is established consisting of a broad selection of stakeholders. The committee is responsible for drafting the standard, and approving the final standard.

Consultation

Draft standards are freely available for public comment. The consultation period is generally at least nine weeks.

Sources: Standards Australia (sub. DR135; 2012).

A useful approach to dealing with these long timeframes may be that proposed by Ben-David (2010). Under this approach, risk-based investment plans would be established by infrastructure investors (or government departments) for 30–50 years into the future. These plans would then be tested against shorter-term investment plans. Such an approach would allow infrastructure investors to examine how short-term investments relate to longer-term goals, and whether these investments are influencing potential future investment options for adapting to climate change.

Box 12.6 Previous Commission reports on infrastructure investment**Urban water**

The Commission's inquiry into urban water outlined a number of shortcomings with the urban water infrastructure decision-making process. First, jurisdictions were not considering supply-side (such as building desalination plants) and demand-side (such as water restrictions or raising prices) options together. Second, jurisdictions were not considering all options when making investment decisions — for example, by restricting the purchase of rural water for urban use, and prohibiting indirect potable reuse and aquifers. Australian Government subsidies may lead jurisdictions to prefer one option over another. Third, there may be barriers to using real options approaches, including institutional and governance arrangements that lead to an undue level of risk aversion, and potential impediments imposed by economic regulators.

Road and rail pricing

In its inquiry to road and rail pricing, the Commission endorsed the 'Auslink' (now replaced by the Nation Building Program) approach to road and rail funding. This approach included detailed guidelines, with merit tests and detailed cost-benefit analysis of projects. However, the Commission noted that the success of the approach would depend on how rigorously it was applied, in particular whether decision making was undertaken in 'a transparent and consultative way, with full engagement of interested parties' (PC 2006b, p. 266).

Sources: PC (2006b, 2011a).

It is important that approaches for assessing adaptation options be embedded in infrastructure providers' risk management frameworks. In general, infrastructure providers will be best placed to consider climate change risks to their investments. Embedding climate change risks in their frameworks will ensure that climate change is given due consideration, alongside the other risks faced by business or government.

Price regulation

Price-based regulation of infrastructure services is costly. Costs include administrative, consultancy, lobbying and appeal costs, and information costs for the regulator. In addition, by limiting the returns infrastructure investors can receive, price-based regulation may curtail infrastructure investment. Finally, while in theory price-setting regulation can allow innovative approaches to managing climate change, such as real options, in practice incorporating such approaches into the regulatory framework may be difficult (PC 2011a).

The Commission has previously advocated a move away from price-setting regulation towards a price-monitoring regime in the airports, urban water and gas sectors (box 12.7). Under a price-monitoring approach, the regulator would collect data, with strict price controls only applied if these data suggest that market power is resulting in prices being set higher than would otherwise be the case. This approach is now applied in the regulation of airports. Price monitoring is likely to be more appropriate than price setting where ‘the scope for abuse of market power is fairly limited, but where some concerns still remain about potential monopoly pricing’ (PC 2011a, p. 319).

Box 12.7 Previous Commission reports on the economic regulation of infrastructure

Urban water

The Commission considered that, while urban water utilities have some degree of market power, the benefits of price-setting regulation would be unlikely to exceed the costs (including administrative, lobbying and information costs). Subject to a suite of governance and institutional reforms, the Commission recommended a move to more light-handed price monitoring, which would involve gathering information to assist with a determination as to whether market power is likely to be a concern.

Gas-access regime

The Commission’s 2004 inquiry into the gas-access regime considered that, in some cases, price-based regulation was used where it was doubtful that it would lead to net economic benefits. The Commission recommended that the option for price monitoring regulation should be added into the regime. This would apply in situations where the case for price-based regulation is not as strong.

Airports

The Commission’s 2002 report into the price regulation of airports noted that, while airports had market power in the provision of aeronautical services, the scope for them to use this power was constrained by their substantial non-aeronautical income. Given this, the Commission recommended price monitoring as a less costly method of regulating the prices charged by airports. This recommendation was accepted by the Australian Government. The Commission reviewed the monitoring regime in 2007 and 2011, and recommended the continuation of the price-monitoring approach. The Commission noted that the monitoring regime had delivered net benefits, and that price outcomes had not been excessive, though some improvements to the monitoring approach were recommended.

Sources: PC (2002, 2004d, 2006a, 2011a, 2011c).

In the case of urban water, the Commission considered that:

- there are significant costs associated with price-setting regulation. In particular, lobbying and compliance costs are high, and regulators do not have perfect information about regulated businesses
- once governance reforms in the sector are implemented, monopoly pricing is unlikely to be an overly significant concern
- the benefits of price-setting regulation would be unlikely to exceed the costs
- price monitoring has greater flexibility than price setting, may be more compatible with approaches such as real options and flexible pricing, and would be likely to have lower costs (PC 2011a)
- price-setting regulation has ‘proven singularly unsuccessful in promoting efficient water procurement and service delivery’ (Banks 2012, p. 22).

A more light-handed approach to economic regulation may facilitate effective adaptation to climate change where there are constraints on market power. This framework would allow infrastructure providers to implement adaptation investments where they deem it necessary to do so, without requiring approval from a regulator. In addition, as noted above, such a framework may better facilitate approaches to manage the uncertainty associated with climate change, such as real options. Finally, improving the regulatory arrangements for infrastructure networks would improve the information content of the price signals faced by consumers (chapter 6). However, there would still be incentives for a business to avoid unnecessary adaptation investments — over-investing, as revealed through price monitoring, may lead to them becoming subject to stricter regulatory controls.

Should there be an explicit requirement to consider adaptation in infrastructure investments?

As noted previously, most jurisdictions do not impose an explicit requirement on infrastructure providers (government or private) to consider climate change risks in their investments. Some participants have suggested that such a requirement is necessary, including the Australian Green Infrastructure Council (sub. 13), the Investor Group on Climate Change (sub. DR145), Redland City Council (sub. 36) and the South-East Councils Climate Change Alliance (sub. DR100). Internationally, the United Kingdom has imposed some requirements to consider adaptation in infrastructure decisions (box 12.8).

Box 12.8 UK approaches to considering adaptation

The United Kingdom has some requirements that climate change be taken into account in infrastructure decision making and management.

- Government agencies must develop adaptation plans. This includes identifying risks to infrastructure, and implementing strategies to manage these risks.
- Some government-owned companies (and some private companies) must report on the impact of climate change on their business. These include utilities and infrastructure operators.
- Major government projects must undergo an economic assessment, following the Treasury's 'Green Book'. The Green Book contains guidance for dealing with the effects of climate change.

Source: Appendix C.

There does not appear to be a strong case for implementing such a requirement. Infrastructure providers appear to already be responding to climate change risks, and developing tools to consider adaptation options. Infrastructure providers have incentives to consider climate change risks in their decisions — as with any other risks that investors face. A legislated requirement to consider these risks would not enhance these incentives, and could result in perverse outcomes such as costly 'box ticking'. Therefore, on balance, the Commission does not support the use of such a requirement.

13 Emergency management

Key points

- Climate change is expected to increase the frequency and/or severity of some extreme weather events. This will pose challenges for how the community prevents, prepares for, responds to, and recovers from natural disasters.
- Following recent natural disasters, some state governments have commenced reforms of emergency management arrangements. However, some problems still remain and these constitute barriers to effective adaptation to climate change.
 - Providers of emergency services are not always well coordinated, or may have poorly-defined or overlapping roles and responsibilities.
 - Some local governments lack the capacity to adequately meet emergency management responsibilities that have been assigned to them.
 - The process of identifying, funding and operating disaster-mitigation infrastructure is often inadequate.
- Reforms to address these barriers have the potential to assist the community to better deal with climate variability and extreme weather events. These reforms will both deliver immediate benefits and facilitate effective adaptation to climate change.
- Broader emergency management arrangements may not be achieving the right balance between government expenditure on disaster prevention and expenditure on recovery. There appears to be an inadequate focus on preventing damages from natural disasters.
- Under existing arrangements for disaster recovery, there are a number of impediments to evaluating and funding the 'betterment' of damaged public assets.
- An independent public review of disaster prevention and recovery arrangements is required. This should cover the Natural Disaster Relief and Recovery Arrangements, as well as the planning and funding mechanisms for disaster mitigation, including the National Partnership Agreement on Natural Disaster Resilience.
- Good risk management processes, including consideration of all available options to manage risks, can help improve the balance between emergency prevention, preparedness, response and recovery.

Emergencies are situations that present imminent danger to life, property or the environment. They include natural disasters, such as bushfires, cyclones, storm surge inundation, floods, and heatwaves. Such emergencies can cause significant damage to the community in the current climate, and the extent of this damage will increase over time as new development raises the value of assets at risk. Emergencies are expected to become more intense and/or frequent due to climate change. This would increase the demand for emergency services and have wide-ranging impacts — for example, more frequent heatwaves could increase pressures on hospitals; more intense cyclones could significantly damage essential transport, communications and energy infrastructure; and larger floods could have significant economic and social consequences.

Emergency management involves:

- prevention — actions taken before an emergency to reduce the potential impacts on the community or the environment — for example, flood-mitigation infrastructure, Total Fire Ban days and cyclone standards in building codes
- preparedness — actions taken to ensure that the community is able to respond to, and cope with, an emergency if it occurs — for example, public education programs, evacuation procedures, cyclone shelters and backup electricity systems
- response — actions taken immediately before, during and after an emergency to reduce the impacts on the community and provide immediate relief and support — for example, ambulance and fire-fighting services, search and rescue operations, and the evacuation of people from disaster-affected areas
- recovery — actions taken to support affected communities to restore damaged property and economic activity, as well as physical, social, emotional and psychological health — for example, restoring damaged infrastructure, establishing counselling programs, and providing temporary housing (Australian Government 2009; SCRGSP 2012).

13.1 Current arrangements

Governments, individuals, businesses and community groups have important roles to play over all four aspects of emergency management (box 13.1). For example, many households take measures to prepare for bushfires or floods, and members of local communities often help each other when natural disasters occur. Governments also provide support, for example, they provide ‘public goods’ — such as early-warning systems and disaster-mitigation infrastructure — that provide benefits to the broader community and may only be adequately provided with

government intervention. These can limit the loss of life, reductions in economic activity, or calls on government expenditure to fund recovery. Governments also fund emergency-response services (such as fire fighting) that can prevent an emergency from spreading, and assist people who may not have the capacity to respond to, or recover from, emergencies on their own.

The emergency management sector encompasses a large number of organisations. These include agencies of the Australian, state, territory and local governments (especially emergency-response organisations such as fire, police and ambulance services, the military, and State Emergency Services), self-organised community groups and other volunteer organisations (such as the Red Cross) (figure 13.1).

Box 13.1 Overarching emergency management arrangements

In 2009, the Australian, state and territory governments agreed to the National Disaster Resilience Statement (COAG 2009b), followed by a National Disaster Resilience Strategy in 2011 (COAG 2011). These set out the roles of governments and others.

- All levels of government are responsible for implementing measures to reduce exposure to hazards, including risk-based land management and planning, clear processes for informing people about risks, supporting preparation by individuals and communities, and ensuring that emergency services are well-coordinated.
- Businesses are responsible for understanding the risks they face and ensuring they are able to provide services during or after a disaster.
- Individuals have a role to play in preventing, preparing for, responding to, and recovering from disasters, including through active planning and preparation for protecting life and property.
- Non-government organisations and volunteers help the community cope with, and recover from, disasters.

The Australian Government's overall approach to emergency management has been set out by Emergency Management Australia (1998, 2004). The broad aims are to ensure that emergency management measures:

- are comprehensive — emergency management operations are organised across the aspects of prevention, preparedness, response and recovery
- include all hazards — the same set of arrangements are used to manage all types of emergencies, including natural disasters
- involve all agencies — collaborative approaches are used to manage emergencies, involving all levels of governments, volunteers and community organisations
- prepare the community — emergency management arrangements allow the community to manage emergencies effectively at the local level.

Roles and responsibilities for emergency management vary across levels of government, and measures have been implemented at each level to address the

impacts of climate change (appendix B). These are generally based on high-level principles and objectives that have been defined for emergency management (box 13.1). Broadly speaking, the role of the Australian Government is to help coordinate national efforts in disaster research, provide important information relevant to emergency services, and provide general assistance in all four aspects of emergency management (Australian Government 2009). Each state and territory government has primary responsibility within its jurisdiction for emergency management and has its own emergency management arrangements. Finally, local governments work in partnership with state and territory governments to manage local emergencies.

Figure 13.1 Major agencies involved in emergency management

Commonwealth level	State and territory level	Local level
<ul style="list-style-type: none"> • Air Services Australia • Australian Defence Force • Australian Maritime Safety Authority • Attorney-General's Department <ul style="list-style-type: none"> • Emergency Management Australia • Bureau of Meteorology • Centrelink • Department of Agriculture, Fisheries and Forestry • Department of Human Services • Department of the Prime Minister and Cabinet • Department of Sustainability, Environment, Water, Population and Communities • Geoscience Australia • The Treasury 	<ul style="list-style-type: none"> • Ambulance services • Department of Premier and Cabinet • Department of Primary Industries • Environmental agencies • Fire services • Health services • Police force • Providers and regulators of essential services • Road management and transport authorities • State coroner • State Emergency Service • State Fire Authority • Volunteer organisations 	<ul style="list-style-type: none"> • Community groups • Local governments • Natural Resource Management bodies • Regional organisations of councils

Sources: Australian Government (2009); Emergency Management Australia (2004); OESC (2012a); Pearce et al. (2009).

Numerous funding arrangements are in place to support these roles. For example:

- the Australian Government funds risk assessments undertaken by some local governments, funds climate-related research and provides relief payments to individuals and businesses affected by disasters
 - the Australian Government also funds disaster-mitigation projects by state, territory and local governments through the National Partnership Agreement on Natural Disaster Resilience (NPA-NDR) (section 13.4), and funds the restoration of essential public infrastructure after a disaster through the Natural Disaster Relief and Recovery Arrangements (NDRRA) (section 13.5)
- state and territory governments provide disaster assistance as well as grants to emergency services organisations and local governments

-
- local governments fund risk assessments and early-warning systems. They also provide some disaster-mitigation infrastructure, such as flood embankments and firebreaks
 - a number of non-government organisations fund recovery programs from public donations.

13.2 Inadequate governance and institutional arrangements

State governments have commissioned a number of reviews following recent large-scale natural disasters that caused significant damage. These investigated the causes of the disasters and responses to them, including the role of emergency management. Reviews include:

- the Victorian Bushfires Royal Commission (2010)
- the Review of the 2010–11 Flood Warnings and Response (Victoria) (2011)
- the Queensland Floods Commission of Inquiry (2012)
- the Perth Hills Bushfire Review (2011).

These inquiries identified a number of inadequacies in existing governance and institutional arrangements for emergency service providers.

Roles and responsibilities

Following recent natural disasters, reviews initiated by state governments found that inadequately defined roles and responsibilities contributed to shortcomings in emergency management that affected the community's response to natural disasters and reduced the effectiveness of emergency services (box 13.2). For example, inquiries into the 2009 Victorian bushfires and the 2010–11 floods in Victoria and Queensland suggested that the chain of command across agencies was sometimes confused and contested. Improved arrangements in this area would improve risk management in the current climate and facilitate effective adaptation to climate change.

Box 13.2 Unclear roles and responsibilities and poor coordination in emergency management

Review of the 2010–11 Flood Warnings and Response (Victoria)

The Review found that the absence of any overarching coordination framework can result in a siloed, uncoordinated management structure where each agency focuses on legislated obligations to address specific hazards. Such a structure usually performs poorly in the face of a significant emergency. Citing the example of the 2010–11 Victorian floods, the Review argued that the lack of effective coordination and command and control arrangements led to an ad hoc response to the floods.

For example, under current arrangements, a dam breach and its resulting impacts would require the involvement of several agencies such as the State Emergency Service, Department of Sustainability and Environment, police force, VicRoads and Department of Primary Industries where each agency is responsible for different things. However, ultimate responsibility for such an emergency does not sit with any particular agency, meaning that nobody is effectively in charge of managing the situation. In another example, many councils were not aware of their specific responsibilities with respect to issuing flash-flood warnings, or lacked the technical and financial capacity to assess the likely local impacts of flash flooding and issue adequate warnings.

Victorian Bushfires Royal Commission

The Royal Commission found that confusion about roles and responsibilities resulted in inadequate management of several fires on ‘Black Saturday’. For example, the operational chain of command in different stages of the fires was unclear and no single person was in charge of operational planning, tasking and accountability on that day. Responsibilities were shared between the Country Fire Authority, Department of Sustainability and Environment, the Chief Commissioner of Police, and the Emergency Services Commissioner. There was consequently no cohesive and unambiguous leadership structure. In a further example, one of the leaders with ultimate responsibility for operational response during a bushfire is the Chief Officer of the Country Fire Authority. However, under the *Country Fire Authority Act 1958* (Vic), operational matters over which the Chief Fire Officer has responsibility is not clear.

Queensland Floods Commission of Inquiry (Final Report)

The Commission of Inquiry indicated that the disaster management system that was in place during the 2010–11 floods was deficient because local government, Queensland police and other disaster agencies were not fully aware of their roles and responsibilities. For example, there was confusion about Emergency Management Queensland’s role in directing, versus supporting, the State Emergency Service when responding to the floods.

(Continued next page)

Box 13.2 (continued)

The Inquiry also found that flood warnings from the Bureau of Meteorology were not always received by local governments and emergency services in a timely manner. This may be explained by ambiguity and inconsistencies in the roles and responsibilities of the Bureau in flood management, especially for flood forecasting and communicating flash-flood warnings (Munro 2011). A review of the Bureau of Meteorology's capacity to respond to future extreme weather and natural disaster events noted that:

There is a high level of confusion surrounding who (if anyone) is responsible for issuing flash flood warnings and variation in arrangements across jurisdictions. Generally the Bureau issues a severe weather warning which highlights weather conditions that could lead to flash flooding in a particular district, rather than a specific flash flooding warning. (Munro 2011, p. 47)

Sources: Munro (2011); Queensland Floods Commission of Inquiry (2011, 2012); Victorian Bushfires Royal Commission (2010); Victorian Government (2011b).

Poorly-defined roles and responsibilities and inadequate coordination in emergency management may arise from existing institutional arrangements. Providers of emergency services generally have different roles, responsibilities and objectives, reflecting differences in the overarching structures governing each entity. For example, local governments are primarily responsible for supporting disaster management in their local government area, while other agencies such as the police and the State Emergency Service perform emergency management activities on a larger scale under command structures determined at the state or territory level.

Inconsistencies in existing emergency management plans can also mean the responsibilities of an emergency service provider are unclear. In New South Wales, for example, the State Disaster Plan (2010) identifies the State Emergency Service as the lead agency for dealing with damage from storms and coastal erosion. However, the State Storm Sub Plan (2007) (a sub plan of the New South Wales Disaster Plan) states that the State Emergency Service is not responsible for any physical mitigation works to protect exposed properties, either during or outside the period of storm activity (Byron Preservation Association, sub. DR120; Coastal Residents Incorporated sub. DR122). According to the Sub Plan, the State Emergency Service has no role in protecting private property against coastal erosion and only has a coordination role in responding to coastal flooding.

A number of inquiry participants indicated that the roles and responsibilities of local governments in the provision of emergency services are not always clear. For example, the Northern Alliance for Greenhouse Action (sub. 6, p. 2) stated that 'there is continuing uncertainty about the scope of roles and responsibilities of different levels of government', and argued that better coordination between local

governments, particularly at the regional scale, would improve the delivery of emergency services. In a further example, the Municipal Association of Victoria (2011, p. 7) noted that:

Under the current system, each council and [the Municipal Emergency Management Planning Committee] spends considerable effort undertaking similar risk assessment processes. But a lack of consistency means the same hazard is identified in multiple municipal districts, with an absence of coordination of treatment leading to different treatment measures being applied across the state.

Unclear roles and responsibilities can also contribute to inadequate provision of disaster-mitigation infrastructure (section 13.4). This can increase the impact of natural disasters on communities, as well as the demand for emergency response services and disaster recovery assistance.

However, it is not always feasible to set out formal responsibilities or arrangements for every member of the community willing to assist during a disaster. For example, a number of people volunteer to help other members of the community (such as assisting a neighbour after a flood or storm) even if they are not part of an official emergency management organisation. Providing general information about emergency management procedures and having processes in place to inform volunteers on how to assist most effectively has the potential to improve disaster response (Regional Development Australia – Northern Rivers, sub. DR115).

Coordination

Each emergency service organisation has its own legislation, organisational hierarchy, training programs, operational processes and resources — which may result in a fragmented (or ‘silo’) approach to emergency management. The Attorney-General’s Department (sub. 64, p. 2) argued that:

... traditional government portfolio areas and service providers, with different and unconnected policy interests may be attempting to achieve the right [prevention, preparedness, response and recovery] balance individually. This has resulted in gaps and overlaps, which may hamper effective action and coordination at all levels and across all sectors.

A lack of consistency and clarity in emergency management arrangements can lead to poorly coordinated emergency services, and cause a number of problems when managing a disaster. For example, on ‘Black Saturday’, the Victorian Country Fire Authority and the Victorian Department of Sustainability and Environment did not always work cooperatively, leading to weaknesses in bushfire warnings and contributing to some warnings being issued too late or not at all (Victorian Bushfires Royal Commission 2010). In a further example, the Victorian Review of

the 2010–11 Flood Warnings and Response (Victorian Government 2011b) argued that separate and incompatible information management and communication systems prevented emergency service providers from readily communicating and sharing information.

Local government capacity

In a number of cases, local governments lack the capacity to meet their existing emergency management obligations (chapter 8). For example, Redland City Council (sub. 36) argued that limited resources make it hard for them to maintain an Emergency Coordination Centre and guarantee uninterrupted communication in an emergency. The Mornington Peninsula Shire (sub. 16, p. 14) is a further example. It stated that:

Little funding has been directed towards local council officer resources, yet local councils carry a lot of responsibility. In most councils, the emergency services co-ordinator is an addition to a person's primary role, due to lack of funding. There also needs to be a greater emphasis and resourcing for the long term impacts of recovery as this is often overlooked.

The Queensland Floods Commission of Inquiry (2011) found that less well-resourced councils have struggled to respond to the 2011 floods due to a shortage of staff trained in emergency management, lack of coordination among council staff and no contingency planning included in councils' disaster-management plans.

Current cost-sharing arrangements for disaster recovery (section 13.5) may also affect the ability of councils to provide adequate response and recovery activities during and after disasters. The Municipal Association of Victoria suggested that waiting for reimbursement of claims can put pressure on council finances. It argued that delays in the delivery of funding for recovery provided by state and Australian governments can leave councils in a vulnerable position and 'councils with limited resources have reported that this uncertainty has resulted in restraint in the provision of immediate relief and recovery services' (Municipal Association of Victoria, sub. DR85, p. 11). However, contrary evidence presented by other participants indicates that it is not clear to what extent this is the case. For example, the Queensland Government (sub. DR161, p. 9) stated that 'the current arrangements allow rapid responses on the ground after a disaster as councils have confidence that they will be reimbursed for expenses'.

Emergency management is just part of a broad range of local government functions that will be affected by climate change, and climate change is only one of the many risks that councils have to manage. A thorough consideration of the risks, benefits,

costs and alternative priorities for scarce local government resources is therefore required before committing additional funding and resources to emergency management at the expense of other priority areas. Coordination and collaboration among councils and improved guidance from state and territory governments could help councils reduce the costs of managing the risks of climate change in different areas, including emergency management (chapter 8).

13.3 Recent reforms

The reviews commissioned by state governments after recent natural disasters made a broad range of recommendations to improve emergency management arrangements (box 13.3). The prospect of greater climate variability as a result of climate change strengthens the need for improving these arrangements (Victorian Government 2011a).

Following these reviews, many state and territory governments have initiated changes to their emergency management structures. For example:

- the Victorian Government appointed a Fire Services Commissioner to improve bushfire planning and preparedness, and manage the response to major fires
- the Victorian Government provided funding to strengthen the emergency management capacity of local governments, including fire-risk management and early-warning systems
- the Queensland Government developed ‘Get Ready Queensland’ to provide information on storms, floods and cyclones, and made a number of improvements to flood mapping, early-warning systems, dam management and floodplain management
- through the Council of Australian Governments, most state and territory governments implemented a telephone-based emergency-warning system (Centre for Risk and Community Safety 2011).

Overall, these reforms may improve the community’s ability to manage disasters — for example, through clarifying roles and responsibilities or improving disaster prevention and preparedness (section 13.6). This is likely to strengthen the climate change adaptation policy framework and facilitate adaptation to climate change by ensuring that appropriate arrangements are in place to manage risks and deal effectively with emergencies when they occur.

These reviews demonstrate that some state governments have adopted transparent processes to investigate how well emergency management arrangements performed during disasters, and to help the community and governments learn from them.

Ongoing transparent review processes will support incremental reforms to emergency management arrangements as the climate changes. (There have also been agreements through the Council of Australian Governments to set out roles and responsibilities for disaster resilience (for example, COAG 2011).) Clearer and more predictable emergency management arrangements within and across governments at all levels can also enhance the support available to local governments in managing disasters (Victorian Local Governance Association, sub. 3).

Box 13.3 Recommendations to improve emergency management arrangements

Recent reviews (section 13.2) found inadequacies in the delivery of emergency services during disasters and made numerous recommendations for improving emergency management arrangements.

Clarifying roles and responsibilities and improving coordination

All of the reviews supported measures to clarify roles, responsibilities, coordination and leadership arrangements in all phases of emergency management. These measures could take the form of evaluations of, and/or changes in, existing emergency management procedures and legislation.

Measures to clarify the roles and responsibilities of those involved in emergency management can include: training of disaster-management personnel to ensure they clearly understand their roles during an event; practice exercises among emergency service organisations; or amendments to existing emergency manuals and procedures to clearly define rescue roles, responsibilities and arrangements.

Leadership and control arrangements can be improved through the appointment of a suitable individual with overall responsibility for disaster response. For example, the Review of the 2010–11 Flood Warnings and Response recommended the appointment of a state emergency controller who is ultimately accountable for all major emergencies.

Improving preparedness

Numerous recommendations related to improving the preparedness of communities by helping them better understand the risks they face. These include putting in place adequate early-warning systems and ensuring that communities can access and understand relevant information.

(Continued next page)

Box 13.3 (continued)

For example, the Perth Hills Bushfire Review recommended that the Fire and Emergency Services Authority collaborate with the Real Estate Institute of Western Australia to provide a package of information to new residents moving into bushfire-prone areas. In a further example, both the Queensland Floods Commission of Inquiry and the Perth Hills Bushfire Review call for the provision of education programs to make communities better prepared for future emergencies.

Building capability and capacity

All of the reviews were in favour of measures to ensure that providers of emergency services have the ability and the resources to operate effectively during an emergency. Recommendations included revising emergency management training procedures to improve capacity, making better information available to emergency response agencies (for example, mapping data), providing emergency services with appropriate equipment, and implementing measures to attract more volunteers.

Sharing responsibility

Another key message from the reviews was the importance of sharing responsibility for hazard preparedness. This requires the involvement of all tiers of government, emergency service providers and the broader community. Communities need to recognise, understand and manage their own risks and not rely solely on the assistance of emergency service organisations and governments. The Review of the 2010–11 Flood Warnings and Response pointed to research suggesting that flood damage can be reduced by up to 80 per cent if a community is well prepared for a flood. Measures implemented to promote this notion of 'shared responsibility' include guidance manuals and websites to provide communities with relevant information.

Broadly similar recommendations were made in a number of other reviews such as the Victorian Government's green paper *Towards A More Disaster Resilient and Safer Victoria* and *A Review of Disaster Management Legislation and Policy in Queensland*.

Sources: O'Sullivan and the Consultancy Bureau Pty Ltd (2009); Queensland Floods Commission of Inquiry (2012); Victorian Bushfires Royal Commission (2010); Victorian Government (2011b, 2011c); WA Government (2011).

13.4 Disaster mitigation

Disaster mitigation (or prevention) aims to reduce the impact of natural disasters on the community. This includes disaster-mitigation infrastructure such as flood levees and firebreaks, community education and awareness initiatives, and critical infrastructure protection programs (Australian Government 2009). State, territory and local emergency management agencies have primary responsibility for disaster mitigation, while the Australian Government provides support for mitigation research and funding for disaster-mitigation activities.

The National Partnership Agreement on Natural Disaster Resilience

To promote resilience to natural disasters, the Australian Government implemented the NPA-NDR in 2009. This Agreement provides approximately \$100 million of Australian Government funding to state and territory governments over the four years from 2009 to 2013 (\$26.1 million is available in 2012-13). Distribution of funds between the states and territories was historically based on population, costs of disasters and relative disadvantage, but have been adjusted to provide a minimum share to the Territories and Tasmania (table 13.1) (COAG 2009c).

Under the Agreement, states and territories have to develop annual Implementation Plans to evaluate whether activities funded through the NPA-NDR are being implemented efficiently, reaching their intended recipients, and contributing to the objectives of the Agreement. These Implementation Plans are provided to the Australian Government, which evaluates the performance of the state and territory governments against benchmarks set out in the Agreement. (A review of the NPA-NDR by the Attorney-General's Department is currently underway and is scheduled for completion by 31 December 2012.)

State and territory governments generally operate a competitive grants scheme to allocate funding available under the NPA-NDR and assess eligibility against their natural-risk priorities. Broadly speaking, projects that receive funding must align with the priorities outlined in the Council of Australian Governments' National Strategy for Disaster Resilience. These include understanding and communicating disaster risk, supporting emergency management capabilities and reducing disaster risk to communities. The Australian Government contributes up to 50 per cent of the estimated costs of selected activities, with states and territories responsible for securing the rest. Funding is available for a number of emergency management projects including natural disaster risk assessments, community education programs, disaster-mitigation infrastructure and early-warning systems.

Table 13.1 **Annual allocations of funding under the National Partnership Agreement on Natural Disaster Resilience**

<i>NSW</i>	<i>Vic</i>	<i>Qld</i>	<i>WA</i>	<i>SA</i>	<i>Tas</i>	<i>ACT</i>	<i>NT</i>
26%	16%	23%	12%	8%	5%	5%	5%

Source: COAG (2009c).

There is no pre-determined allocation of funding to particular activities, and the types of activities funded vary across states. In New South Wales, for example, most of 2012-13 funding is allocated to the Floodplain Risk Management Grants Scheme, which provides financial support to councils and public land managers for the preparation and implementation of floodplain risk management plans, and to the

Bush Fire Risk Management Grants Scheme, which promotes bushfire mitigation by funding capital works and maintenance for relevant agencies (table 13.2).

The annual Implementation Plans of the NPA-NDR indicate that state and territory governments usually allocate funding to relatively small-scale projects such as risk-management programs, vulnerability assessments, volunteer support schemes and infrastructure upgrades. In Victoria, for example, the Natural Disaster Resilience Grants Scheme (funded under the NPA-NDR) generally caps funding for individual projects at \$250 000 (OESC 2012b).

Table 13.2 New South Wales Implementation Plan
2012-13

<i>Project</i>	<i>Funding (\$)</i>
Auxiliary Disaster Resilience Grants Scheme	950 040
Floodplain Risk Management Grants Scheme	7 193 160
Bush Fire Risk Management Grants Scheme	2 578 680
Emergency Volunteer Support Scheme	950 040
State Emergency Management Projects	1 357 200
Emergency Risk Management Program	542 880
Total estimated budget^a	13 572 000

^a The total estimated budget includes a \$6 786 000 contribution from the Australian Government. This represents 26 per cent of the total funds available through the NPA-NDR in 2012-13.

Source: NSW Government (2012c).

It is not clear if the current funding process underlying the NPA-NDR is the most appropriate way to support disaster mitigation. States and territories receive a fixed percentage of funding and operate separate competitive grant schemes (such as the Natural Disaster Resilience Grants Scheme in Victoria). The Victorian Review of the 2010–11 Flood Warnings and Response (Victorian Government 2011b, p. 41) noted that:

... funding offered through the Commonwealth Government's Natural Disaster Resilience Grants Scheme (NDGRS) remains insufficient to ensure adequate improvements are made to the flood warning network, despite flood warning systems being funded more generously than mitigation projects.

A better criterion would be to allocate national funding to projects where the biggest expected net benefit can be gained. How to achieve this, along with the process for identifying suitable projects, should be considered as part of a broader review of emergency management arrangements (recommendation 13.1).

The disparity between mitigation and recovery expenditure

Even though there are funding mechanisms in place across all tiers of government for disaster mitigation, expenditure on disaster recovery generally exceeds expenditure on disaster mitigation. For example, Suncorp Group (sub. 28) pointed out that the Australian Government funding for disaster recovery and rebuilding in 2011 was significantly greater than funding for disaster-mitigation works, citing figures of \$5.6 billion and \$27 million respectively (excluding expenditures by state, territory and local governments). In a further example, the Insurance Council of Australia (2012c, p. 1) stated that:

... in comparison to post event funding under the [Natural Disaster Relief and Recovery Arrangements], Commonwealth support for natural disaster mitigation is particularly modest. For example, spending of \$30 million in 2011/12 represents a mere \$300 per property identified by the Natural Disaster Insurance Review as being at risk of high or extreme flooding.

Figures for Australian Government funding for disaster mitigation and recovery in recent years also suggest a marked disparity between mitigation and recovery expenditure (table 13.3). However, the Commission was unable to fully establish the extent of this disparity as estimates of state, territory and local government funding for disaster mitigation are not available. Furthermore, recovery spending was unusually high in 2011 (mainly due to extreme weather events in Queensland and Victoria) and spending in previous years has been substantially less.

Table 13.3 **Australian Government funding for disaster mitigation and recovery, 2005-06 to 2010-11**

	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	Total 2005-11
	\$m	\$m	\$m	\$m	\$m	\$m	\$m
Disaster mitigation or resilience ^a	31	24	30	37	34	26	182
Natural Disaster Relief and Recovery Arrangements	69	104	18	292	106	6 116 ^b	6 705

^a Specific Purpose Payments made to states for natural disaster mitigation or resilience, plus payments for bushfire mitigation. ^b This figure includes expected future costs for natural disasters that occurred in 2010-11.

Sources: Treasury (2006, 2007, 2008, 2009, 2010b, 2011a).

There is a wide range of mitigation activities undertaken by state, territory and local governments, and a myriad of funding sources available. Moreover, such activities and their funding arrangements are often not separately reported or explicitly identified as disaster mitigation. While there are also challenges in obtaining precise estimates of disaster recovery expenditure, examples of such expenditure are

typically available for major disasters (box 13.4), along with insurance claims for losses (table 13.4). Even if complete data on disaster-mitigation expenditure were available, these would not indicate, on their own, if expenditure on mitigation was appropriate. However, the low levels of expenditure on mitigation, and the potential for disaster-mitigation expenditure to reduce very high levels of recovery expenditure, suggest that a greater emphasis on prevention would increase the wellbeing of the community.

Table 13.4 Number of claims and insured losses from recent natural disasters^a

<i>Event</i>	<i>Number of claims</i>	<i>Insured losses (\$m)^b</i>
2010–11 Queensland floods	56 685	2 377
Cyclone Yasi	73 250	1 405
2009 Victorian bushfires	10 280	1 070

^a Data are only an approximation of the insured loss based on submissions of general insurance companies to the Insurance Council of Australia. ^b Costs are reported as original figures.

Sources: Insurance Council of Australia (2010, 2012a, 2012b).

Box 13.4 Disaster relief and recovery funding after recent disasters

2009 Victorian bushfires

As at 30 April 2010, the Australian Government had provided approximately \$465 million to the bushfire recovery effort. (Of that amount, \$237 million was provided through the Natural Disaster Relief and Recovery Arrangements.) In addition, the Victorian Government allocated approximately \$269 million to a number of rehabilitation and recovery projects in the 2009-10 state budget. These include establishing the Victorian Bushfire Reconstruction and Recovery Authority, supporting individuals and businesses affected by the fires, and funding a clean-up and demolition program. (Charitable donations amounting to \$379 million (as at April 2009) were also available for relief activities through the Victorian Bushfire Appeal Fund.)

2010–11 Queensland floods and Cyclone Yasi

As at June 2011, the total forecast expenditure on recovery projects related to the 2010–11 Queensland floods and Cyclone Yasi was \$6.8 billion over four years. (Of this amount, \$5.1 billion will be provided through the Natural Disaster Relief and Recovery Arrangements.) This includes \$4.1 billion for Queensland Government initiatives and \$2.7 billion set aside for local governments. The Queensland Government is also providing up to \$128 million to a number of recovery programs. In total, it will be liable for approximately \$1.8 billion in damage costs. (Approximately \$266 million (as at June 2011) from charitable donations was also available through the Premier's Disaster Relief Appeal.)

Sources: Queensland Reconstruction Authority (2011); Victorian Bushfires Royal Commission (2010); Victorian Department of Human Services (2012).

Disaster-mitigation infrastructure

Disaster-mitigation infrastructure can prevent or mitigate the impact of natural disasters and includes dams, levees, flood gates, firebreaks and seawalls. It is generally provided by governments due to its public-good characteristics and widespread effects on the community. For example, a flood levee around a town may protect the whole community from floods, irrespective of who pays for the levee to be constructed. Therefore, it is unlikely to be privately provided to an adequate level.

The potential benefits of disaster-mitigation infrastructure are wide ranging. It can reduce or avoid public and private property damage, road and beach closures, disruption to economic activity and emotional trauma. It can also alleviate demand on emergency services during the response and recovery phases of a disaster (box 13.5). Furthermore, the presence of disaster-mitigation infrastructure can improve the affordability of insurance premiums in hazard-prone areas (chapter 16). For example, Suncorp Group (2012) estimated that insurance premiums for its customers in Goondiwindi (Queensland) are 33 per cent lower than they would have been without a flood levee.

Inadequate disaster-mitigation infrastructure can have significant consequences for the community by increasing the damage from a disaster and influencing the way in which people manage their risks. For example, frequent natural disasters can cause financial and emotional stress to vulnerable members of the community, reducing their ability to manage future risks. Suncorp Group (sub. DR127, p. 5) submitted that:

The under-investment in disaster mitigation is particularly clear in Roma [Queensland]. A flood levee to protect the township of Roma has been discussed since 2005, with cost estimates ranging between \$2m and \$15m. This preventive measure has not been invested in and, as a result, some households in Roma have now been inundated by flood water three times in as many years.

A flood-mitigation study commissioned by Maranoa Regional Council as a result of the large floods that hit Roma in 2010, 2011 and 2012 suggested that a flood levee would have significantly reduced direct flood damage.

Without having undertaken a formal cost benefit analysis, the comparison between the cost of implementing the flood protection measures and the cost of potential flood damages without the mitigation measures shows a significant return on the investment. The estimated cost for implementing the mitigation strategy [a flood levee] (less than \$8m) is less than 15% of the estimated direct flood damages (\$58m) to the residential houses in Roma, [incurred] over the last three years. The proposed levee bank could provide unlimited years of protection with the appropriate maintenance strategy. (Engeny 2012, p. 84)

Box 13.5 **Benefits of disaster-mitigation infrastructure**

Lismore, New South Wales

A flood levee constructed at a cost of \$19 million in 2005 is estimated to have prevented flood damage of around \$15 million that year. This levee has also prevented damage from subsequent floods.

Nathalia, Victoria

A temporary levee purchased by Moira Shire Council at a cost of approximately \$500 000 was deployed in early 2012 when flood waters approached the town of Nathalia. While the levee only just held, it is credited with preventing the inundation of 176 houses.

Charleville, Queensland

The Queensland Government indicated that a \$28 million expenditure on mitigation works in Charleville has saved approximately \$50 million in potential Natural Disaster Relief and Recovery Arrangements and other recovery costs for the 2012 floods alone. It also submitted that:

A recent study into the effectiveness of flood mitigation measures in Charleville in South-western Queensland demonstrated that the economic benefits drawn from those measures were two times the actual cost of the works, for a single flood event. If Charleville were again to be subject to other flood events in the future, the benefits of the works (and therefore the cost-effectiveness of those measures) would be concordantly greater. (Queensland Government, sub. DR161, p. 3)

Roma, Queensland

The town of Roma suffered damages estimated at \$58.8 million after significant floods in 2010, 2011 and 2012. Roma was not protected by a flood levee during that time. A recent Flood Study and Mitigation Project has estimated the total cost of mitigation works to protect the town, including constructing a levee (approximately \$9 million of the total), raising houses and improving drainage, at approximately \$15 million (Engeny 2012; Maranoa Regional Council 2012).

Sources: ABC News (2012); Engeny (2012); Maranoa Regional Council (2012); McClelland (2011); Parliament of Victoria (2012); Queensland Government (sub. DR161).

Repeated property damage due to inadequate mitigation infrastructure can affect the availability and cost of insurance, as illustrated in Roma and Emerald (Queensland). Following floods in January 2012, Suncorp Group placed an embargo on new home and contents insurance policies in both towns and increased the premiums of existing customers significantly.

However, disaster-mitigation infrastructure can be costly and these costs need to be weighed up against the benefits (reduced risk of damage) to the community, as well as against the broader range of competing priorities for government funds. The

appropriateness of a given disaster-mitigation investment will depend on the specific circumstances (section 13.6). In addition, infrastructure is just one of many options for mitigating the effects of a disaster. In some cases, alternative options such as changes to land-use planning and building regulation in hazard-prone areas, and improving emergency preparedness, may bring greater benefits to the community as a whole (chapters 9, 10 and 11).

Barriers to the provision of disaster-mitigation infrastructure

Inquiry participants suggested that there may be barriers affecting the provision, management and maintenance of disaster-mitigation infrastructure. These range from unclear roles and responsibilities across different tiers of government, legal liability issues, restrictive government regulation and inadequate funding.

Confusion over roles and responsibilities

It is not always clear which level of government is responsible for providing and managing disaster-mitigation infrastructure. As discussed in section 13.2, unclear roles and responsibilities can reduce the effectiveness of emergency response services, especially during a large-scale disaster. For example, the NSW Government (2011a, p. 3) indicated that during the 2010–11 floods in Victoria:

... communication between the agencies responsible for administering legislation that regulates flood mitigation infrastructure and works in NSW and Victoria did not seem to be effective. For NSW staff it was difficult to ascertain which agency regulated levee banks in Victoria. For example, the Victorian Department of Sustainability and Environment (DSE) sets policy, however, the responsibility for implementation rests at the local government level with various councils involved.

Furthermore, it is not always clear who is responsible for the maintenance of disaster-mitigation infrastructure, especially in cases where it is on both public and private land (East Gippsland Shire Council 2011; Parliament of Victoria 2012). An inquiry into flood-mitigation infrastructure in Victoria found that:

There is great uncertainty regarding the ownership of, and maintenance responsibilities for, many of Victoria's levees. Local governments generally, but not always, claim ownership of modern urban levees, which were built under approved schemes. However, responsibilities for older urban levees, rural levees with previous government involvement, and privately constructed levees on public land, are often unclear or disputed. (Parliament of Victoria 2012, p. xv)

The Insurance Council of Australia (trans., p. 6) made a similar argument.

... [E]ven where mitigation has been in place in many of these locations, often we've found that [it is] not maintained. It can be quite difficult to identify who owns the

mitigation and who operates it in an emergency ... There's no program for auditing these or maintaining these, or making sure that the very hefty infrastructure spend that's been undertaken is maintained for 20, 30, 40 years, the life of this infrastructure.

Given that more than one group of people usually benefit from protective works such as flood-warning infrastructure, it is important to identify who should have operational and maintenance responsibilities. For example, East Gippsland Shire Council (2011, p. 6) noted that:

... appropriate mechanisms for sharing costs associated with the installation, maintenance and replacement of gauging infrastructure needs to be developed to recognise the wide range of agencies that use and benefit from this infrastructure in addition to Local Government.

In view of the confusion surrounding the provision, operation and maintenance of disaster-mitigation infrastructure, there is scope for current arrangements to be clarified, especially at the local government level, since local governments generally have primary responsibility for providing protective measures (chapter 8). However, state governments often provide assistance to local governments and should therefore be considered in any review of existing arrangements.

Regulation

Inquiry participants argued that state government regulation is limiting the private provision of disaster-mitigation infrastructure, especially in New South Wales. For example, the *Coastal Protection Act 1979* (NSW) requires that landowners building a seawall must:

- show that the works will not unreasonably limit public access to a beach
- show that the works will not pose a threat to public safety
- make arrangements for the restoration of beaches and land damaged by the works, and for the maintenance of the works, over the lifetime of the works.

These arrangements can be met by a legally-binding obligation, or payment by landowners of a coastal-protection service charge to the relevant council — an annual charge used to cover the costs of restoration and maintenance services provided by the council. The Byron Preservation Foundation (sub. DR120, p. 5) considered that this obligation:

... casts impossible burdens on the frontline of property owners. It again fails to recognise the need for a whole of community strategic approach to the issue of protection of coastal communities and strategic assets. A strategic approach would take into account the interests of the community as a whole, its property and infrastructure as well as the natural environment and beach amenity.

In a further example, Coastal Residents Incorporated (sub. DR122, p. 3) considered these requirements meant that ‘owners of properties on NSW beaches are faced with the reality that they cannot obtain approval for Permanent Protection Works for coastal erosion because the compliance requirements cannot be achieved’. The NSW Government announced in September 2012 forthcoming changes to legislation which are expected to make it easier for coastal property owners to install temporary protective works on their properties (Hartcher 2012).

However, current arrangements in New South Wales may have some merit in improving community wellbeing. The impact that disaster-mitigation infrastructure has on others should be considered and private landowners who benefit from protection should bear at least some of the cost burden associated with disaster-mitigation infrastructure.

It is unclear what impact this legislation is having in practice. Such legislation should be subject to periodic review, to ensure that it is not imposing onerous requirements on property owners, or preventing disaster-mitigation infrastructure with net benefits (once external impacts are taken into account) from being built.

Legal liability

A further issue that may be limiting the provision of disaster-mitigation infrastructure is the legal liability of local governments in relation to such structures. For example, the construction of a seawall may provide an expectation that this structure will provide adequate protection against storm surges. If the seawall fails, or causes damage to neighbouring properties, the local government may be liable (Clarence City Council, sub. 10, attachment 2). The legal liability of local governments is discussed further in chapter 8.

Inadequate funding

Inquiry participants suggested that total funding under the NPA-NDR may be inadequate and lead to insufficient investment in disaster-mitigation infrastructure. For example, Insurance Australia Group (sub. DR110, p. 9) submitted that:

This means there is very little, if any, capacity for this funding to be directed toward larger scale disaster mitigation infrastructure projects of local, state or national significance. Further, it is arguable that this arrangement encourages a piece-meal approach to disaster mitigation rather than one that focuses on long-term, strategic priorities.

The Insurance Council of Australia (2012c, p. 2) presented a similar argument in their submission to the 2012-13 Australian Government Budget:

the [Natural Disaster Resilience Program] could also be improved by providing for additional flexibility in terms of the shared funding approach with the States and local governments. Although the ICA concurs that resilience against natural disasters is a shared responsibility across all sections of the community (governments, business and individuals), the ICA submits that the matched funding arrangements in the [Natural Disaster Resilience Program] can act as a disincentive to pursue larger mitigation projects beyond the financial scope of local authorities/communities.

Given the high cost of disaster-mitigation infrastructure and the potential for significant savings in recovery expenditure when such infrastructure is in place, there is a case for the Australian Government to review the current funding arrangements of the NPA-NDR (section 13.6).

In addition to funding provided through the NPA-NDR, state, territory and local governments have access to a range of own-source and grant arrangements to finance investment in disaster-mitigation infrastructure. For example, the Queensland Government recently committed \$40 million to a Floodplain Security Scheme for building flood-mitigation infrastructure (Queensland Government 2012a). However, mitigation funding may still be insufficient, especially for local governments. Their capacity to access revenue affects their ability to build and maintain disaster-mitigation infrastructure and, in a number of cases, local governments indicated that their revenue levels are inadequate to meet such responsibilities (chapter 8). Furthermore, local governments generally have to go through a lengthy and competitive process to obtain funding for mitigation works. This involves hazard mapping and expert assessments, project approval at the Council level, and competitive rounds of funding at the state and Australian government level (Insurance Council of Australia, trans., p. 21).

Alternative funding models for local governments

To overcome financial constraints, local governments can put in place alternative arrangements to fund disaster-mitigation infrastructure. One option may be to require those who benefit from the protective works to pay for their construction and maintenance. (For example, *Australia's Future Tax System Review* deemed that user charges are an appropriate funding mechanism for local governments to deliver services (Treasury 2010a).) A number of local governments have used or proposed this approach. For example:

- Mackay Regional Council (2009) has a policy of applying a special levy to cover the costs of seawall construction that have largely private benefits.
- Pittwater Council (2012) has applied a special levy to cover the costs of infrastructure upgrades, including emergency-management infrastructure.

-
- Gold Coast City Council (2012) requires waterfront property owners to pay for the maintenance costs of revetment walls that benefit their property.

Requiring private landowners to pay at least some of the costs associated with constructing and maintaining disaster-mitigation infrastructure may facilitate effective climate change adaptation (though these costs can, in some cases, be large). This is because such an approach aligns the costs of infrastructure with those that benefit from it. This would also encourage households and businesses to take into account the cost of protective works in their decisions, for instance, when making a choice between relocation and construction of disaster-mitigation infrastructure.

13.5 Disaster recovery: the Natural Disaster Relief and Recovery Arrangements

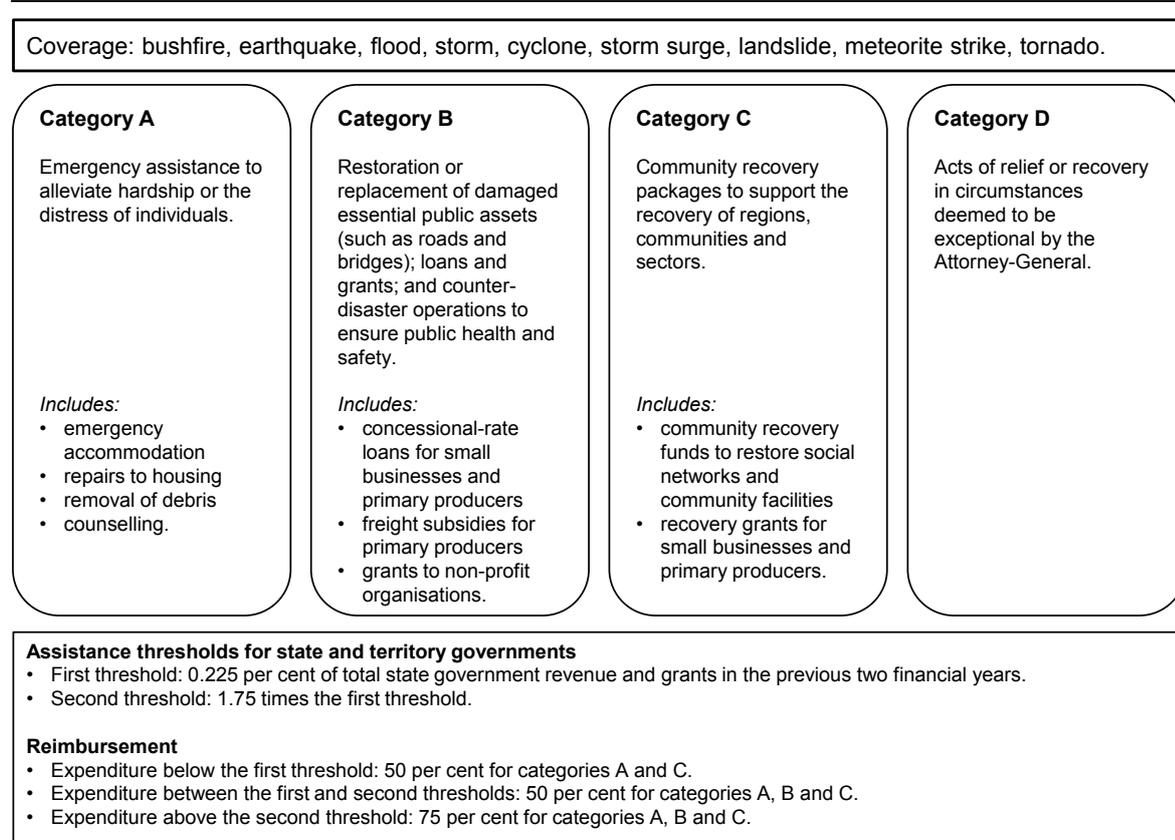
As outlined in section 13.4, natural disasters impose costs on the community. To facilitate recovery after major disasters, the Australian Government provides assistance through the NDRRA. These arrangements fund a proportion of the recovery costs incurred by state and territory governments after a natural disaster, including:

- one-off payments and other assistance for individuals and businesses
- the cost of restoring essential publicly-owned infrastructure (such as roads, bridges and schools), including recovery funding provided to local governments (figure 13.2).

The amount that the Australian Government reimburses a disaster-affected state or territory depends on expenditure thresholds and criteria for eligible spending (Attorney-General's Department 2011). Remaining costs are paid by the states, although these costs are often spread among all states through GST allocations (ERC 2011).

There are concerns that there could be large fiscal burdens on the Australian Government if extreme weather events become more frequent or severe due to climate change (Department of Climate Change and Energy Efficiency, sub. 57). In 2010-11, Australian Government expenditure on the NDRRA has been estimated at \$6.1 billion (including expected future costs for disasters in that year) (table 13.3). In Queensland, for example, most state recovery expenditure after the flooding and cyclone that is eligible under the NDRRA has been used to replace state roads and local government assets (table 13.5).

Figure 13.2 Natural Disaster Relief and Recovery Arrangements



Source: Attorney-General's Department (2011).

Effects on insurance arrangements

The NDRRA may reduce incentives for state and territory governments to manage their residual risks by adopting adequate insurance arrangements (whether through self-insurance, commercial insurance or decisions not to insure). This may be because NDRRA payments to states are made net of any insurance payouts they may receive (ERC 2011). In particular, a large proportion of NDRRA expenditure is used to rebuild roads, which are not insured by most state and territory governments (with the exception of Victoria and the ACT) (Department of Finance and Deregulation 2012).

Table 13.5 Estimated NDRRA-eligible expenditures
Queensland floods and Cyclone Yasi, 2010-11

<i>Item</i>	<i>Expenditure</i>
	\$m
State roads	2 894
Local government assets	3 114
Other state assets	150
Support services and other payments	496
Loans	230
Total	6 884

Source: Queensland Government (2012b).

However, the absence of insurance arrangements for some state-owned assets does not necessarily imply a barrier to effective adaptation — in some cases, it can be more efficient for states to bear risks and costs themselves. New clauses in the 2011 NDRRA determination require states to implement ‘disaster-mitigation strategies’ and report on their insurance arrangements to the Australian Government, which may reduce funding if it deems these to be inadequate (Attorney-General’s Department 2011). It is not clear whether these clauses will be sufficient to ensure an appropriate balance between disaster prevention, preparedness, response and recovery.

Effects on infrastructure decisions

In their current form, the NDRRA may also give rise to a barrier to effective adaptation to climate change by distorting the incentives that state and territory governments have to reduce their risks through disaster-mitigation measures. The NDRRA may lower the incentives to adequately maintain infrastructure and manage climate-related risks — a form of ‘moral hazard’ — which can lead to a poor balance of disaster prevention, preparedness, response and recovery (Attorney-General’s Department, sub. 64; ERC 2011; Mortimer, Bergin and Carter 2011). This arises because state and territory governments do not bear the full cost of rebuilding infrastructure after a disaster. Some inquiry participants also suggested that relief payments to individuals (including NDRRA assistance) can reduce incentives to take out adequate insurance, although there is little evidence to support this view (chapter 16).

Furthermore, the NDRRA encourage damaged infrastructure to be rebuilt without requiring an assessment of the costs and benefits to the community. This may also be a barrier to effective adaptation by discouraging states and territories from changing the design, location or objectives of infrastructure to make it more

resilient to future disasters. Under current arrangements, funding is provided on the condition that essential public assets are restored or replaced to their pre-disaster standard. A cost-effectiveness test is imposed only when additional funding is requested to build new disaster-resilient infrastructure under the ‘betterment’ provision of the NDRRA.

The ‘betterment’ provision

The betterment provision of the NDRRA provides for ‘the restoration or replacement of [a damaged] asset to a more disaster-resilient standard’ (Attorney-General’s Department 2011, p. 5). Expenditure is eligible for reimbursement if:

- the asset is an essential public asset [such as a road or a bridge]
- the State informs the Secretary [of the Attorney-General’s Department] of its decision to restore the asset to a more disaster-resilient standard, and of its reasons for doing so; and
- the Secretary is satisfied with the cost effectiveness of the proposal; and
- the Secretary is satisfied that the increased disaster-resilience of the asset will mitigate the impact of future natural disasters. (Attorney-General’s Department 2011, p. 5)

For example, if a busy road is regularly flooded and becomes unusable for extended periods of time, there can be significant economic and social costs. Rather than restoring the road to its pre-disaster standard each time it is damaged (which may be eligible for standard NDRRA funding), an option for ‘betterment’ may be to raise or divert the road to make it less vulnerable to future flooding.

The NDRRA’s betterment provision appears to be used infrequently. As of May 2012, only one betterment proposal has been successfully developed and implemented under this provision of the NDRRA (Queensland Government sub. DR161). Tumut Shire Council (New South Wales) received \$778 000 in betterment funding (representing one third of total project cost) to relocate the Adelong swimming pool that was damaged during a flood in 2010.

Essential assets are therefore typically restored to their pre-disaster standard, leaving them potentially vulnerable to future extreme weather events. For example, the Insurance Council of Australia (sub. DR132, p. 3) submitted that:

Betterment provisions in the current scheme appear to be infrequently used, leading to a situation where much of the infrastructure replaced following the [Queensland] and [Victorian] floods of 2011 is unimproved and will fail again during future floods of a similar magnitude.

Clarence Valley Council (sub. DR98, p. 4) reinforced this point:

Natural Disaster Relief funds do not flood proof for example, roads, levees, and boat ramps against future floods, with present emphasis being excessively on repairs and [maintenance of] the status quo in terms of asset condition. The result is often that the same or similar repairs are again required after subsequent floods.

Impediments to the use of the betterment provision

There are a number of factors that may be limiting the use of the betterment provision. Examples identified by the Queensland Government (sub. DR161) include inadequate guidelines and processes for project evaluation, ambiguous cost-sharing arrangements across levels of government, and difficulties in securing funding. The Review of the 2010–11 Flood Warnings and Response (Victoria) also noted significant confusion by local governments about the processes for the betterment of damaged assets, including the need to provide detailed information and receive pre-approval from the Australian Government before construction can commence (Victorian Government 2011b). The Australian Local Government Association (ALGA 2011) noted that it is unclear whether all local governments are even aware of the betterment provision.

These factors may lead to state, territory and local governments using the NDRRA to replace damaged assets to their previous standard without considering betterment options, regardless of the benefits to the community. (While the Queensland Department of Community Safety has prepared a detailed framework for assessing the costs and benefits of betterment options (Queensland Government, sub. DR161, attachment 1), it is not clear whether this framework will be adopted by the Australian Government.)

Inadequate guidelines and processes

While there is a generally well-established process for the restoration and repair of essential public assets under the NDRRA, the Queensland Government (sub. DR161) argued that the guidelines for using the betterment provision are unclear. For example, it noted that:

- there are no agreed national guidelines for the assessment and approval of betterment proposals
- guidelines for betterment are not uniform across states and territories, leading to potential confusion when applying for funding under the betterment provision of the NDRRA. For example, the betterment provision in New South Wales

appears to be restricted to public roads, and is not mentioned in Tasmanian guidelines.

Ambiguous cost-sharing arrangements

It is not clear if the cost-sharing arrangements between the Australian, state and territory governments for NDRRA claims also apply to betterment proposals. The Queensland Government (sub. DR161) submitted that in the absence of formal guidelines, state, territory and local governments have interpreted the arrangements as allowing for a one-third funding split between each level of government for local government assets, and a 50:50 split between state, territory and Australian governments for state-owned assets. Blunden (2010, p. 5) argued that:

An anomaly exists in the NDRRA funding between the Commonwealth and State Governments for betterment works. If eligible expenditure exceeds the State's first threshold the Commonwealth will fund only one-third of the betterment cost compared to half of the replacement or repair cost to restore the asset to its pre-disaster condition. There are benefits to the State and the Commonwealth if betterment works are completed and an appropriate incentive would be funding betterment works on a dollar for dollar basis similar to personal hardship and distress.

Further, the Municipal Association of Victoria (sub. DR85, p. 11) stated that:

The one third component for many Victorian councils is prohibitive in many cases. As a result, there have been a number of examples where roads have been restored to original condition, only to be damaged again in the next flood.

Current arrangements may therefore make the betterment of an asset less financially attractive compared to restoration for local governments, which often have limited resources.

13.6 Getting the balance right

All aspects of emergency management — prevention, preparedness, response and recovery — have a role to play in helping the community deal with the impact of extreme weather events and other emergencies. For example, the Attorney-General's Department (sub. 64, p. 2) emphasised that:

In the context of emergency management, effective adaptation to climate change means getting the [prevention, preparedness, response and recovery] balance right in order to minimise the harm done by natural disasters.

Some inquiry participants submitted that current arrangements do not achieve the right balance. For example, Clarence City Council (sub. 10, p. 4) stated that:

It would seem logical in many circumstances to implement preventative measures where appropriate rather than to rely on emergency response and management when events occur. At present there appears to be no understanding of the economic benefits of protect versus recover in relation to coastal processes.

It is difficult to identify the appropriate balance between prevention, preparedness, response and recovery. For example, whether a preventive measure such as a flood levee is appropriate will depend on specific local circumstances, other options available to manage emergencies, and the preferences of the community. In some cases, the best option may be to build the levee differently, delay it or not build it at all. It is also difficult to determine the appropriate level of prevention to undertake before a disaster. As stated by Suncorp Group (sub. DR127, p. 4):

... the current approach to risk management does not appropriately balance the four phases of emergency management. Communities (and therefore government) naturally focus on disaster response and recovery. It is clear when disaster strikes that strong and decisive action is needed to appropriately manage the impacts of that disaster. It is, however, substantially more difficult to determine what actions should be taken prior to a disaster.

More broadly, all government-funding decisions for disaster prevention involve making tradeoffs between alternatives that have different costs and benefits for the broader community. The choice will depend on a number of factors, such as:

- the likelihood and expected severity of natural disasters
- the cost of, and responsibility for, building, operating and maintaining disaster-mitigation infrastructure
- environmental impacts
- potential damage to surrounding properties, public areas and infrastructure
- other government spending priorities.

For example, local governments could construct permanent flood levees to protect some towns located near rivers, or purchase low-cost temporary levees — as was done by Moira Shire Council in Victoria and which protected the town of Nathalia from flooding in early 2012 (ABC News 2012).

Expenditure on emergency prevention or preparedness could be too low, leaving the community facing high levels of risk, or it could be too high, and resources could be better used to meet other policy objectives. While disaster-mitigation infrastructure can reduce damage if a disaster occurs, sometimes it could be more efficient to use limited funds to strengthen response arrangements (such as fire services) or provide recovery assistance after an emergency. This may be the case where disasters are

difficult to predict, the potential damage is low, or preventive infrastructure is very costly.

The Commission is not in a position to assess the adequacy of specific arrangements that are in place across Australia nor what the right balance between prevention, preparedness, response and recovery would be in specific cases. However, there are principles that can guide government decision making in this area.

A key part of this is identifying risks and considering all options available to manage these risks. This can be done through a risk management framework that evaluates risks and their consequences, and sets out options to reduce the impacts on the community (chapter 3). Taking this approach, governments can help to inform the community of the range of risks they face and consider tradeoffs between ways of dealing with those risks — whether through prevention, preparedness, response or recovery. This can be further facilitated by ongoing consultation with the community, transparent decision-making processes and clearly defined roles and responsibilities (section 13.3). Taking into account the community's perception of, and appetite for, risk is also important since underestimating risk exposure can have adverse impacts on the preparedness and response to natural disasters (box 13.6 and chapter 4).

All levels of government can work towards achieving a good balance between prevention, preparedness, response and recovery by assessing the costs and benefits of each option, and selecting the options that are likely to most improve the wellbeing of the wider community. In each case, the costs and benefits will depend on the specific circumstances — for example, the extent of flood or bushfire risk in a local area, the costs of specific infrastructure projects, or the current capacity of local fire services. This assessment of costs and benefits should also consider the implications that investment in one aspect of emergency management may have on others — for example, whether increased prevention can reduce the cost of providing emergency response services (section 13.4), or whether recovery payments create disincentives for good risk management (chapter 16).

Given high uncertainty about some of the impacts of climate change — and the effects of extreme weather events more generally — ‘real options’ approaches may be appropriate in some circumstances (chapter 5). This means taking actions that have relatively low costs today but leaving options open for further measures to be taken in the future as information improves. For example, given that the frequency and intensity of flooding is expected to increase in the future due to climate change, one option may be to buy a relatively low-cost portable or temporary flood levee. This could allow decisions about whether to invest in more permanent or expensive

levees to be deferred until the need becomes clearer (for example, as projections of flooding due to climate change can be made with greater confidence).

Box 13.6 Risk perception

Perceptions of risk can affect how a community prepares for and responds to a disaster. For example, while some people may find the risk of a potential bushfire or flood unacceptable, others may not be as concerned — attitudes to risk vary. Factors that influence risk perception include socio-economic characteristics, knowledge of the environment and hazards, and values and social norms.

Recent reviews of natural disasters have indicated that underestimating risks can have adverse effects. Evidence presented to the Victorian Bushfires Royal Commission (2010, p. 356) indicated that ‘people underestimated the threat posed by the bushfires of 7 February and appeared reluctant to change their plans, sometimes with fatal consequences’. The Commission also argued that maintaining ‘community memory’ of bushfires can be difficult, leading to complacency and underestimation of future bushfire risk. In a further example, the Queensland Floods Commission of Inquiry noted that almost a quarter of the deaths during the 2010–11 floods occurred when people were attempting to drive through floodwaters. It seemed that in some cases, warning signs were ignored, suggesting that risks were underestimated.

Measures that have been implemented to maintain community awareness of natural hazards include the ‘If it’s flooded, forget it’ program to educate the public about the dangers of floodwaters, and the inclusion of bushfire safety and history in the school curriculum in Victoria. Furthermore, the National Emergency Management Committee has committed to examine the use and publication of risk registers to communicate information to the public (Attorney-General’s Department 2012a). A number of local governments also communicate natural hazard information on property title documents (chapter 7).

Informing communities about the natural hazards they may face can improve their risk perception and preparedness and response to future disasters. As noted in the Review of the 2010–11 Flood Warnings and Response (Victorian Government 2011b, p. 218), ‘the disaster resilience of peoples and households is significantly increased by active planning and preparation for protecting life and property, based on awareness of the threats relevant to their locality’.

Sources: Attorney-General’s Department (2012a); Queensland Floods Commission of Inquiry (2012); Victorian Bushfires Royal Commission (2010); Victorian Government (2011b).

Using these principles, governments and communities can work towards an appropriate balance between prevention, preparedness, response and recovery. Even though extreme weather events and the impacts of climate change can be uncertain, these principles provide a framework to identify and manage risks, deal with emergencies, and facilitate effective adaptation to climate change.

Arrangements should be reviewed

The Australian Government should undertake a public and independent review of disaster prevention and recovery arrangements. This should cover the NDRRA and funding mechanisms for disaster mitigation, including the NPA-NDR. The review should examine whether current arrangements result in inappropriate infrastructure investment in the prevention and recovery phases of a disaster, and consider the costs and benefits of potential reform options. (Even though the Attorney-General's Department is currently conducting a review of the NPA-NDR, the Commission is recommending a more extensive assessment of the Agreement to examine the adequacy of disaster-mitigation arrangements.)

In examining the NDRRA, the review should consider whether current arrangements affect insurance, disaster recovery or other risk management decisions by state and territory governments, as well as by individuals, businesses and local governments that receive assistance through the NDRRA. Furthermore, the review should examine alternative arrangements and funding models that may reduce any distortions. These could include, for example:

- requirements for all infrastructure for which NDRRA funding is provided to undergo a cost-benefit assessment in accordance with the Best Practice Regulation Handbook (Australian Government 2010b)
- the use of lump-sum funding grants that are not tied to rebuilding or restoration costs (giving states an incentive to consider all available options for using these funds, including modifying the design and location of infrastructure)
- a consistent framework with clear guidelines and processes for developing, evaluating, approving and funding the betterment of essential public assets
- requirements for state and territory governments to develop and update disaster plans for infrastructure that set out how essential infrastructure will be rebuilt after damage occurs
- public disclosure of all approved projects and funding amounts under the NDRRA.

In examining the arrangements for disaster mitigation, the review should outline a clear process for identifying and prioritising disaster-mitigation infrastructure needs, and the arrangements for providing and funding this infrastructure by all levels of government. In particular, this review should evaluate:

- the need for stronger national policy on disaster-mitigation infrastructure
- the adequacy of disaster-mitigation funding available to states and territories

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- processes required to identify responsibilities for the management of disaster-mitigation infrastructure, including funding, implementation, operation and maintenance.

RECOMMENDATION 13.1

The Australian Government should commission an independent public review of disaster prevention and recovery arrangements. This should be broader than the review currently being conducted by the Attorney-General's Department. The review should cover the Natural Disaster Relief and Recovery Arrangements, as well as the funding mechanisms for disaster mitigation, including the National Partnership Agreement on Natural Disaster Resilience. This review should:

- *consider whether arrangements lead to inadequate disaster-mitigation infrastructure investments or insurance decisions, or reduce the incentives of state and territory governments to appropriately manage their risks*
- *clearly outline the process for the identification of disaster-mitigation infrastructure needs, the provision and appropriate funding of this infrastructure, and the allocation of operational responsibilities*
- *evaluate the adequacy of current arrangements for the provision of post-disaster assistance, including guidelines and processes for project evaluation and the criteria for approving and funding the betterment of essential public assets*
- *consider the balance of resources devoted to prevention and preparedness relative to response and recovery through a cost-benefit analysis of reform options*
- *involve extensive consultation with the community and all levels of government.*

14 Environmental management

Key points

- Climate change is likely to exacerbate current pressures on environments and the services they provide, as well as giving rise to new pressures. This could lead to irreversible damage to some ecosystems, habitats or biodiversity.
- Barriers to effective adaptation to climate change could arise where:
 - policies and regulations reduce the resilience of environments to climate change
 - there are market failures (such as spillovers or imperfect information)
 - conservation strategies or objectives fail to meet the community's needs
 - policy frameworks are inflexible or resources are poorly allocated
 - governance and institutional structures are inappropriate.
- Governments can address barriers and support the adaptive capacity of environments and communities by:
 - reducing pressures faced by ecosystems and species
 - providing appropriate information, research and monitoring
 - ensuring that the community's values are properly factored into decision making
 - using flexible policy frameworks, such as adaptive management and market-based approaches, to respond to changing circumstances
 - reviewing and, if necessary, revising objectives and strategies for biodiversity conservation to ensure these remain appropriate in a changing climate
 - embedding consideration of climate change risks into existing governance arrangements and ensuring that responsibilities are allocated appropriately.
- These actions are likely to have benefits in the current climate and facilitate effective adaptation to climate change.

14.1 Climate change and the environment

Climate change is likely to significantly affect natural environments (box 14.1). In many cases, climate change will exacerbate current pressures on ecosystems and species, including habitat and biodiversity loss, pollution, fire, and the spread of weeds and introduced animal species (SCCCEA 2012). Climate change could also introduce new pressures on some ecosystems. This could occur directly — for example, as temperatures, carbon dioxide concentrations or sea levels rise — or indirectly, as settlement patterns and economic activities adapt to climate change.

Box 14.1 Environmental impacts of climate change

Climate change could affect natural environments in a number of ways, due to:

- changes in temperature, humidity, rainfall variability, water availability and carbon dioxide concentrations in the air and water
- changes in the frequency and severity of heatwaves, fires, cyclones and storm surges
- changes in life-cycle events (such as seed germination, flowering or egg hatching) and migration patterns of species
- changes in the habitats, geographic range and distribution of species (both native and introduced), including increased threats of extinction for some species
- genetic changes as species evolve in response to environmental conditions
- interactions between species as they adapt in different ways and at different rates
- interactions between climate change and environmental management activities
- changes in land and water use as human activities (such as agriculture, urban development or tourism) adapt to climate change.

These impacts can be complex to predict and may have unforeseen consequences for many ecosystems and species. In some cases, irreversible damage could occur.

Sources: Australian Conservation Foundation (sub. 47); Director of National Parks (sub. 60); Dunlop and Brown (2008); Government of South Australia (sub. DR88); Hughes et al. (2011); State of the Environment 2011 Committee (2011); Steffen et al. (2009).

These impacts will affect human activities. For example, climate change could have adverse impacts on valuable environmental services, such as the maintenance of soil and water quality, nutrient cycling, crop pollination, biodiversity and flood protection (Hughes et al. 2011). In turn, this may affect the viability of some agricultural activities, tourism and recreation that are dependent on vulnerable ecosystems, such as the Murray–Darling Basin and Great Barrier Reef (Great Barrier Reef Marine Park Authority, sub. DR92). There could also be impacts on the cultural, spiritual and physical wellbeing of Indigenous communities that are reliant on healthy ecosystems (Torres Strait Regional Authority, sub. DR152).

Some ecosystems and species that are most vulnerable to the impacts of climate change are also among the most highly valued. These include:

- the Australian Alps — habitats may shrink for many alpine plant and animal species
- the Great Barrier Reef — rising sea temperatures and coral bleaching may irreversibly damage reef ecosystems
- waterways in the Murray–Darling Basin — average water inflows may be lower over the long term, leading to the degradation of wetlands and other ecosystems

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- the Queensland Wet Tropics, Kakadu wetlands and ecosystems in south-west Australia — significant loss of biodiversity could occur (CSIRO 2008b; Hennessy et al. 2007; Steffen et al. 2009).

There are some indications that changing climatic conditions are already affecting these and other environments. For example, changes have been observed in the migration and lifecycle patterns of some species, leaf sizes and flowering times have changed for some plants, the boundaries between some vegetation types have shifted, ocean temperatures around parts of Australia have risen, and there has been an increased number of mass coral bleaching events in the Great Barrier Reef (Government of South Australia, sub. DR88; Poloczanska, Hobday and Richardson 2012; Steffen et al. 2009).

Some species and ecosystems are able to adjust to climate variability and other pressures, and may be able to adapt to a change in climate. However, in other cases climate change might be too severe, or occur faster, than species are able to adjust through evolutionary processes (Director of National Parks, sub. 60; Hennessy et al. 2007; Hughes et al. 2011; IPCC 2007a). There is also a risk that sudden and irreversible changes could occur if climate change impacts are non-linear or as ‘tipping points’ are reached (Dunlop and Brown 2008; Steffen et al. 2009). As a result, climate change may lead to the collapse of some vulnerable ecosystems or the loss of biodiversity, especially for species that are endemic to Australia and are restricted in their geographic and climatic range (Department of Sustainability, Environment, Water, Population and Communities, sub. 77; Hennessy et al. 2007).

14.2 Barriers to effective adaptation

Climate change will have implications for many of the environmental policies and management activities of governments (box 14.2). Where these policies and activities are not appropriate, there may be barriers to effective climate change adaptation. Governments play a significant role in environmental management because of the ‘public good’ nature of ecosystems, biodiversity and landscapes, and the need to ensure that scarce resources are used appropriately without posing risks to environmental or human health.

As the climate changes, some management strategies could become increasingly valuable, whereas others could add further stress to vulnerable ecosystems. While governments are not expected to be able to completely offset all climate change impacts, changes to the way that environments are managed may help to reduce these impacts, and maintain and improve the capacity of natural environments to adapt to the impacts of climate change.

Box 14.2 Environmental policy in Australia

The **Australian Government** protects ecosystems of 'national significance' through the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth). Under this Act, the Government lists threatened species and ecosystems; develops recovery plans for threatened species; and protects heritage, wetland and marine areas. This includes world heritage areas of cultural or natural significance and wetlands listed under the Convention on Wetlands of International Importance ('Ramsar Convention'). Climate change has been identified as a 'key threatening process' under the Act.

Parks Australia manages reserves that have been proclaimed under the Environment Protection and Biodiversity Conservation Act, including the Kakadu, Uluru-Kata Tjuta, Norfolk Island and Christmas Island national parks. Other authorities have been established by the Australian Government to manage water resources in the Murray–Darling Basin and to protect the Great Barrier Reef.

In addition, the Australian Government funds environmental conservation through the Caring for our Country scheme, which covers the National Reserve System, biodiversity, coastal environments, sustainable land practices, natural resource management and community engagement. The Government also provides funding through the Biodiversity Fund for farmers and other land managers to protect or enhance native vegetation and control invasive pests and weeds.

State and territory governments have primary responsibility for managing most national parks, providing large infrastructure, monitoring pollution and undertaking land-use planning (where this is not delegated to local governments).

In addition, agreements between the Australian, state and territory governments have established 56 natural resource management regions (mostly based on catchment areas or 'bioregions'). Management bodies in each region have responsibilities that cover land-use planning, waterway protection and vegetation management.

Local governments perform a number of functions that can impact the environment, including land-use planning, infrastructure provision, and the management of open spaces and coastal environments. Local governments also implement some Australian, state and territory government environmental legislation.

Voluntary and community-based groups also play an important role. For example, a number of Landcare and Coastcare groups have been established to manage local environments, undertake environmental protection and remediation, and share resources. Some of these groups receive government funding. In addition, Indigenous groups manage environments across large areas of Australia.

Sources: Caring for our Country (2011a, 2011b); Department of Agriculture, Fisheries and Forestry (sub. 68); DSEWPC (2012a); Landcare Australia (2012).

For governments, effectively managing the impacts of climate change on the environment will involve addressing specific barriers to adaptation. Barriers can arise from market failure, regulation or governance (chapter 4), including where:

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- policies and regulations reduce the resilience of natural environments to climate change or discourage conservation activities by landowners and the community
 - private activities have negative spillovers on the environment
 - ‘public goods’, such as information and research, are not adequately provided
 - environmental assets are poorly protected or valued
 - conservation strategies and objectives fail to meet the community’s needs in a changing climate
 - policy frameworks are unresponsive to changing conditions and improved information
 - financial and management resources are not allocated where the environmental benefits are greatest
 - governance and institutional arrangements are fragmented or unclear.

Specific barriers will not always be easy to identify. In some cases a barrier may arise because of a specific regulation imposed by governments, whereas in other cases (such as market failure) it could be the lack of an effective policy response that creates a barrier.

14.3 Supporting adaptive capacity

There is a number of ways in which governments can address barriers to effective adaptation and support the capacity of natural environments to adapt to climate change. Reforms in these areas can also help to build the capacity of environmental managers and communities to deal with a changing climate and ensure that resources are allocated where the environmental payoffs are greatest. In many cases, these will be ‘no regrets’ reforms that have benefits in the current climate.

Reducing pressures on ecosystems

Many ecosystems currently face multiple pressures that cause environmental damage or harm species (box 14.3). While these pressures vary across locations and contexts, many are influenced by government policies and activities. Effectively managing these pressures can maintain or improve the adaptive capacity of the environment.

Box 14.3 **Current pressures on ecosystems**

Many ecosystems currently face multiple pressures that can damage or fragment habitats, disturb species or reduce biodiversity. These can include:

- human settlement and activities, including urban development, grazing and cropping activities, fertiliser use, fire management, water extraction and mining
- pollution from chemicals and waste products (soil, water or air pollution)
- salination of waterways, ground water and soils
- invasive plant and animal species
- overexploitation of natural resources (such as overfishing and overgrazing)
- extreme weather events, including fire, flood and storm surge.

The type and severity of pressures varies across ecosystem types and locations — in some cases, multiple pressures can compound to cause significant harm.

Source: State of the Environment 2011 Committee (2011).

Reducing the pressures that ecosystems and habitats currently face — known as ‘baseline’ pressures — can help to reduce the extent to which these pressures are exacerbated by climate change (Council of Australian Biological Collections, sub. 23; Great Barrier Reef Marine Park Authority, sub. DR92; Kylie Jones, sub. 11; State of the Environment 2011 Committee 2011; Steffen et al. 2009). Improving the general health of ecosystems, habitats and species can also improve their resilience and capacity to adapt to climate-related changes (Director of National Parks, sub. 60).

Environmental management in Australia currently focuses on reducing pressures affecting or threatening environments. For example, this is a key focus of management strategies for most national parks and reserves.

... [T]he best overall approach of addressing climate change is to build the resilience of natural environments so they are in the best position to withstand those existing impacts which may be exacerbated by climate change. (Director of National Parks, sub. 60, p. 5)

This has also been identified as key priority for dealing with climate change in biodiversity conservation (NRMMC 2010).

Inquiry participants identified options for further improving the resilience of ecosystems and species. These include:

- increasing control of invasive species, especially those that may pose increased threats to biodiversity in a changing climate (Invasive Species Council, sub. 37)

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- changing fire-management practices to better align with natural fire patterns (Department of Sustainability, Environment, Water, Population and Communities, sub. 77; Director of National Parks, sub. 60)
 - increasing the connectivity of conservation reserves and wildlife corridors (see below).

Actions to reduce pressures on ecosystems and improve their resilience can have environmental and economic benefits in the current climate, such as tourism opportunities and improvements in the quality and availability of ecosystem services (State of the Environment 2011 Committee 2011). The benefits may increase as the climate changes. However, reducing existing pressures is unlikely to be sufficient to prevent or offset all impacts that climate change may have on environments, and further actions by governments may also be necessary.

Improving environmental information

A barrier to effective adaptation can arise where governments do not provide (or underprovide) environmental research, information and monitoring that benefit the community (chapter 7). Understanding how ecosystems and environments function — and how these are affected by human activities and climate change — allows governments to prioritise environmental activities and consider how decisions might affect the environment as the climate changes (Australian Conservation Foundation, sub. 47; Bureau of Meteorology, sub. DR166; Great Barrier Reef Marine Park Authority, sub. DR92; South East Queensland Catchments, sub. DR114). For example, good information on local biodiversity can help local governments to make decisions affecting coastal land that may be exposed to climate change (such as whether to allow private development, construct physical measures to protect the shoreline, or set land aside for environmental conservation).

At present, governments provide (or have committed to provide) a diverse range of environmental research, information and monitoring (box 14.4). This provides a basis for protecting the most valuable environments and minimising the costs of climate change. Where this information is used for governments' own activities, it should be made publicly available (chapter 7). However, environmental knowledge is not complete — for example, interactions between species within an ecosystem can be complex and difficult to predict over time. Ongoing prioritisation of research efforts and monitoring of environmental conditions can help to ensure that adequate information is available to support adaptation activities.

Box 14.4 Environmental information

Governments have recently taken steps to improve the collection and distribution of environmental information, including information on climate change. For example:

- 'State of the Environment' reports are prepared by Australian, state and territory governments (along with some local governments) on a regular basis
- environmental indicators for some regions and ecosystems are provided in a clear and accessible form — for example, report cards on the Great Barrier Reef (Queensland Government 2011b) and on projected climate change impacts for marine areas (Poloczanska, Hobday and Richardson 2012)
- governments have commissioned assessments of the vulnerability of national reserves, world heritage areas, highly-valued ecosystems and biodiversity to climate change impacts (ANU 2009; Dunlop and Brown 2008; Dunlop et al. 2012; Johnson and Marshall 2007; Steffen et al. 2009; Tasmanian DPIPWE 2010)
- the Bureau of Meteorology (sub. DR166) regularly assesses and reports on the availability, quality and use of water resources, and is working with other organisations to develop monitoring systems and forecasting models for the health of the Great Barrier Reef
- a National Plan for Environmental Information is being developed by the Australian Government to improve the quality and coverage of environmental information — including bringing together information from multiple sources, establishing information standards and providing information services (BOM 2012c; Department of Sustainability, Environment, Water, Population and Communities, sub. 77)
- a system of environmental and economic accounts is being developed by the Australian Bureau of Statistics (based on the United Nations System of Integrated Environmental and Economic Accounting) that will include measures of natural resources, environmental services and waste products over time (ABS 2010).

In addition, some regional natural resource management bodies have been trialling a system for monitoring and reporting the condition of environmental assets (developed by the Wentworth Group) (Cosier and Sbrocchi 2012).

Understanding community values

Barriers to adaptation can also arise where the community's values are not well understood or taken into account in government decision making (for example, when deciding whether to protect a habitat by creating a national park, or whether to allow agriculture or urban development on that land). This could potentially result in tradeoffs being made that leave the community worse off.

A key aspect is valuing environmental services, which have uses beyond economic activities and may not always be well understood. When environmental services are not properly valued, there is a risk that they will be over used or inadequately

protected. Inquiry participants emphasised the benefits of better valuation of environmental services.

Improved valuation of ecosystem services (including their capacity to ameliorate the socio-economic impacts of climate change) and better understanding of the vulnerability of ecosystem services to climate change would encourage more informed and better targeted decision-making ... (Director of National Parks, sub. 60, p. 9)

Policy interventions to facilitate adaptation could be enhanced by improved recognition and inclusion of the value of ecosystem services ... and further understanding of the vulnerability of ecosystem services to climate change. (Department of Sustainability, Environment, Water, Population and Communities, sub. 77, p. 13)

However, values relating to the environment can be complex, and encompass economic, amenity, leisure and existence values. They can also vary across people and locations, and change over time. These values are difficult to quantify, not least because many environmental features and services (such as clean air and biodiversity) are not traded on markets.

There is no easy way to place a dollar value on every natural resource, or to fully understand how every segment of the community values each possible environmental outcome. Techniques such as stated and revealed preference methods can sometimes help (Land and Water Australia 2005; PC 2006d). In many cases, a qualitative understanding of how people value environmental services and resources — drawing on the community's views and preferences — can inform decisions about environmental management and policy objectives, and improve how resources are allocated to meet these.

Using flexible policy frameworks

Policy frameworks that allow for flexible environmental management will be important in a changing climate. Barriers to effective adaptation can arise where policy frameworks are unresponsive to changing circumstances — for example, where the impacts of environmental policies are not properly evaluated, where bans on clearing native vegetation compromise landowners' efforts to manage pests and weeds, or where policy objectives become out of date.

In essence, environmental management is flexible when strategies and priorities can be quickly adjusted as circumstances change, or as better information becomes available. Flexibility can be used to prepare for a range of potential future scenarios, and to incorporate a consideration of climate change impacts into environmental policy and management frameworks (including biodiversity conservation). Flexibility can be of significant value when the impacts of climate change on

specific environments are poorly understood or uncertain, or if it becomes likely that ecological ‘tipping points’ will soon be reached.

Several approaches are available to help environmental managers deal with changing conditions and uncertainty. One widely-used technique is adaptive management, which involves drawing on research, monitoring and evaluation to improve the effectiveness of environmental management (Hughes et al. 2011; Stankey and Allan 2009). A variant, ‘active’ adaptive management, involves the use of targeted experiments and interventions to gather information about how effective these interventions are, allowing management activities to be revised (Hughes et al. 2011). Such approaches can also incorporate ‘real options’ strategies and scenario planning (chapter 5) to prepare for and manage sudden changes or unexpected events (for example, by protecting multiple habitat types when it is uncertain how a species will adapt to climate change).

Inquiry participants identified flexibility, including adaptive management, as an important strategy for dealing with the uncertainties involved with climate change. For example:

We need to prepare for these [climate change] impacts by ensuring policies, institutions and management approaches are flexible and able to deal with the uncertainty posed by a changing climate. (Wentworth Group of Concerned Scientists, sub. 4, p. 1)

In the absence of robust, definitive and location-specific research, a risk management approach needs to be taken supporting dynamic and adaptive reserve management. (Director of National Parks, sub. 60, p. 8)

However, adaptive management will not be the best approach in every case. For example, when there is a risk that some activities could lead immediately to serious or irreversible environmental harm, more rigid approaches to prevent this harm may be needed (Queensland Murray–Darling Committee, sub. DR124). Adaptive management may offer limited value if data from monitoring activities quickly become out of date (Dunlop and Brown 2008), complexities in ecosystems make data difficult to interpret, or effective management approaches are known and well understood.

Flexibility can also be embedded in policy frameworks by using instruments that are responsive to changing conditions and impose the least costs on the community to meet environmental objectives. Market-based instruments will sometimes be appropriate (box 14.5). These can facilitate effective adaptation by improving how biodiversity and economic resources are valued, and by signalling changes in the scarcity of natural resources (Agrawala and Fankhauser 2008; NRMCC 2010). For example, market instruments may offer flexible and low-cost ways to manage environmental water flows in a changing climate (box 14.6).

Box 14.5 Types of environmental policy instrument

Market-based instruments

Market-based instruments can involve changing market prices and quantities, improving how markets function or creating markets where none currently exist. This might include defining property rights to facilitate trade or providing financial incentives, such as taxes and subsidies. Examples include the system of tradable water entitlements in the Murray–Darling river system (where limits are set on the total amount of water that can be extracted for irrigation) and the Bush Tender system in Victoria (where competitive tendering is used to fund the protection of native vegetation on private land).

Regulation

In some cases, regulations can be used to prohibit or limit activities that have negative impacts on the environment. This can be efficient when there is a significant risk that those impacts will cause irreversible damage. For example, regulations are used to control the clearing of native vegetation, the use of pesticides and herbicides that may run off into the Great Barrier Reef, and the uses of different parcels of land.

Voluntary approaches

Voluntary and community-based approaches are sometimes used to manage natural resources or undertake conservation activities. For example, many farmers and Indigenous groups regenerate native vegetation or control invasive species, and a number of Landcare and Coastcare groups (involving landowners, farmers, government agencies and volunteers) work to improve environmental outcomes. Further, regional natural resource management bodies in all states draw on community input to undertake floodplain and water management. Governments sometimes support such arrangements through funding or legislative backing.

However, market-based approaches may not be viable in all cases — for example, where property rights are difficult to define or enforce, or where outcomes are difficult to measure (Murtough, Aretino and Matysek 2002). In these cases, regulatory and voluntary approaches may be more effective. For example, regulations might be used to limit activities that pose significant risks of irreversible environmental damage (such as regulations on agricultural runoff to protect the Great Barrier Reef (GBRMPA 2009)). Voluntary and community-based approaches can be used to draw on community resources and address local priorities, and in some cases can be a more effective way to manage natural resources (Dietz, Ostrom and Stern 2003).

Box 14.6 Flexible environmental water management

Governments and river management bodies throughout Australia ensure that adequate water is available to meet environmental objectives, such as maintaining the health of wetlands and other ecosystems. However, climate change means that future water availability in many regions is uncertain (NWC 2012).

Studies have identified flexible approaches that may help to manage water resources and meet environmental objectives in a changing climate.

- Purchasing water entitlements on water markets can be a cost-effective way to recover water for the environment (compared to alternative options such as regulation or subsidising water-saving infrastructure) (PC 2006c, 2010b). This can be done flexibly by using legal entities that can buy, sell and hold water permits for environmental purposes (such as the Commonwealth Environmental Water Holder for the Murray–Darling Basin) without compromising the property rights of water permit holders (NWC 2012).
- Short-term environmental water needs can be met flexibly using various water trading instruments to respond to changing conditions and to make contingency plans for unexpected outcomes. This could involve, for example, purchasing seasonal allocations, options contracts or leases (Commonwealth Environmental Water 2011; PC 2010b). ‘Real options’ approaches (chapter 5) can also be used to identify options for meeting environmental objectives when forecast water-availability scenarios do not arise (Beare and Page 2010).

As the climate changes, water managers may need to prioritise high-value environmental uses of water (for example, when there is a risk that crossing an ecological threshold could irreversibly harm an ecosystem) (NWC 2012). There may also be a need to review specific environmental policy objectives to ensure that water resources are allocated to the uses most valued by the community (for example, to support specific ecosystems or for other activities such as agriculture). Ongoing community consultation will be a key part of making these difficult decisions.

Overall, it will be important to establish frameworks for environmental management that provide scope for a range of approaches and allow priorities and strategies to be adjusted over time as necessary. Such frameworks would also need to draw on available information and research to prioritise interventions where the environmental risks are greatest. Monitoring and evaluating outcomes will play an important role, regardless of the specific management strategies adopted.

Reviewing approaches for biodiversity conservation

Australia’s biodiversity could be significantly affected by changes in the distribution of species and habitats due to climate change (Australian Conservation Foundation, sub. 47; CSIRO, sub. DR136; Department of Sustainability, Environment, Water, Population and Communities, sub. 77; Director of National

Parks, sub. 60; Invasive Species Council, sub. 37). Where current approaches used by governments to conserve biodiversity become less effective due to climate change, policy or regulatory barriers to effective adaptation may be present.

There may be a need to review — and, if necessary, change — approaches used to conserve biodiversity as the climate changes. This can include changes to broad policy objectives, or to the mix of strategies and activities used to meet those objectives (box 14.7).

Box 14.7 Approaches for managing biodiversity

Governments use a range of approaches to manage biodiversity. These include setting aside land and sea areas for conservation purposes, facilitating conservation activities by private landowners, and preserving species outside their natural habitats.

Conservation reserves

A large area of land is used to meet environmental objectives, including national parks, Indigenous Protected Areas and local conservation areas. Other land also supports habitats and species, such as privately-owned farmland, remnant forests and land owned by the Department of Defence.

The National Reserve System and Marine Protected Areas set aside large areas of land and sea for conservation purposes. For example, the National Reserve System consists of over 9400 land parcels covering around 14 per cent of the Australian land mass. It includes national parks, Indigenous Protected Areas and some private land.

The overriding objective of this system is to achieve the long-term conservation of nature and the ecosystem services and cultural values it provides. Reserve areas are selected on the basis of contributing to the system's overall:

- comprehensiveness — by including examples of regional-scale ecosystems
- adequacy — by including ecosystems in ways that ensure ecological viability and maintain the integrity of populations and species
- representativeness — by conserving genetic diversity and habitat variability.

Wildlife corridors

Wildlife corridors consist of natural connections across landscapes, such as remnant forests, waterways, conservation reserves and patches of vegetation. These can facilitate the movement of species as they adapt to climate change, and can help landscapes to maintain ecological functions that improve the resilience of ecosystems to pressures (including climate change).

(Continued next page)

Box 14.7 (continued)

The Australian Government has released a draft National Wildlife Corridors Plan that proposes a national corridor system based on existing corridors established by state governments and others. This aims to improve connectivity between landscapes at continental, regional and local scales, and will involve collaboration between governments, regional bodies, Indigenous groups, community groups and landowners.

Private land management

Governments encourage private landowners to contribute to biodiversity in a number of ways. These include payments (or tax concessions) for maintaining native vegetation, wetlands or other environmental assets, and voluntary agreements with landowners to set aside land for conservation. Governments also limit or regulate how land may be used when there are spillover impacts on the environment (for example, by placing covenants on land use or requiring environmental impact assessments).

In addition, governments have provided funding and support to voluntary and community-based groups that undertake activities to conserve biodiversity. This includes funding provided through the Caring for our Country scheme and the Biodiversity Fund, along with support for Landcare and Coastcare groups and non-profit organisations such as Bush Heritage Australia and Australian Wildlife Conservancy.

***Ex situ* approaches**

Ex situ ('off site') approaches are used to conserve highly-valued and endangered species outside their natural habitats. These approaches include botanic gardens, zoos and seedbanks, which also undertake important biological research.

Sources: Director of National Parks (sub. 60); DSEWPC (2012b, 2012c); National Wildlife Corridors Plan Advisory Group (2012).

For example, the National Reserve System can help animal and plant species adapt to climate change (Department of Sustainability, Environment, Water, Population and Communities, sub. 77), and is likely to remain representative of the mix of habitats across Australia, even if significant climate change occurs (Dunlop et al. 2012). However, this system — which is based on fixed land boundaries — may not be sufficiently flexible to allow some species to adapt (Director of National Parks, sub. 60, p. 7). There may be scope to modify how land is selected or managed to improve the overall comprehensiveness, adequacy and representativeness of the National Reserve System. Options include adjusting the criteria used to select new reserves, changing the boundaries of some existing reserves, or selling land that no longer offers high conservation value (Director of National Parks, sub. 60). Similar challenges may also be faced in the management of the National Representative System of Marine Protected Areas. However, the value of these approaches can sometimes be limited — for example, where

amending reserve boundaries is expensive or impractical because of natural boundaries or neighbouring land uses.

In some cases, wildlife corridors that connect conservation reserves and other habitats might be a more effective strategy. However, the benefits need to be weighed up against the costs in each case. Costs can arise when land cannot be used for economic activities, or the rights of landholders are compromised (National Farmers' Federation, sub. DR153). Further, the environmental benefits may be limited when improved connectivity also facilitates the spread of weeds, diseases or fire (Hughes et al. 2011). It might sometimes be more effective to focus on improving the health of current habitats and protecting these in isolation (including habitats that could act as 'refuges', or environments where intervention is likely to be most effective) (Dunlop et al. 2012).

More broadly, conservation objectives may need to be adjusted to ensure they remain appropriate in a changing climate. Some objectives may become increasingly difficult to meet in a changing climate, or no longer reflect community values. For example, an objective to preserve a particular species in a specific habitat may not be effective if that species needs to migrate as conditions change (CSIRO, sub. DR136; Northern Grampians Shire Council, sub. DR101; Steffen et al. 2009). Such an objective would also be inappropriate if preserving that species becomes prohibitively expensive (for example, if there is already a high likelihood of extinction) and available resources could be used more effectively to support other environmental outcomes the community values more highly.

Several options have been put forward for how objectives might be revised, including:

- focusing on maintaining ecosystem processes and functions at a landscape or regional scale rather than conserving individual species in a given location (Steffen et al. 2009)
- managing environments to minimise the loss of biodiversity and maintain evolutionary processes and ecosystem functions (Hughes et al. 2011)
- minimising ecological losses by facilitating natural change by species and ecosystems (Dunlop and Brown 2008)
- protecting plant and animal species that are highly valued by the community (Prober and Dunlop 2011).

Governments may thus need to review strategies and objectives for biodiversity conservation and related environmental policies, such as the management of environmental water flows, definition of invasive species, or protection of threatened species (CSIRO, sub. DR136; Hughes et al. 2011; NWC 2012; Prober

and Dunlop 2011). It will also be important to address regulatory barriers to private conservation, such as regulations that discourage landowners from retaining or caring for native vegetation, or from effectively removing weeds and pests (PC 2004b).

The most effective approaches (or mix of approaches) are likely to vary across geographic areas and over time. This means that ongoing consultation with landowners, Indigenous groups and the broader community will be necessary to draw on local expertise and values, and to identify environmental and economic tradeoffs. Cooperation across levels of government will also be required in many cases.

Adopting good governance

Good governance is a cornerstone of effective environmental management, and will be fundamental for managing the environment in a changing climate. (Principles of good governance are outlined in chapter 4.) Barriers to adaptation may arise where environmental responsibilities are not clearly allocated, or where regulations and management activities conflict or overlap.

In many cases, existing policy frameworks, strategies and institutional arrangements will be best placed to adjust priorities and activities to manage climate change risks. This means that consideration of climate change may need to be ‘embedded’ in these arrangements.

It will also be important to ensure that responsibilities are clear and appropriately assigned. In many cases, local or regional approaches may be the most effective way to manage local environmental outcomes and foster community involvement. Sometimes a broader level of governance may be necessary — such as strategic oversight or coordination at the national or state level — where there are complex interactions between ecosystems or there are wider community benefits (for example, legislative protection of world heritage areas). Allocating and clarifying responsibilities is likely to require cooperation between levels of government, landowners, Indigenous groups and the broader community.

15 The health system

Key points

- Climate change is likely to affect human health both physically and mentally through extreme weather events (such as heatwaves) as well as more gradual changes (such as changes in the geographic distribution of vector-borne diseases).
- These impacts may add to the pressures faced by governments in providing health services.
- The Commission has received little information on specific policy and regulatory barriers to adaptation by health services.
- However, it will be important to ensure that the health sector is aware of climate change risks and has the capacity to prepare for and respond to the challenges of climate change.
 - This requires ongoing monitoring of public health, and evaluating and reviewing strategies to deal with heatwaves and disease outbreaks.
- In many cases, incremental adjustments to existing arrangements will be an important part of ensuring that health services can meet the changing needs of the community over time.
 - Reforms should only proceed where the benefits to the community are likely to exceed the costs.
- Overall, an appropriately-resourced and flexible health system would be well placed to manage the impacts of climate change.

Climate change is likely to have a range of effects on human health, arising from extreme weather events and gradual changes in temperature, rainfall and other climatic factors (box 15.1). These may include an increase in the number of heat-related deaths, greater incidence of vector-borne diseases in some parts of Australia, or increased mental health problems as people cope with droughts or floods. There will also be economic consequences, such as lower worker productivity during heatwaves or increased days off work due to illness.

The effects will be felt disproportionately by some groups. For example, children, the elderly, people that already have an illness, people of low socio-economic status, those living in rural or remote areas, and remote Indigenous communities are especially vulnerable to the health impacts of climate change (Bambrick et al. 2011; Bi et al. 2011; Climate Commission 2011b).

Climate change will pose challenges for the health system. For example, its impacts may increase demand for ambulance services, doctors, hospitals, disease prevention, pharmaceuticals and mental health services. This could have implications for all levels of government — for example, the Australian Government in providing and/or funding aged care and medical research; state and territory governments in providing public hospitals; and local governments in providing some healthcare facilities, responding to heatwaves and managing water supplies.

Box 15.1 **Climate change and human health**

Changing patterns of temperature and rainfall in Australia — along with changes in weather variability and the frequency or severity of extreme weather events — could affect human health. Impacts could arise directly (such as injury or death from a bushfire or flood), or indirectly (such as altered disease patterns as climate change affects ecological, biological or social systems) (NCCARF 2009). Impacts could also vary depending on the characteristics of regions and populations (Bell 2011).

There are several potential impacts.

- Extreme weather events — such as heatwaves, droughts, bushfires, cyclones and flash floods — could lead to increased injury, death or mental health problems (such as depression, stress or anxiety). In particular, the number of heat-related deaths is likely to increase (well in excess of any reduction in cold-related deaths). Extreme weather events could also exacerbate existing health conditions, such as cardiovascular and respiratory problems.
- Gradual changes could occur in the incidence, geographic range, seasonality and/or timing of disease and illness.
 - For example, there could be a southward extension (or longer seasons) of suitable conditions for vector-borne diseases — such as the Ross River, dengue or Barmah forest viruses — as breeding patterns and distributions of vector species (such as mosquitoes) change.
 - Patterns of gastrointestinal diseases could also change as a result of increased food contamination (due to warmer temperatures) or water contamination (for example, due to increased algal growth or flooding and runoff).
 - Respiratory problems could be exacerbated by changes in air quality — for example, due to increased smog on hot days, changed distributions of plant allergens, or higher levels of wind-borne particulates during bushfires or droughts.

More broadly, mental health may be affected by climate-related changes in economic, social and environmental conditions (including changes that occur as people and environments adapt to climate change).

Sources: Australian Psychological Society (sub. DR87); Bambrick et al. (2008); Bell (2011); Bi et al. (2011); Blashki et al. (2011); Climate Commission (2011b); Fritze et al. (2008); Harley et al. (2011); McMichael et al. (2003); NCCARF (2009); PWC (2011); WA Department of Health (2008).

15.1 Effective adaptation in the health system

Climate change adds to the pressures that governments already face in providing or funding health services, such as population ageing, changing patterns of disease and disability, and increasing costs of medicines and treatments. The impacts of climate change could affect the degree to which governments can meet health policy objectives, such as equitable access to healthcare and reducing the spread of disease.

The Commission has received little detailed information on specific policy or regulatory barriers to adaptation by health services. Some participants submitted that there may be a need to clarify the roles and responsibilities of health service providers and other bodies, such as emergency services (chapter 13) and local governments (Northern Grampians Shire Council, sub. DR101). Others noted that the risks climate change poses for health services may need more detailed assessment, with health professionals made aware of these risks (Climate and Health Alliance, sub. DR109).

Specific actions to adapt health services to climate change have been proposed by researchers and governments (box 15.2). These would mostly involve adjusting existing areas of health and emergency-service provision, or ensuring that climate change impacts on human health are considered in a broad range of policy decisions. In cases where specific reforms may be justified to deal with climate change, these will need to be evaluated on a case-by-case basis to assess whether the benefits to the community as a whole outweigh the costs.

One specific challenge of climate change is more prevalent heatwaves, which are likely to affect many parts of the health and aged-care systems (box 15.3). These systems and their workforces already deal with heatwaves across most of Australia, and it will be important to ensure they have the capacity to deal with changing heatwave patterns. This may require changes to health-service planning and resourcing, or improved coordination among relevant organisations and care providers. For example, developing or reviewing heatwave plans and early-warning systems will be important to help health and aged-care service providers manage the impacts of heatwaves.

Box 15.2 Examples of proposed adaptation responses

Actions have been proposed to help manage the health impacts of climate change. These include:

- educating and training the health workforce to ensure they are aware of the health impacts of climate change and are able to respond to these impacts (including heatwaves, disease outbreaks, high air-pollution days and mental health incidents)
- ensuring that health facilities and emergency services have adequate plans, capacity, communication systems, equipment and back-up systems to manage climate change impacts
- monitoring disease patterns and environmental conditions (such as air quality and vector populations)
- implementing or strengthening early-warning and communication systems
- undertaking vector-control activities (such as draining mosquito breeding sites)
- providing mental health support and counselling to people affected by climate change impacts
- engaging with the community to raise awareness of the health risks of climate change and options to manage these
- developing Occupational Health and Safety guidelines to manage the impact of heatwaves on outdoor workforces
- evaluating the health impacts of climate change in planning, building, environmental, emergency management, infrastructure and other decisions
- improving communication between health professionals, government agencies, emergency services, researchers and others
- researching and forecasting potential climate change impacts, their likely geographical incidence and the implications for health
- evaluating and reviewing early-warning systems, public health programs and educational material.

Some specific strategies have been devised to respond to the health challenges of climate change. For example, the Southern Grampians and Glenelg Primary Care Partnership (a collaboration between healthcare providers, governments and others in south-west Victoria) has developed a plan to facilitate adaptation by health service providers across the region (Rowe and Thomas 2008).

Sources: Bambrick et al. (2011); Blashki et al. (2010, 2011); Climate and Health Alliance (sub. DR109); Climate Commission (2011b); COAG (2007b); Kjellstrom and Weaver (2009); National Centre for Epidemiology and Population Health (sub. DR112); WA Department of Health (2008).

Box 15.3 Planning for heatwaves

A heatwave is a period of abnormally hot weather, with specific temperature thresholds for what represents abnormally hot weather varying across districts or areas. There is high scientific confidence in projections of more heatwaves in many parts of Australia as the climate changes (chapter 2).

More prevalent heatwaves could result in greater numbers of heat-related illnesses and deaths, especially for the elderly and people with existing medical conditions (Bi et al. 2011; PWC 2011). There is evidence that illness and death can increase rapidly above particular temperature thresholds (Bambrick et al. 2008). Heatwaves could also have significant economic impacts by reducing the amount or type of work that people can do outdoors or in places without air conditioning (Hanna et al. 2011; National Centre for Epidemiology and Population Health, sub. DR112).

Coping with heatwaves will require actions across many parts of government and the community. For example, heatwaves increase pressures on emergency services, hospitals, aged-care facilities, local governments and community organisations (Bi et al. 2011; Municipal Association of Victoria, sub. 79; PWC 2011).

Some state (and local) governments have developed plans to prepare for and respond to heatwaves — including New South Wales, Victoria and Queensland (NSW Government 2011b; Queensland Health 2004; Victorian Department of Health 2011). These plans typically specify when a heatwave will be declared (that is, temperature thresholds), early-warning procedures, awareness-raising activities and response strategies (for example, checking on vulnerable people in the community). The plans also set out roles and responsibilities for government agencies, local governments, emergency services, health service providers and others.

Clear information will also be important for managing heatwaves and alerting the community. Forecasts and warnings of heatwaves (for example, issued by the Bureau of Meteorology) can help governments and communities to prepare (Municipal Association of Victoria, sub. 79; Prof Neville Nicholls, sub. 9).

Governments may also need to respond to changing patterns of vector-borne and infectious diseases. These changes may increase pressures on existing monitoring activities, early-warning systems (including the National Notifiable Diseases Surveillance Scheme), and vector-control activities (such as mosquito eradication by local governments). These activities can be strengthened through flexible responses to changes in disease patterns, along with regular evaluation of how successful these responses are (Blashki et al. 2011; Harley et al. 2011). Providing information and guidance to households to facilitate disease-prevention efforts will also be important.

Maintaining a flexible and appropriately-resourced health system

In many cases, incremental adjustments to existing arrangements will be an important part of ensuring that health services can meet the changing needs of the community over time and deal with new challenges as they arise — whether due to climate change or other pressures that the health system faces. In particular, it will be important to appropriately evaluate and review health service provision, funding levels, planning and prevention strategies to ensure that health services are meeting policy objectives and can manage the health impacts of climate change. Reforms should only proceed where the benefits to the community are likely to exceed the costs.

A range of decisions in broader policy areas will also have consequences for human health, such as land-use planning, building regulation and environmental management. Some of these health impacts might be affected by climate change, or by actions taken to adapt to climate change. As such, there may be scope to consider climate change in health impact assessments when making policy decisions that could pose significant risks to human health (Climate and Health Alliance, sub. DR109).

In addition, ongoing research will play a crucial role in understanding and managing the health impacts of climate change, as emphasised by inquiry participants (Climate and Health Alliance, sub. DR109; National Centre for Epidemiology and Population Health, sub. DR112; National Climate Change Adaptation Research Facility, sub. DR118). This might include research on how climate change can affect human health and ways to manage these impacts. Governments can support this research by providing appropriate funding where there are widespread benefits for the community (chapter 7).

Overall, the ability of the health system to prepare for and respond to the impacts of climate change will depend on the quality, capacity and flexibility of health services. In the Commission's view, an appropriately-resourced and flexible health system would be well placed to respond effectively to climate change impacts and meet public health objectives efficiently, without imposing excessive burdens on the community.

16 The role of insurance

Key points

- Insurance can help people to manage risks. The price and availability of insurance provide incentives to reduce exposure to risk and adapt to climate change.
- However, climate change may affect how insurance is provided and lead to higher premiums, or reduced availability of insurance, for some types of hazard.
- Concerns have arisen about the uptake of insurance by households, its affordability, and its availability for some types of hazard (such as flood and gradual processes of erosion and sea-level rise). Increased risk of extreme weather events due to climate change may escalate these concerns.
- Overall, there appear to be few barriers to the Australian insurance market facilitating effective adaptation to climate change.
 - However, state insurance taxes and levies are inefficient. These should be phased out and replaced with less distortionary taxes.
- Other regulations or government policies may have implications for the cost, uptake and provision of insurance.
 - Governments can provide disaster-mitigation infrastructure and information on natural hazards where the benefits to the community exceed the costs.
 - Planning and building regulations affect the community's exposure to risk and how insurers price that risk.
 - Government assistance after disasters may affect the uptake of insurance, although there is insufficient evidence to support or counter such claims.
- Reforms to address barriers to adaptation in these areas could improve the uptake and affordability of insurance across households and businesses, and strengthen the role of insurance in facilitating effective adaptation to climate change.
- The Australian Government has recently enacted or proposed several reforms to insurance regulations.
 - Insurers could be required to offer flood cover to all households, while allowing consumers to 'opt out'. This reform should only proceed if it can be demonstrated that it would bring net benefits to the wider community.
 - Subsidies for insurance would distort risk management decisions and impose costs on the wider community, and should not be pursued.
 - Other reforms to improve disclosure in insurance contracts may have some benefits and modest costs. Reviews should be scheduled to occur after these reforms are implemented to assess whether policy objectives are being met.

16.1 Insurance in a changing climate

Insurance can help households, businesses and governments to manage risk. It offers financial protection from a number of hazards — such as fire, wind, hail and flood — that can be costly for the community and may become more frequent and/or severe due to climate change. Insurance markets do this by pooling risks and paying policyholders when they suffer a loss (box 16.1).

Insurance provides incentives that can facilitate adaptation to climate change. In principle, the premium that a policyholder pays is proportional to the chance of the policyholder experiencing a loss and the expected size of any loss. This premium gives the policyholder an incentive to reduce their exposure to risk. For example, they might invest in a measure to make their house more resistant to wind damage, or relocate to an area less prone to bushfire. In addition, insurance can be difficult to obtain for some kinds of risks. This provides an incentive to reduce exposure to those risks.

In responding to these incentives, households, businesses and governments can make decisions that reduce their exposure to risks and adapt to climate change. While these responses can be costly, they can reduce insurance premiums and the overall costs of disasters. Many remaining or ‘residual’ risks that cannot be avoided can then be pooled and managed through insurance.

Box 16.1 How insurance works

Insurance is the pooling of risks

An insurance contract generally involves a policyholder making a payment (premium) to an insurer. In return, the insurer covers the policyholder for losses that occur following an agreed event (such as fire or storm damage). This benefits policyholders that prefer to pay a small, certain cost (the premium) to avoid a large, uncertain loss. When insurers can accumulate a larger pool of premiums from many customers facing unrelated risks, claims on the pool can become more manageable.

Premiums are based on risk

Insurance premiums are generally set in line with the degree of risk that a policyholder faces. This involves calculating an ‘actuarially fair’ base premium — essentially, the expected size of a loss multiplied by the probability of it occurring over the length of the insurance contract. This gives policyholders an incentive to reduce the risks that they face. (A margin is also added to the base premium to cover administrative, capital and tax-related costs.)

(Continued next page)

Box 16.1 (continued)

Only some risks are insurable

Insurance is generally only offered if the insurer can reasonably estimate the probability of a loss, there is a degree of randomness or chance, the risk can be diversified by the insurer (by offsetting it against unrelated risks faced by other policyholders), and the policyholder is willing to pay the premium charged (Berliner 1982; Charpentier 2008; Faure 1995). As few risks meet these criteria perfectly, whether insurance is provided for a given risk will depend on the circumstances. For example, when there is a chance of widespread losses across many policyholders from a single event (such as a cyclone or flood), insurers may not be willing to offer insurance if they might suffer significant losses themselves. However, an insurer may be able to offer cover if they can set aside extra capital, pool the risks with enough other unrelated risks (say, risks in a different region or those unrelated to environmental hazards), or purchase their own insurance cover through 'reinsurance' arrangements.

Information is essential for properly pricing risks

Setting premiums that accurately reflect the true risks requires reliable information (such as historical data, projections of future hazards or details of policyholders' property). Where information is poor or lacking, there can be market failures or insurance might not be provided. If an insurer cannot distinguish between high and low-risk customers and charges both the same premium, low-risk customers may choose not to insure, leaving the insurer with high-risk customers and potentially large claims — a problem of 'adverse selection' (Faure 1995). 'Moral hazard' arises when policyholders are less inclined to reduce their risks because they have insurance, but the insurer cannot observe their actions and increase the premium to reflect the higher risk the insurer faces as a result.

Insurance markets can overcome information problems

Insurance markets have developed ways to address problems that arise when policyholders have better information than the insurer. For example, insurers might distinguish between high and low-risk policyholders by offering discounts to those that do not make claims ('no claim bonuses') or limiting the amount they will pay out following some types of event, such as flood ('sub-limits'). In addition, insurers can improve policyholders' incentives to reduce risks by setting an 'excess' or 'deductible' amount that the policyholder must bear themselves when making a claim.

Sources: Berliner (1982); Charpentier (2008); Faure (1995).

Climate change could affect how insurance is provided

Climate change could have a number of effects on insurance markets. For example:

- changes in the types of natural hazards or level of risk faced by the community could increase demand for insurance
- more frequent or severe extreme weather events could lead to larger, and more variable, insurance payouts
- losses might become more correlated across geographic areas, or affect a larger portion of policyholders, making it more difficult for insurers to diversify risks
- changes in climatic trends could mean that historical data become less useful for estimating the risks that policyholders face, and insurers may need to rely more on climate projections and models (Charpentier 2008; Hecht 2008; Mills 2005).

These factors could affect the provision and cost of insurance. If losses become larger — or more volatile, frequent or uncertain — insurers may need to set aside more capital or purchase more reinsurance to ensure they can pay claims and remain solvent (Hecht 2008; Kunreuther and Michel-Kerjan 2009). Even for a given underlying level of risk, greater uncertainty or less reliable information can make it more difficult for insurers to estimate that level of risk (Agrawala and Fankhauser 2008; Tooth 2011). This could also raise the cost of insurance.

As these pressures build over time, insurers could respond in several ways. For example, they might charge higher premiums in particular areas that face increasing risks of bushfire or cyclone. Alternatively, they might set higher excess amounts in insurance contracts to limit their exposure to hazards, or even withdraw cover for particular hazards (or in some high-risk geographic areas) if capital and reinsurance costs become too high (Kunreuther and Michel-Kerjan 2009). Further, opportunities could arise for insurers to provide different insurance products (box 16.2), expand cover in some markets or educate the community about preventing losses.

Many of these changes may be extensions of how insurers currently deal with climate variability. Insurers set different premiums across geographic areas based on the types of hazards and degree of risk properties are exposed to. After a large disaster, insurers sometimes reassess their estimates of the underlying risks, which can sometimes lead to higher premiums (or cover being withdrawn). There is evidence that this occurred following recent floods and cyclones (SCSPLA 2012b; Suncorp Group, sub. DR127), and that global reinsurers have increased their ‘risk ratings’ for Australia, leading to higher reinsurance costs (Institute of Actuaries of Australia 2011b; Insurance Council of Australia, sub. DR132; SCSPLA 2012b). However, research to date suggests that there is no clear link between overall losses from extreme weather events and climate change (Risk Frontiers, sub. DR168).

Box 16.2 Insurance products for climate-related risks

Parametric and index-based insurance

Under a parametric or index-based insurance contract, the policyholder pays a premium and the insurer agrees to make a pre-defined payout when a 'trigger' is reached (such as a set level of rainfall or the number of days exceeding a given temperature) (IMF 2008). The trigger is not based directly on actions or losses of the policyholder. This can reduce information problems and transaction costs by making it relatively easy to determine when a payout should be made and the size of the payout (Economics of Climate Adaptation Working Group 2009). However, the policyholder will not be covered if the trigger is not reached, and thus may bear more risk (or loss) themselves. Parametric insurance products such as 'weather derivatives' are being increasingly used in some parts of the world to insure agricultural activities where specific actions and/or losses of policyholders have been difficult or costly to monitor (Agrawala and Fankhauser 2008).

Catastrophe bonds

Catastrophe bonds are a financial product where a purchaser (such as a large investor) provides capital and an issuer (such as an insurer or reinsurer) pays interest. Should a pre-defined event occur — such as a large cyclone or earthquake — the purchaser forfeits some or all of the capital and/or interest to the issuer (Agrawala and Fankhauser 2008). Catastrophe bonds can draw on the resources of capital markets once a disaster occurs (Michel-Kerjan and Morlaye 2008), and can be provided in several forms, such as indemnity insurance (based on actual losses), parametric insurance (based on an independent trigger), or linked to total insurance industry losses (OECD 2011b). While there has been little use of catastrophe bonds in Australia, internationally their use has been increasing (IMF 2008; OECD 2011b). Well-known examples include the Caribbean Catastrophe Risk Insurance Facility run by several Caribbean governments, and US insurers' use of catastrophe bonds to cover cyclones.

Multi-peril crop insurance

Insurance products could be developed to insure against hazards that have historically been difficult to cover. For example, most Australian insurers have never offered 'multi-peril' crop insurance (insurance that covers all or most weather-related events that could damage crop yields, usually provided on an indemnity basis). This has been due to information problems, highly correlated risks and the way governments have provided drought support (Keogh, Granger and Middleton 2011; PC 2009). At present, a related product is being trialled in Western Australia (Western Australian Farmers Federation, sub. 26) through a mutualised arrangement that is exempt from some insurance regulations (Keogh, Granger and Middleton 2011). In other cases, multi-peril crop insurance may not be viable without government subsidies (National Farmers' Federation, sub. 76).

The Australian insurance market

The insurance products most directly related to climate change adaptation are building and contents insurance for households, and business interruption and property insurance for businesses (some other kinds of insurance could also facilitate adaptation, such as insurance of government assets). Historically, many of the most expensive insurance claims in Australia have been weather related — mainly from cyclones, hail, storms, floods and bushfires (Attorney-General’s Department 2012b). For example, insurance payouts (across all types of insurance product) were around \$1.1 billion for the Victorian bushfires in 2009 and approximately \$2.4 billion (to date) for the 2011 Queensland floods (Insurance Council of Australia 2012b). Further, it has been estimated that around half of all property insurance payouts are for weather-related events (Institute of Actuaries of Australia 2011b).

Most building and contents policies provide cover for several kinds of hazard, including theft and damage from fire, wind, hail and stormwater inundation. Only some policies provide cover for riverine flooding and most exclude landslide and ‘actions of the sea’ (usually meaning storm surge and gradual processes such as erosion and sea-level rise). Further, not all households have building or contents insurance, or have insurance that covers all the hazards that they may face or the full cost of replacing their assets (box 16.3).

Box 16.3 Non-insurance and under-insurance for natural hazards

There have been several Australian studies of non-insurance (where insurance is not taken out, or does not cover a relevant hazard such as flooding) and under-insurance (where an insurance policy provides cover for less than the cost of replacing property). There are no regularly-reported data and most studies have drawn on surveys.

- In 2005, it was reported that between 27 and 81 per cent of households were underinsured by 10 per cent or more (compared to rebuilding costs), and that structures destroyed in the 2003 Canberra bushfires were underinsured by an average of 40 per cent of the rebuilding cost (ASIC 2005).
- In 2007, an estimated 4 per cent of owner-occupied households in Australia lacked building insurance, and 12 per cent of owner-occupied and 67 per cent of rental households lacked contents insurance. Non-insurance was found to be greatest for low-income households and among people that were younger, not in full-time employment, born in non-Western countries, or had lower levels of education (Tooth and Barker 2007).

(Continued next page)

Box 16.3 (continued)

- In December 2011, an estimated 9 per cent of house owners did not have both building and contents insurance, and around 39 per cent of households that rented privately or lived in public housing lacked contents insurance — levels similar to those found in a survey 10 years earlier. Further, around a quarter of households had reduced their level of cover (or increased the excess) to reduce the premium (Insurance Australia Group, sub. DR110, att. 1).
- Recently, it has been estimated that 52 per cent of renters lack contents insurance (GIO Insurance 2010) and low-income households are less likely to have contents insurance (Collins 2011). In one survey, 5 per cent of households could not meet their home or contents insurance costs in 2011 (Centre for Social Impact 2012).

These studies have identified the cost of insurance relative to household income and other expenditure as the major reason for non-insurance and under-insurance. Other factors include:

- decisions to self-insure, or not considering insurance to be worthwhile (given the risks faced and potential impact of a loss)
- assumptions that government-provided infrastructure (such as flood barriers) will always prevent damage from natural disasters
- expectations that governments will provide compensation following a disaster
- a lack of trusted information or advice
- difficulty understanding or comparing insurance products
- difficulty estimating the cost of replacing assets
- negative past experiences with insurance claims (such as claims being denied).

Sources: ASIC (2005); Centre for Social Impact (2012); Collins (2011); GIO Insurance (2010); Insurance Australia Group (sub. DR110, att. 1); Insurance Council of Australia (2011); NDIR (2011); Sheehan and Renouf (2006); Tooth and Barker (2007).

Concerns about the uptake and provision of household and small business property insurance in Australia have been raised in recent inquiries (box 16.4). Similar concerns were raised by some participants in this inquiry (Australian Sea Level Rise Partnership, sub. 44; Consumer Action Law Centre, sub. DR131; Ecological Water Solutions, sub. 66; Institute of Actuaries of Australia, sub. 43; Insurance Australia Group, sub. 39, DR110; Insurance Council of Australia, sub. 42, DR132; John Trowbridge, Jim Minto and John Berrill, sub. DR164; Suncorp Group, sub. 28, DR127).

Box 16.4 Recent inquiries covering insurance for natural hazards

The *Victorian Bushfires Royal Commission* (completed July 2010) investigated the cause of the Victorian bushfires of February 2009 and made recommendations on preventing, preparing for, responding to and recovering from bushfires. In relation to insurance, it recommended that the Fire Services Levy charged on building insurance be removed because it is inequitable and reduces the uptake of insurance.

The *Natural Disaster Insurance Review* (completed September 2011) investigated the extent of flood insurance in Australia and problems with claims processing and dispute handling following the Queensland floods of late 2010 and early 2011. It recommended that flood insurance be mandatory in all home building, contents and strata-title policies, and that flood premiums for existing properties that exceed an 'affordability threshold' be discounted for a limited period of time. This would be done through a government-backed reinsurance scheme that underwrites some of the risk.

The *Queensland Floods Commission of Inquiry* (completed March 2012) likewise investigated the Queensland floods and made recommendations covering flood-risk management, land-use planning, emergency response and the performance of insurers. In particular, it recommended that insurers communicate with policyholders more clearly after a disaster to explain why a claim was accepted or rejected.

The *House of Representatives Standing Committee on Social Policy and Legal Affairs* recently investigated claims processing, dispute resolution and strata-title insurance.

- Volume 1 (completed February 2012) recommended amendments to the General Insurance Code of Practice to change claims-handling and dispute-resolution processes, and recommended that insurers be required to offer 'standard cover' policies (that cover flood and 'actions of the sea', and where assets are insured at their full replacement value).
- Volume 2 (completed March 2012) recommended a 12-month moratorium on stamp duty charged by the Queensland Government on strata-title insurance north of the tropic of Capricorn, as well as a review of competition in the strata-title insurance market and a review of factors that have increased premiums recently.

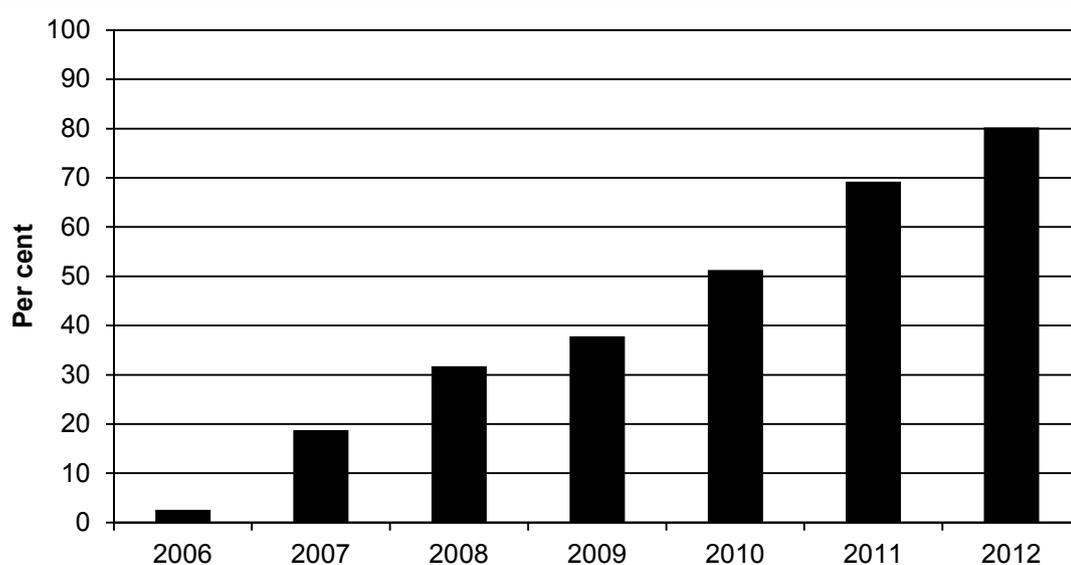
In June 2012, the Australian Government announced that the cause of recent premium increases for strata-title insurance in North Queensland would be investigated by the Australian Government Actuary, with a report to be provided to the Government by 30 September 2012.

Sources: NDIR (2011); Queensland Floods Commission of Inquiry (2012); SCSPLA (2012a, 2012b); Shorten (2012); Victorian Bushfires Royal Commission (2010).

These concerns have mainly centred on the availability, cost and uptake of flood insurance and difficulties that consumers face in understanding insurance contracts. An estimated 7 per cent of residential properties are exposed to the risk of riverine flooding (Insurance Council of Australia 2011, p. 2), with less than 2 per cent of households facing extreme levels of risk (Insurance Council of Australia, trans., p. 19). Flood cover can be very expensive for these households — in some cases,

thousands of dollars a year. Riverine flooding is excluded from some household insurance policies, unlike hazards such as bushfire and storm. While flood cover has increased significantly in recent years — from inclusion in around 3 per cent of household building policies taken out in 2006 to 80 per cent at present (figure 16.1) — many high-risk households choose not to take out flood cover, even when offered it by their insurer (Suncorp Group, trans., p. 106).

Figure 16.1 Household building insurance policies with flood cover



Source: Insurance Council of Australia (pers. comm., 10 September 2012).

In response to these concerns, the Australian Government has recently introduced several reforms (section 16.3). In addition, some insurers have responded to competitive pressures and growing concern about the cost and availability of flood insurance by offering it to more households (in some cases, as an automatic inclusion in all new policies) (Fanning 2012).

16.2 Factors affecting insurance costs and provision

A number of factors affect how insurance markets set and adjust premiums in line with risks — including taxes, planning and building regulations (chapters 9 and 10), and government-provided goods, such as information (chapter 7). These factors can also influence how households, businesses and governments respond to the incentives that insurance premiums and the availability of insurance give them. Where reforms in these areas are justified on the basis of current climate variability, climate change strengthens the case for reform.

Insurance taxes

Taxes make up a significant portion of the cost of insurance to policyholders. Aside from the Goods and Services Tax, insurance is subject to specific state and territory taxes and levies. General insurance tax (transfer or stamp duty) ranges from 7.5 to 11 per cent across jurisdictions (NSW Treasury 2011). In addition to this, New South Wales, Victoria and Tasmania currently impose Fire Services Levies to partly fund fire-fighting services (levied only on commercial property insurance in Tasmania). In total, these taxes and levies amounted to \$5.0 billion in revenue for state and territory governments in 2010-11 (ABS 2012).

The cost to policyholders can be substantial. For example, Suncorp Group (sub. 28) estimated that the combination of insurance taxes and levies (including Goods and Services Tax) adds around 44 per cent to base premiums paid by NSW households for building and contents insurance. Taxes and levies on insurance for small businesses can be even higher.

State and territory insurance taxes and levies can distort the ways that households and businesses manage the risks they face. Some inquiry participants argued that by raising the cost of insurance, these taxes and levies can discourage people from taking out adequate insurance, or from insuring their assets at all (Insurance Australia Group, sub. 39; Insurance Council of Australia, sub. 42; Suncorp Group, sub. 28; Water Services Association of Australia, sub. 52, DR147). For example:

... these taxes can deter individuals and businesses from entering the insurance market or taking out adequate level of insurance to manage climate-related risk effectively. (Australian Chamber of Commerce and Industry, sub. DR102, p. 6)

To the extent that taxes and levies raise the final cost to consumers, it could be reasonably expected that the uptake of insurance would be reduced. While there have been few empirical studies of the impact of insurance taxes, one found that states with higher insurance taxes tend to have higher rates of non-insurance (for household buildings and contents), and that the removal of the Fire Services Levy in Western Australia was associated with reduced levels of non-insurance (Tooth and Barker 2007).

There is growing support for phasing out insurance taxes and levies. The *Australia's Future Tax System* review argued that specific taxes and levies on insurance can raise levels of non-insurance and under-insurance. It recommended removing these taxes and levies and subjecting insurance only to a broad-based consumption tax, such as the Goods and Services Tax (Treasury 2010a). A House of Representatives inquiry found that state insurance taxes have exacerbated premium rises for strata-title insurance in some parts of Queensland (SCSPLA 2012b). Further, the

Victorian Bushfires Royal Commission (2010) criticised insurance levies on equity grounds, arguing that the Victorian Fire Services Levy meant that households that chose not to insure (or that under-insured) did not make a fair contribution to the cost of fire services.

Removing state and territory taxes and levies on general insurance would facilitate effective adaptation to climate change. This reform would improve the affordability of insurance for some households and businesses, and ensure that insurance premiums more closely reflect the level of risk faced. This may also reduce levels of non-insurance and under-insurance.

Some states and territories have already begun to phase out particular insurance taxes or levies.

- Queensland, Western Australia, South Australia and the ACT have already phased out fire services levies and replaced these with charges added to rates notices. Victoria will do likewise by July 2013 (Victorian Department of Treasury and Finance 2012).
- The NSW Government recently commenced public consultation on alternative funding arrangements for emergency services (other than the Emergency Services Levy on insurance contracts) (NSW Government 2012b).
- The ACT Government recently announced that it would phase out duties on general insurance over the next five years, with the revenue impact on the government offset mainly through changes to general rates and land taxes (ACT Government 2012b).

Other state-level taxes, such as property-based charges or land taxes, can be a more efficient revenue base for state governments (chapter 6), and would not discourage the uptake of insurance.

RECOMMENDATION 16.1

State and territory taxes and levies on general insurance constitute a barrier to effective adaptation to climate change. State and territory governments should phase out these taxes and replace them with less distortionary taxes.

Information

Information plays a key role in insurance provision. Reliable estimates of the frequency of natural hazards and the damage caused are essential for accurately assessing and pricing risks. For example, flood insurance has not been widely available in Australia until recently in part because flood maps and elevation

modelling were not available to a sufficient degree of accuracy (Handmer 2002; Mason 2011). In addition, storm surge and coastal erosion are excluded from most insurance policies because the localised impacts are not understood well enough (Mortimer, Bergin and Carter 2011).

Improvements in the quality, extent or availability of information can make insurers more willing to provide cover. By reducing uncertainty, this can lower the cost of doing so. For example, the Insurance Council of Australia (trans., p. 7) noted that a lack of adequate information can lead to high premiums.

Right across Australia we have large areas where we understand there is a flood risk, but we don't have a particular flood map to assess the precise details of that. Underwriters are left with little choice but to prudentially or defensively price those areas because they simply can't put their book at risk of that event.

Reliable information — provided in a suitable form — can also facilitate good risk management and adaptation decisions by households, businesses and local governments. For example, households that are aware of their exposure to particular risks can make decisions about where they live, how they prepare for (or adapt to) hazards, and which insurance products they purchase.

Many insurers collect or purchase information that they need to set premiums and provide cover. For example, the insurance industry has developed a National Flood Information Database that overlays property addresses with known flood risks according to government flood maps (Insurance Council of Australia 2011). The Insurance Council of Australia is working with Climate Risk and other organisations to develop a 'resilience rating system' that can be used to assess the durability of specific buildings to natural hazards, which may allow insurers to match premiums more closely to the risks faced by individual properties (Climate Risk, sub. 38; Insurance Council of Australia, sub. 42, DR132). Further, the Risk Frontiers (sub. DR168) research centre has developed a database of exposure to natural hazards at a property level, which is made available to insurers on a commercial basis. Some insurers also undertake their own detailed modelling of natural hazards and the potential impacts on properties.

In some cases, information can have additional 'public good' benefits. For example, data on natural hazards such as floods, bushfires, cyclones and storm surges can benefit households, businesses and local governments, as well as insurers. There can be a role for governments to provide information in cases where the benefits to the broader community exceed the costs (chapter 7).

Several participants in the inquiry submitted that governments should provide more information and natural hazard mapping (for example, Insurance Australia Group, sub. 39; Municipal Association of Victoria, sub. 79; Suncorp Group, sub. 28), or

make existing publicly-funded research publicly available (Risk Frontiers, sub. DR168). Some participants also favoured greater consistency in the way that risk information is provided to households, along with mandatory disclosure by local governments (Insurance Council of Australia, sub. 42). Recently, the Australian Government proposed to collate flood maps from all levels of government and make these available to households, insurers, local governments and others through a single portal, managed by Geoscience Australia (following a recommendation from the Natural Disaster Insurance Review) (Treasury 2011c). Chapter 7 outlines the role of information, the capacity of households to understand and act on it, and options for governments to improve the availability and quality of information.

Planning and building regulation

Planning and building regulation can reduce losses that occur from weather-related events (for example, by locating settlements away from flood or bushfire-prone areas), and can help insurers to quantify risks more accurately. This may then be reflected in lower insurance premiums.

Some participants from the insurance sector put forward a case for stronger land-use planning and building regulation. For example, there were concerns that insurance can be expensive for properties that were built when some natural hazards may not have been adequately considered, either by governments or households (Insurance Council of Australia, sub. 42). There was also support for stronger building codes to improve the ‘durability’ of buildings and prevent or reduce damage during cyclones, bushfires, floods and other events (Insurance Australia Group, sub. 39; Insurance Council of Australia, sub. 42, DR132).

Building owners already have an incentive to ensure that their properties are appropriately constructed and can withstand extreme weather events. To the extent that stronger planning and building regulations further reduce insurance claims (or reduce uncertainty faced by insurers), they could lead to lower premiums. On the other hand, any benefits must be weighed against the costs that regulations can impose on the community — such as increased construction costs or the costs of potentially limiting other ways of adapting to natural hazards. Chapters 9 and 10, respectively, examine the case for reforming planning and building regulations to address barriers to adaptation (including scope to improve the interaction between these sets of regulation).

Disaster-mitigation infrastructure

Governments construct and maintain a range of infrastructure that can prevent or mitigate the impact of extreme weather events, such as flood barriers, dikes, dams, firebreaks and seawalls. This is mostly done by state, territory and local governments, with some funding contributed by the Australian Government. In many cases, this infrastructure has widespread benefits for the community and public good characteristics. Its presence or absence can also be used by insurers to assess risks to properties and set premiums (Insurance Council of Australia, sub. 42). For example, Suncorp Group recently placed a temporary embargo on new policies for household building and contents insurance in the Queensland towns of Emerald and Roma because it considered that governments had underinvested in flood-mitigation infrastructure (Elsworth 2012; Suncorp Group, sub. DR127).

Some inquiry participants argued that increased government spending on disaster-mitigation infrastructure could reduce insurance premiums as well as the total economic impact of disasters. For example, the Consumer Action Law Centre (sub. DR131) submitted that disaster mitigation can be more effective when undertaken at a community level than by individual households, and some insurers argued that government funding and coordination of disaster-mitigation infrastructure have been inadequate. For example:

... we are concerned that disaster mitigation funding is not being prioritised on a national basis according to transparent, consistent and coherent criteria. (Insurance Australia Group, sub. DR110, p. 10)

... given the extent of repetitive community loss to flood, it can be argued that disaster mitigation funding and processes in Australia are not robust and are failing to protect the community. (Insurance Council of Australia, sub. DR132, p. 1)

In general, the appropriateness of investment in disaster-mitigation infrastructure will depend on local circumstances and other options available to manage risks or meet policy objectives (such as land-use planning). In general, governments' investment and infrastructure decisions are best made through a cost-benefit framework, taking into account all monetary and non-monetary costs and benefits to the community, as well as a thorough assessment of risks. However, there may be scope to improve the way that disaster-mitigation infrastructure is provided and how responsibilities are allocated among governments. Chapter 13 further examines the funding, risk assessment and prioritisation challenges that governments face in providing disaster-mitigation infrastructure, and the need to review current arrangements.

Consumer understanding of insurance contracts

The role of insurance in facilitating adaptation to climate change will depend on the ability of consumers to use insurance to manage their risks. In turn, this will be influenced by how well they understand and trust insurance products, and their awareness of the risks they face. Cognitive constraints on decision making or other behavioural barriers (chapter 4), for example, could affect how consumers make decisions about insurance.

Concerns about insurance contracts, consumer understanding and insurers' assessments of claims have been a focus of recent inquiries (box 16.4). In particular, riverine flooding is not covered in all insurance contracts. Consumers have not always been aware when it is excluded — in part because contracts were lengthy or confusing, or simply not read (Connolly 2011; NDIR 2011). For example, around 40–50 per cent of households surveyed in December 2011 were unsure whether they had flood cover (Insurance Australia Group, sub. DR110, att. 1). As a result, some consumers who believed their insurance policy would cover flooding have discovered, after a flood, that it did not. There have also been lengthy disputes between consumers and insurers about whether water damage was caused by riverine flooding (which may not be covered) or stormwater (which is usually covered) (NDIR 2011; Queensland Floods Commission of Inquiry 2012).

Another concern is the ability of insurers to provide personal advice to policyholders about which insurance products are best suited to their needs (that is, in addition to information about specific products). This relates to wider concerns that financial regulations have limited the provision of advice to consumers that need it (ASIC 2010). For example, Suncorp Group (sub. 28) submitted that financial advice regulations are costly for insurers to comply with, due to the difficulty in distinguishing between general and personal advice, and the stricter regulatory requirements when providing the latter. It noted that:

The advice regulations restrict you from taking into account [a customer's] personal circumstances; you can only present the options available and say, 'All right, the decision is now up to you' ... We don't necessarily understand why there's such heavy restrictions on general insurance when there's no evidence that there's any detriment ever come of somebody getting advice on general insurance. (Suncorp Group, trans., pp. 109–10)

Suncorp Group argued that these regulations can discourage insurers from offering personalised financial advice to households that could help them adapt to climate-related risks. They proposed that general insurers be exempted from financial advice regulations because dispute resolution processes are in place (Suncorp Group, trans., p. 110).

Reforms are already underway in these areas. The Australian Government has recently enacted regulations that specify a standard definition of ‘flood’ in household, small business and strata-title insurance contracts (which does not include storm surge).⁶ Regulations are also being developed to require a ‘key fact sheet’ that sets out which hazards are covered in a household insurance policy and which are not (Treasury 2011d, 2012). Recent legislative changes have sought to reduce regulatory requirements for insurers that provide ‘scaled’ financial advice to consumers (through the Future of Financial Advice reforms) (Australian Government 2011a) and to extend legislation covering ‘unfair’ contract terms to insurance (which is currently exempt) (Treasury 2011f). Section 16.3 further discusses these proposed reforms. In addition, the Insurance Council of Australia has initiated an independent review of the General Insurance Code of Practice that will consider recommendations made in recent government inquiries (box 16.4) (Insurance Council of Australia 2012d).

Government as ‘insurer of last resort’

Governments at all levels provide financial and other assistance to households and small businesses following large disasters, with charities often providing further assistance to households and communities. This is an important component of emergency management. (The Australian Government also provides assistance to the states and territories through the Natural Disaster Relief and Recovery Arrangements, discussed in chapter 13.) In addition, governments and communities have sometimes encouraged insurance companies to process claims faster or interpret insurance policies more leniently after a disaster.

In most cases, assistance payments are modest compared to the size of insurance payouts — for example, the Australian Government provides a Disaster Recovery Payment of \$1000 per adult and \$400 per child to help people to meet immediate needs after a declared natural disaster (Centrelink 2009), regardless of the extent of an individual’s losses (most other Australian Government recovery spending is directed to repairing or replacing damaged public assets (chapter 13)). State and territory governments also provide modest assistance payments, which in many cases are means tested and provided only to households that were not insured. Significantly higher payments (over \$100 000 in some cases) have been made to

⁶ Flood is defined as: ‘the covering of normally dry land by water that has escaped or been released from the normal confines of any of the following: a lake (whether or not it has been altered or modified); a river (whether or not it has been altered or modified); a creek (whether or not it has been altered or modified); another natural watercourse (whether or not it has been altered or modified); a reservoir; a canal; a dam’ (Insurance Contracts Amendment Regulation 2012 (Cwlth), r. 29D(1)).

some households by charitable funds following large disasters, such as the Victorian bushfires in 2009 and Queensland floods in 2010-11 (NDIR 2011). These have been mostly funded by private donations, with some funding from state governments.

This assistance can meet important equity objectives and generally has broad support — some amount of assistance can support vulnerable people and communities to recover quickly after a disaster. However, concerns have been raised that recovery assistance can reduce incentives to privately manage risks — a form of ‘moral hazard’ (Mortimer, Bergin and Carter 2011; NDIR 2011). For example:

... individuals electing not to insure their assets place a burden on the community when governments, in the absence of private insurance, are faced with the position of taking on the responsibility of insurer of ‘last resort’. While there may be an equity argument for individuals who are financially disadvantaged to access government assistance, open-ended assistance is inequitable when it is provided to individuals who are able to responsibly insure, but choose not to do so. (Insurance Australia Group, sub. 39, p. 22)

It is well recognised that many disaster recovery payments are not well targeted and yet can be very expensive for the Government. ... [A] case can be made for a more equitable and targeted set of relief payments. If greater individual responsibility is to be encouraged, including holding insurance, such an approach could well result in reduced disaster recovery payments ... (John Trowbridge, Jim Minto and John Berrill, sub. DR164, p. 8)

There has also been concern about government assistance arrangements being used more extensively in the future if levels of non-insurance or under-insurance increase as the climate changes.

In contrast, some inquiry participants suggested that government assistance is unlikely to have a material impact on insurance. For example:

The Tasmanian Government considers that existing disaster recovery policies ... do not impede the efficient operation of the Australian insurance market, or reduce incentives to take up insurance. (Tasmanian Government, sub. 51, p. 8)

[Assistance arrangements are] essentially short-term adjustment mechanisms for families in the absence of assistance in the private sector. The arrangements don’t go to compensating for property loss — large-scale property loss. To that extent it doesn’t crowd out the private sector insurance. (Insurance Council of Australia, trans., p. 11)

It is possible that the expectation of a payment from governments (or charities) after a natural disaster could lead to some households reducing the amount of insurance cover they take out, or taking fewer measures to reduce their exposure to hazards. Government support might also ‘crowd out’ the development or provision of some insurance products. This could give rise to barriers to effective adaptation.

While there may be an in-principle case for claims that assistance payments can affect the uptake of private insurance, the Commission is not aware of detailed evidence either in support of, or counter to, such claims. As such, it is not in a position to assess the merits of specific post-disaster assistance arrangements that either governments or charities have put in place, or whether these arrangements constitute a barrier to effective climate change adaptation.

Nevertheless, it will be important for governments to evaluate the impact of assistance payments on households after disasters occur. This could help to ensure that future assistance is provided in ways that meet equity objectives cost effectively with minimal distortion to risk management decisions.

Reform priorities

Phasing out state and territory taxes and levies on general insurance would most likely have net benefits for the wider community in both current and future climates, and should be prioritised. Reforms to address barriers to adaptation in other areas — including information provision, local government, land-use planning, building regulation, existing settlements, infrastructure provision and emergency management (chapters 7–13) — could further improve how insurance markets price risks and how the community manages the risks that it faces. Addressing barriers in these areas could also reduce exposure to natural hazards and improve understanding of risks, potentially making insurance premiums more affordable for some households, or making cover for specific hazards easier to obtain. This could address concerns about the cost and provision of insurance (for example, by making insurance premiums more affordable for some households) and strengthen the role of insurance in facilitating effective adaptation to climate change.

More generally, clarification of the roles and responsibilities of households, businesses, other organisations and each level of government for managing risks can improve how effectively these risks are managed. This may also go some way towards addressing concerns about governments acting as insurers of last resort following disasters.

16.3 Reforms to insurance regulations

Reforms to regulations covering insurance markets can benefit the community by addressing market failures related to the cost, availability or uptake of insurance, or by meeting specific equity objectives. However, it is important that any reform is

based on evidence of a policy-relevant problem (box 16.5), an assessment of the likely costs and benefits for the community, and consideration of alternative options and strategies for implementing reform (chapter 5). These alternatives could include making no changes to current arrangements, or addressing underlying barriers to adaptation in areas other than insurance regulation (such as land-use planning or disaster-mitigation infrastructure provision) (chapters 7–13). A reform would only be justified when there are clear benefits to the community (such as lower exposure to risks) that outweigh the costs.

Poorly-designed regulatory intervention in insurance markets can create barriers to effective adaptation to climate change. For instance, if insurers are prevented from setting premiums in line with underlying risks — such as by being required to provide insurance with regulated or subsidised premiums — the incentives that premiums give households and businesses to manage their risks efficiently could be distorted. Alternatively, costs can arise by restricting the options available to households and businesses to manage their own risks and allocate resources in ways best suited to their individual circumstances. In these cases, regulatory intervention may have costs to the wider community that exceed any benefits.

The Government's reforms

The Australian Government is currently consulting on a proposal to require insurers to cover riverine flooding in all household building and contents policies, while giving them the option to let consumers ‘opt out’ of flood cover when taking out or renewing a policy (Treasury 2011c) (this would be in addition to other hazards, such as bushfire and storm, that are already included in household policies). The Government has also announced that it will publish data on the uptake of flood insurance by households on a quarterly basis (Shorten 2012).

As noted in section 16.2, the Australian Government has recently enacted regulations for a standard definition of ‘flood’, and is currently developing regulations that will require insurers to provide a one-page ‘key fact sheet’ with household building or contents policies (enabling legislation has passed both houses of parliament) (Treasury 2012). In addition, the Government reformed regulations for providing ‘scaled’ advice (Australian Government 2011a) and committed to collate flood maps in a publicly-accessible portal (Treasury 2011c) and extend legislation covering unfair contract terms to general insurance (Treasury 2011f).

Further, the Government has stated that it will consider introducing flood insurance premium discounts and establishing a flood reinsurance pool, following a

consultation process in 2012 (Australian Government 2011b). This statement was made in response to the Natural Disaster Insurance Review.

Box 16.5 Identifying the objectives of reform

It is important to clearly identify the objective targeted by any reform to insurance regulations.

Market failures

One objective could be to address a well-defined market failure, such as asymmetric information, spillovers, market power or underprovided public goods (chapter 4). However, in the case of insurance, observed levels of insurance premiums and the uptake of insurance do not necessarily reflect market failures.

- Non-insurance and under-insurance (box 16.3) do not, in themselves, indicate a market failure. This may reflect decisions that households have made about the value of insurance and which risks they prefer to bear themselves.
- Insurance may be unavailable (or very expensive) in some cases because the underlying risks are difficult to insure (for example, as with landslide and ‘actions of the sea’). In these cases, insurance may not be an effective way to manage risks — compared to other options — given the costs involved. If no insurer is willing to provide cover for commercial reasons, this does not necessarily indicate a market failure.

In some cases, insurance might be expensive or difficult to obtain because of failures in other markets — for example, because public goods such as information or infrastructure are underprovided. In these cases, the most effective policy response is likely to entail directly targeting the underlying market failure.

Equity objectives

Another objective could be to meet a well-defined equity outcome. For example:

- some low-income households may struggle to pay insurance premiums, along with other household expenditures
- some disadvantaged households may be unable to adequately protect their property from extreme weather events.

There are various options available to governments to meet equity objectives without creating distortions in insurance markets. Governments could make direct payments, through the existing social safety net, to the most vulnerable households. Governments could also phase out taxes and levies on insurance, improve the disclosure of risk information to households, or reduce the risks that households are exposed to by investing in disaster-mitigation infrastructure (such as dikes or firebreaks) where this has net benefits. Implemented appropriately, such options can improve the adaptive capacity of disadvantaged members of the community.

Mandating flood cover

The proposed regulations to require insurers to cover riverine flooding — while allowing insurers to let consumers opt out of flood cover — have several potential benefits and costs.

This reform could benefit some consumers. For example, it would allow consumers to more easily compare insurance quotes with and without flood cover. This would allow them to assess the extent of their flood risk (as estimated by the insurer and reflected in the premium). In some cases, the reform could also reduce scope for confusion or disputes with insurers after water damage occurs — for example, whether damage is due to stormwater or riverine flooding (Treasury 2011c).

However, this reform would also impose costs on the community. While many insurers already offer flood cover in most areas (and some have made it a standard inclusion in their policies), some do not. In many cases, this is because they lack suitable data with which they can price flood risks (Insurance Council of Australia, sub. 39; Tooth 2011). Requiring all insurers to offer flood cover could increase some insurers' capital and operating costs — for example, the costs of obtaining reinsurance or more accurate flood information. These higher costs may be passed through to the premiums charged to policyholders.

Alternatively, some insurers may choose to withdraw all household cover in areas where they are not willing to cover flood. To the extent that this reduces competition in the insurance market, it would also reduce consumer choice and could lead to higher premiums — thereby impeding effective adaptation to climate change. Such outcomes could be exacerbated if regulations restrict how insurers can apply sub-limits to flood payouts or set flood-specific excess amounts for policyholders.

More generally, the benefits of the reform are likely to be small for households that already take out flood cover. Many households face very low flood risks and a growing proportion have flood cover in their insurance policies — for example, around 80 per cent of household building policies already include flood cover (Insurance Council of Australia, pers. comm., 10 September 2012). Of the relatively small number of households in the highest-risk areas for flooding — less than 2 per cent of all households (Insurance Council of Australia, trans., p. 19) — some may choose to 'opt out' of flood cover when faced with potentially very high premiums (in line with the risks they face). For example, one insurer has observed that around 50 per cent of high-risk customers chose to opt out of flood cover when given the choice to do so (Suncorp Group, trans., p. 106).

Thus, uptake of flood cover among high-risk households as a result of the reform may be limited. More broadly, provided that they are well informed of the level of risk they face, decisions by these households not to purchase flood cover or otherwise reduce their exposure to flood risks would generally not warrant government intervention in insurance markets.

A more appropriate policy response to concerns about the extent of flood cover would be to address barriers to effective adaptation in other policy areas that bear on the cost, uptake and provision of insurance (section 16.2). This could include phasing out taxes and levies on insurance, improving disclosure of risk information to households so that they are more aware of their exposure to natural hazards (chapter 7), or increasing investment in flood-mitigation infrastructure where this has net benefits for the wider community (chapter 13). Addressing barriers in these areas could reduce exposure to risks and strengthen the incentives that insurance provides to manage risks effectively.

After that, there may be scope to examine changes to insurance regulations to target a clearly-defined market failure or equity problem for which there is sufficient evidence. Should such a situation arise, a reform should proceed only if there are clear benefits for the wider community that exceed the costs. These should be assessed prior to implementation using the Regulation Impact Statement process, in accordance with the *Best Practice Regulation Handbook* (Australian Government 2010b). Further, a review should be scheduled to occur after any reform is implemented to assess whether policy objectives are being met effectively.

Following publication of the Commission's draft report, the Australian Government announced that it would defer consideration of reforms to require insurers to offer flood cover until after it has received this final report (Shorten 2012).

RECOMMENDATION 16.2

The Australian Government should only proceed with reforms that require all household insurers to offer flood cover if it can be demonstrated that the benefits to the wider community would exceed the costs.

Other changes to insurance regulations

As noted above, the Australian Government has recently completed or proposed other legislative changes that affect insurance. These consist of the standard definition of 'flood', 'key fact sheet', application of unfair contract terms legislation to general insurance, and reforms to financial advice regulations.

These reforms could improve outcomes for consumers, with generally modest costs for insurers. The Australian Government has published Regulation Impact Statements for the key fact sheet and standard definition of flood, although both Statements noted that sufficient data were not available to empirically assess the costs and benefits of the reforms (Treasury 2011b, 2011e).

It will be important to schedule reviews to occur after each of these reforms is implemented, to evaluate the impacts on the wider community. These reviews should be supported by empirical evidence and, where feasible, completed before any further reforms to insurance regulations are implemented.

Subsidising insurance

Insurance subsidies have been put forward as a way to temporarily assist the relatively small number of households that live in very high flood-risk areas, and to increase the uptake of insurance across the community. This has partly reflected concerns that levels of non-insurance and under-insurance could rise as the climate changes and insurance becomes more expensive or less easily obtainable for properties in high-risk areas.

Following recent concerns about the affordability of insurance and levels of non-insurance in the community, the Natural Disaster Insurance Review recommended that flood insurance premiums be discounted, on a time-limited basis, for some existing flood-exposed properties (that meet an ‘affordability threshold’). These discounts would be provided through an Australian Government-backed reinsurance facility that would underwrite flood risks above a particular risk threshold and provide reinsurance cover for insurers at a discounted rate (NDIR 2011). In response, the Government stated that it will consider these options in 2012, following a consultation process (Australian Government 2011b; Treasury 2011c).

This echoes proposals put forward by others.

- Some inquiry participants favoured schemes where governments would temporarily fund subsidies for insurance premiums — either directly or by backing a reinsurance pool — to reduce the cost of insurance for the small number of properties facing very high flood risks (Institute of Actuaries of Australia 2011a; Insurance Council of Australia 2011, sub. DR132). These participants argued that this could give governments greater incentives to reduce those risks through land-use planning decisions and disaster-mitigation infrastructure.

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- The Consumer Action Law Centre (sub. DR131) submitted that households facing high flood risks generally have few options available to reduce their exposure to these risks, and that subsidies could make insurance more affordable for these households.
 - Uniting Care Australia (trans., p. 178) proposed that governments create a universal insurance scheme to provide means-tested insurance support to low-income households that cannot afford to mitigate their risks.

While temporary subsidies may make insurance more affordable for those households that receive them, the underlying market failures or equity problems are not always clear. As noted in box 16.5, high insurance premiums and observed levels of non-insurance do not, in themselves, clearly indicate a market failure. Moreover, the impacts of the availability and cost of insurance vary across households and it is not clear that premium subsidies would direct assistance to those households that are most in need (in an overall sense).

Without clear evidence of market failures or the distribution of outcomes across households, it would be difficult to design or justify intervention in insurance markets that would improve the overall wellbeing of the community. In particular, subsidising insurance — whether by providing subsidies directly to insurers or households, or indirectly by governments underwriting risks — can be costly.

- Subsidies reduce the incentives that insurance premiums give households to reduce their exposure to risks. This would likely impede structural adjustment required to adapt to climate change — for example, a household might face weaker incentives to protect their property from hazards, or to move to a lower-risk area.
 - Subsidies could also encourage excessive development in hazard-prone areas if not restricted to existing properties. This could further impede adaptation.
 - Subsidies could distort risk management decisions by households more broadly if funded through cross-subsidisation by lower-risk policyholders.
- There could be potentially large budgetary costs if governments fund subsidies or underwrite risks, such as by insuring households directly or by backing a reinsurance pool.
 - These costs could exceed recent disaster-assistance payments made by the Australian Government to households following natural disasters, which were not based on the size of property losses.
 - International experience suggests that government-backed reinsurance can be costly. For example, the National Flood Insurance Program in the United

States has required large funding injections from the US Government in recent years to remain solvent (Michel-Kerjan 2010).

- Government expenditure on insurance subsidies could be used for other purposes that have greater net benefits for the community (including programs that target equity objectives more directly).
- A government-backed reinsurance pool could ‘crowd out’ private-sector insurance products and potentially reduce competition in the insurance market.

A number of inquiry participants submitted that governments should not subsidise insurance, pointing to some of these costs (Australian Chamber of Commerce and Industry, sub. DR102; Insurance Australia Group, sub. DR110; Suncorp Group, sub. DR127). In effect, the result of insurance subsidies would be that governments take on private risks and become an ‘insurer of last resort’.

In the Commission’s view, the costs to the community as a whole of subsidising insurance are likely to exceed any benefits. In essence, subsidies would not reduce the physical risks that individual properties face, but would mean that governments bear some of the losses to these properties.

Government intervention would be more effective when closely targeted at a well-defined market failure or equity objective, supported by clear evidence. Alternative reform options may be more appropriate ways to meet policy objectives. For example, there would be net benefits for the community from phasing out taxes and levies on insurance, ensuring land-use and building regulation can facilitate adaptation, or by appropriately providing information and disaster-mitigation infrastructure to reduce exposure to risks (section 16.2). Addressing barriers to adaptation in these areas may largely address community concerns about the provision, affordability and uptake of insurance.

RECOMMENDATION 16.3

Governments should not subsidise household or business property insurance, whether directly or by underwriting risks.

17 Reform priorities

Key points

- A range of policy reforms would help households, businesses and governments deal with *current climate* variability and extreme weather events. These reforms would also build adaptive capacity to respond to *future climate* impacts. Examples include:
 - reducing perverse incentives in tax, transfer and regulatory arrangements that impede the mobility of labour and capital
 - increasing the quality and availability of natural hazard mapping
 - clarifying the roles, responsibilities and legal liability of local governments, and improving their capacity to manage climate risks
 - reviewing emergency management arrangements in a public and consultative manner to better prepare for natural disasters and limit resultant losses
 - reducing tax and regulatory distortions in insurance markets.
- Further actions are required to reduce barriers to adaptation to *future climate* trends and to strengthen the climate change adaptation policy framework. These include:
 - designing flexible land-use planning regulation
 - conducting a public review, sponsored by COAG, to develop appropriate adaptive responses for existing settlements that face significant climate change risks
 - developing a work program to consider climate change in the building code
 - aligning land-use planning with building regulation.
- Governments at all levels should:
 - embed consideration of climate change in their risk management practices
 - ensure there is sufficient flexibility in regulatory and policy settings to allow households, businesses and communities to manage the risks of climate change.
- Some measures should not be implemented.
 - A systematic review of regulation to identify impediments to adaptation.
 - Requiring insurers to provide flood cover in household policies (whether or not the requirement includes an ‘opt out’ provision).
 - Government subsidies for household insurance premiums.
 - Changes to arrangements for regulating infrastructure network prices to require regulators to base their decisions on longer time frames.
 - Mandatory reporting of adaptation action by governments or businesses.

17.1 Two groups of reforms

The Commission has identified a number of reforms that would build the community's capacity to adapt to climate change, address barriers to effective adaptation and facilitate more effective risk management by households, businesses, other organisations and governments. These reforms can be grouped broadly into two categories.

- Some reforms are focused mainly on helping households, businesses and governments manage the risks of *current* climate variability and extreme weather events. These reforms would most likely involve incremental changes to existing institutions, regulations and practices. As well as improving the community's ability to manage the risks it faces in the current climate, these reforms would assist adaptation to future climate change.
- Other reforms are focused on facilitating adaptation to *future* climate change and strengthening the adaptation policy framework. These reforms are most likely to be justified where they relate to decisions that have long-lasting effects, and where preparatory action can be taken at relatively low cost.

17.2 Who should implement adaptation reforms?

Effective adaptation will require action by all levels of government (table 17.1). Clearly allocating responsibilities to different levels of government is important to ensure accountability and effective risk management.

Embedding climate risks in agencies' risk management frameworks

Consideration of current and future climate risks should be embedded in the risk management practices of government agencies at all levels. This will involve considering climate change risks alongside other risks that government activities face, and managing them in a way that is proportionate to the threats they pose (and the opportunities they present). For example:

- At the Australian Government level, the Attorney-General's Department is responsible for maintaining and improving the national emergency management system. Climate variability, extreme weather events and climate change are all relevant in this task. Other agencies with specialised responsibilities (such as the Australian Institute of Marine Science and the Great Barrier Reef Marine Park Authority) will need to consider climate change and adaptation in their areas of responsibility.

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- Climate change could add to the pressures faced by state and territory governments in providing health services. This will require ongoing monitoring of public health outcomes, and evaluating and reviewing strategies to deal with impacts such as heatwaves and disease outbreaks.
 - Local governments will need to monitor and manage the potential impacts of climate change on their assets, such as roads.

Many agencies are already appropriately incorporating climate risks into their activities. Where this is not yet the case, there could be a role for a single agency to facilitate the process of embedding climate risk management into agencies' practices. This agency would need to have knowledge and capacity with respect to climate science and potential climate impacts, and the capacity to understand how climate change could affect other agencies' activities.

- At the Australian Government level, the appropriate agency would most likely be the Department of Climate Change and Energy Efficiency. This role would be unlikely to require significant additional program funding.
- At the state and territory level, some governments have established climate change adaptation units within their departments of Premier and Cabinet, or within environmental agencies (appendix B).

At all levels of government, the responsible agency should encourage other agencies to take a proportionate approach to managing climate change risks. Where possible, agencies should draw on existing governmental resources — such as existing research into climate change impacts.

The Australian Government

In general, reform tasks that have been allocated to the Australian Government address barriers that are national in scale, or are in areas where a national approach would most likely be more efficient than separate action by each jurisdiction. Most of the Australian Government reform recommendations would address barriers to effective risk management in the current climate.

Reforms to address specific barriers

Some reforms would directly target particular barriers, including:

- commissioning an independent public review of disaster prevention and recovery arrangements

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- improving the coordination and dissemination of flood risk information, and expanding this over time to encompass other natural hazards (action in this area would also be required by state, territory and local governments)
 - improving weather forecasting and flash flood warning systems.

Increasing adaptive capacity

The Australian Government should implement reforms to increase the adaptive capacity of the community. This includes, for example, reforms to transfer payments that reduce the incentives for people to adapt to change (such as drought support payments).

Addressing the distributional effects of climate change and adaptation

In some cases, the impacts and resultant damages of climate change could exacerbate existing disadvantage. The Australian Government is responsible for the majority of social safety net programs. In the main, the social security and tax systems — along with other standard adjustment measures (such as job search, placement and training services) — will be the most appropriate means of assisting the process of adjustment to a changing climate and moderating adverse distributional effects. In the event of extreme weather events, more targeted, temporary support measures would likely be important to complement the social safety net. However, care must be taken to avoid measures that diminish incentives for individuals and households to manage risk.

The impacts of climate change are just one among an array of challenges likely to be faced by disadvantaged individuals and communities in the future. Structural adjustment associated with climate change will occur in the context of ongoing economic, social, political and technological change. Measures to alleviate disadvantage and manage distributional impacts should reflect the range of influences on disadvantage, rather than focusing on climate change adaptation alone.

State and territory governments

Most of the reforms the Commission has identified for state and territory governments relate either to their role in supporting local governments or the related area of land-use planning.

Local governments are created under state and territory legislation, and are often assigned roles and responsibilities by state and territory governments. These are sometimes beyond the capacity of local governments to fulfil. As a first step to facilitating adaptation by local governments and their residents, state and territory governments should provide clear policy frameworks, clarify the roles, responsibilities and legal liability of local governments, and ensure that they have access to sufficient funding and technical skills to fulfil these roles and responsibilities.

State and territory governments will also have a role in implementing reforms to land-use planning regulations. Better alignment of land-use planning regulations with building regulations would improve risk management in the current climate. Barriers to future climate change adaptation could be addressed by ensuring land-use planning frameworks incorporate risk-management principles, and establishing guidelines for risk management in existing settlements.

More broadly, replacing inefficient taxes and charges (such as stamp duties on insurance and property transfers) with less distortionary revenue sources (such as broad-based land taxes) would improve the flexibility of the economy and would make the cost of insurance more reflective of insured risks.

Local governments

Most climate change adaptation actions will be undertaken at the local level, and local governments will have an important role in reforms to address barriers to effective adaptation. As well as managing the risks of climate change to their own assets and activities, local governments will need to provide information to local communities to enable them to identify the risks they face and manage those risks. In particular, local governments should improve their communication of climate risk information — such as information about the potential for flooding, coastal inundation or bushfire.

Local governments should consider the impacts of climate change in land-use planning decisions and should also consider changes to land-use planning regulations. This could include incorporating new instruments into planning regimes.

The Commission has recommended a public inquiry to examine responses to managing the risks of climate change to existing settlements. Local governments should participate in the inquiry, and should act on any recommendations to improve the management of climate change risks in areas that face significant risks.

National policy coordination

Some climate change adaptation policy issues will require cooperation between several levels of government. The most effective way to coordinate policy responses will depend on the nature of the policy issue and the roles, responsibilities and capabilities of each level of government. In some cases, existing bodies (including Council of Australian Governments (COAG) bodies) are best placed to develop reforms. In other cases, specially-commissioned bodies may be better suited to particular policy issues.

At a broad level, the COAG Select Council on Climate Change (box 17.1) provides a forum for the Australian Government to work with state, territory and local governments on implementing climate change programs. This includes developing national adaptation priorities and work plans.

Box 17.1 The COAG Select Council on Climate Change

As part of the new system of ministerial councils established by COAG, a new Select Council on Climate Change was announced on 13 February 2011. The terms of reference for the Select Council were published in March 2012, and the Select Council is due to provide a final report to COAG on 31 March 2013 that details the Council's achievement against its objectives. The Select Council has a number of responsibilities, most of them related to greenhouse gas emissions-reduction policies. However, it also has a role in:

Developing national adaptation priorities for agreement by COAG and work plans for these priorities, by building on intergovernmental work already undertaken, in liaison with other ministerial bodies as required, and including, where necessary, recommendations to COAG on matters requiring broader cross-portfolio reform. (Australian Government 2012a, p. 2)

National policy coordination is required to incorporate a consideration of climate change impacts in the National Construction Code (NCC). The NCC is developed and maintained by the Australian Building Codes Board, which reports to the COAG Building Ministers' Forum. The Commission has recommended that the COAG Building Ministers' Forum should develop a work program to embed consideration of climate change in the NCC.

The extent of the cross-jurisdictional issues surrounding the management of climate change risks for existing settlements facing significant risks suggests that a national approach is required to respond to the challenges that climate change poses to these settlements. COAG should commission an independent public inquiry to develop an appropriate response to managing the risks of climate change to existing settlements. The inquiry should be jointly sponsored by all levels of government.

Table 17.1 **Priority reforms by level of government**

	<i>Current climate risks</i>	<i>Future climate risks</i>
Characteristics	<i>Reasonably well understood</i>	<i>Uncertainty about timing, nature and/or magnitude of climate impacts and the assets at risk and their value</i>
Effective adaptation	<i>Take action today to improve risk management and build adaptive capacity</i>	<i>Begin taking preparatory actions</i>
<i>Reform priorities</i>		
All levels of government	<ul style="list-style-type: none"> • Embed consideration of current climate risks and future climate change in agencies' risk management practices • Pursue ongoing reforms to enhance flexibility and adaptive capacity, including to: <ul style="list-style-type: none"> – taxes that act as barriers to adaptation – regulations that inhibit adaptation – transfer payments that reduce incentives for businesses and households to adapt 	<ul style="list-style-type: none"> • The COAG Building Ministers' Forum should develop a work program to consider climate change projections in the National Construction Code • COAG should commission a separate inquiry to develop an appropriate response to managing climate change risks to existing settlements
Australian Government	<ul style="list-style-type: none"> • Review natural disaster prevention and recovery arrangements • Improve hazard mapping • Improve weather forecasting and flash flood warning systems • Reform transfers that impede adaptation (such as drought support) 	
State and territory governments	<ul style="list-style-type: none"> • Clarify the roles, responsibilities and legal liability of local governments • Better align building and planning regulation • Replace inefficient taxes (such as taxes on insurance and property transfers) with less distortionary taxes 	<ul style="list-style-type: none"> • Ensure land-use planning frameworks facilitate a risk management approach to responding to climate change impacts • Establish guidelines to support local governments to manage risks to existing settlements
Local governments	<ul style="list-style-type: none"> • Improve communication of hazard information to residents 	<ul style="list-style-type: none"> • Consider new planning instruments to flexibly manage climate change risks

17.3 Reform options that should not be pursued

There are several reform options for which there is insufficient evidence that the benefits would exceed the costs.

Household insurance regulations and subsidies

The Australian Government is consulting on a proposal to require insurers to cover riverine flooding in all household building and contents policies, while giving them the option to let consumers ‘opt out’ of flood cover when taking out or renewing a policy. This measure could benefit some consumers (by providing them with information about their levels of flood risk), but could also increase some insurers’ capital and operating costs (for example, reinsurance costs and the cost of obtaining more accurate flood information). This proposal should not proceed unless it can be demonstrated through regulatory impact analysis that the benefits to the wider community would exceed the costs.

The National Disaster Insurance Review, and participants in this inquiry, have suggested that governments should provide subsidies to assist the relatively small number of households that live in very high flood-risk areas, and to increase the uptake of insurance across the community. A variety of instruments have been proposed, including government provision of insurance or reinsurance. Such proposals would be costly, would reduce incentives for adaptation and risk management, and should not be pursued (chapter 16).

Changes to infrastructure price regulation

Some participants raised concerns that current arrangements for regulating infrastructure network prices may represent a barrier to investment in adaptation. In general, infrastructure price regulation places the onus on the infrastructure provider to prove that an investment is necessary. Participants suggested that regulatory bodies tend to base their decisions on relatively short time-frames, and that this leads them to not approve investments that would reduce the vulnerability of networks to risks that may increase as a result of climate change (chapter 12).

The Commission has not found evidence that current regulatory arrangements in this area are a barrier to effective climate change adaptation. Existing regulatory arrangements appear able to accommodate the need for climate change adaptation investment, on presentation of adequate supporting evidence. Reform to the regulation of infrastructure network prices is not required to facilitate effective

adaptation, although a more light-handed approach to economic regulation may have benefits for adaptation.

A systematic review of regulation

The Department of Climate Change and Energy Efficiency (sub. 57, p. 13) suggested that one way to identify barriers to adaptation could be to undertake a systematic review of regulation ‘to assess whether and to what extent adaptation is supported or constrained’. It then referred to the example of the Legislative Review Program (LRP) conducted as part of the National Competition Policy reforms. Under the LRP, legislation and regulation were systematically reviewed to determine the effects they had on competition. If the regulation had an adverse effect on competition, the onus of proof was on those who wanted to retain the regulation to demonstrate that it delivered a net benefit.

The Commission’s report on *Identifying and Evaluating Regulation Reforms* found that ‘principles-based’ reviews (such as the LRP) ‘have considerable potential to identify and achieve significant reforms’ (PC 2011d, p. 84). However, this type of review tends to have high costs.

The LRP demonstrated the enormity of the effort required to undertake such a comprehensive review of regulation across the economy ... The program ran five years longer than initially envisaged. Resources were often stretched thin and the quality of some of the reviews was inevitably poor. For smaller jurisdictions the gains from some of their review effort may not have justified the costs involved. A few high profile regulations managed to avoid review and/or reform. (PC 2011d, p. 81)

A systematic review to identify regulation that constrains adaptation would be likely to have high costs. Through this inquiry process the Commission has identified a number of regulatory barriers to effective adaptation, and has proposed reforms to address them. It is not clear that a full review of regulation would identify many more significant barriers to adaptation. As such, the case for such a review process is weak.

Mandatory reporting on climate change impacts

The Department of Climate Change and Energy Efficiency (sub. 57, p. 15) stated that:

Monitoring and reporting on adaptation outcomes is essential for setting priorities, guiding implementation and assessing progress towards adaptation. ... This type of reporting could potentially draw on regular reports of adaptation progress by key agencies delivering elements of adaptation.

The Department noted that adaptation reporting is a requirement of the UK Government. The UK Government’s Adaptation Reporting Power requires some government-owned companies and statutory authorities — as well as some large private companies — to report on the current and predicted impacts of climate change on their activities, and their approach to adapting to these impacts. This requirement covers most large utilities and their regulators, including water providers, electricity generators and distributors, gas distributors and transport infrastructure operators (airports, ports, road and rail) (appendix C).

Collecting and reporting data is time consuming and costly, and introducing mandatory reporting on adaptation would only be justified if the benefits to the wider community were likely to outweigh the costs. Any proposal to introduce such reporting in Australia would need to be subject to regulatory impact assessment.

Mandatory reporting on climate change adaptation is unlikely to deliver net benefits. While the costs are relatively certain, it is highly questionable whether such reporting would deliver significant benefits. Provided governments take steps to reduce or remove barriers to effective adaptation, households, businesses, other organisations and governments will be well placed to take action to adapt to climate change. Mandatory reporting and monitoring of actions is not required.

A Public consultation

In keeping with its standard practice, the Commission has actively encouraged public participation in this inquiry.

- Following receipt of the terms of reference on 20 September 2011 it advertised the inquiry in major metropolitan press and sent a circular to likely interested parties.
- In early late October 2011, it released an issues paper to assist those wishing to make written submissions. Some 79 written submissions were subsequently received. After releasing the draft report in April 2012, the Commission received a further 89 submissions. (These are denoted in table A.1 with the prefix ‘DR’.) All submissions are available online at: www.pc.gov.au/projects/inquiry/climate-adaptation.
- Following release of the draft report, public hearings were held in Sydney, Canberra, Melbourne and Adelaide. The participants at these hearings are listed in table A.2.
- As detailed in table A.3, it met informally with a wide range of stakeholders across Australia. It also met with various parties in New Zealand.

The Commission is grateful to all inquiry participants for their input.

Table A.1 Submissions

<i>Participant</i>	<i>Submission number</i>
Abel, Nick	DR156
Adaptive Futures	31*, DR95
Attorney-General's Department	64
Australian Academy of Technological Sciences and Engineering	18
Australian Building Codes Board Chairman	DR134
Australian Bureau of Statistics	DR126
Australian Centre for Cultural Environmental Research	DR86
Australian Chamber of Commerce and Industry	DR102
Australian Climate Change Adaptation Research Network for Settlements and Infrastructure	19
Australian Coastal Society	15#, DR123
Australian Conservation Foundation	47
Australian Green Infrastructure Council	13
Australian Industry Greenhouse Network	29
Australian Institute of Aboriginal and Torres Strait Islander Studies	62
Australian Institute of Architects	DR133
Australian Institute of Landscape Architects	DR129
Australian Local Government Association	25#, DR159
Australian Network of Environmental Defender's Offices	DR106
Australian Petroleum Production and Exploration Association Limited	59#
Australian Psychological Society	35, DR87
Australian Sea Level Rise Partnership	44
Australian Sustainable Built Environment Council Climate Change Task Group	5, DR157#
Bluescope Steel	8, DR97
Brotherhood of St Laurence	74
buildingSMART Australasia	78#
Bureau of Meteorology	DR166
Byron Preservation Association	DR120
Cairns Regional Council	DR108
Carruthers, Ian	33, DR84
Cement Concrete and Aggregates Australia	7
City of Busselton	DR125
City of Mandurah	DR104
City of Vincent	DR105
City of West Torrens	DR138
Clarence City Council	10#, DR98
Climate and Health Alliance	DR109
Climate Risk	38#*
Coastal Residents Incorporated	DR122
Coastal Zone Management and Planning	DR91
Coasts and Climate Change Council	30*

(Continued next page)

Table A.1 (continued)

<i>Participant</i>	<i>Submission number</i>
Consult Australia	71, DR148
Consumer Action Law Centre	DR131#
Council of Australian Biological Collections	23
Council of Capital City Lord Mayors	67
CSIRO	40, DR136
Department of Agriculture, Fisheries and Forestry	68
Department of Climate Change and Energy Efficiency	57, DR163
Department of Industry, Innovation, Science, Research and Tertiary Education	DR121
Department of Sustainability, Environment, Water, Population and Communities	77
Director of National Parks	60
Dobes, Dr Leo	63, DR154
Ecological Water Solutions	66
Edge Environment	54
Elliston, John	DR130#
Eureka Funds Management	DR82
FloodSax	DR117
Floris, Maurizio	DR162
Geoscience Australia	DR167
Gippsland Climate Change Network	DR103
Gippsland Coastal Board	65, DR140
Gold Coast City Council	17
Good Shepherd Australia New Zealand	20
Government of South Australia	DR88
Great Barrier Reef Marine Park Authority	DR92
Green Building Council Australia	61#
Grenatec	DR80
Housing Industry Association	69, DR151
Institute for Sustainable Futures	DR158
Institute of Actuaries of Australia	43
Insurance Australia Group	39, DR110
Insurance Council of Australia	42, DR132
Invasive Species Council	37#*
Investor Group of Climate Change	73, DR145
Jones, Kylie	11
Ku-ring-gai Council	1
Lake Macquarie City Council	DR107
Leith, Dr Peat and Jennings, Dr Sarah	22
Local Government Association of Queensland	41#, DR116
Local Government Association of South Australia	DR139
Local Government Association of Tasmania	DR146
Middle, Gary	DR160
Moreton Bay Regional Council	DR143

(Continued next page)

Table A.1 (continued)

<i>Participant</i>	<i>Submission number</i>
Mornington Peninsula Ratepayers' and Residents' Association	34
Mornington Peninsula Shire	16, DR96
Municipal Association of Victoria	79, DR85
Mushalik, Matt	DR113
National Centre for Epidemiology and Population Health	DR112
National Climate Change Adaptation Research Facility	49, DR118
National Farmers' Federation	76, DR153
National Sea Change Taskforce	75, DR90#*
NCCARF Adaptation College	21
NCCARF Water Governance Research Initiative	32#
Nicholls, Prof Neville	9
Northern Alliance for Greenhouse Action	6, DR99
Northern Grampians Shire Council	DR101
NSW Young Lawyers	72
Office of the NSW Small Business Commissioner	DR142
Petheram, R J	DR83
Pittock, Dr Barrie	46#
Pittock, Dr Jamie	DR94
Property Council of Australia	48
Pullen, Barry	27
Queensland Farmers Federation	55
Queensland Government	DR161
Queensland Murray–Darling Committee	DR124
Queensland Seafood Industry Association, Australian Prawn Farmers Association, Oceanwatch Australia and Pro-vision Reef	24
Rae, Ian	2
Redland City Council	36
Regional Australia – Northern Rivers NSW	DR115
Risk Frontiers	DR168
Sarah, Ian	DR93
Shire of Busselton	50
South East Councils Climate Change Alliance	12, DR100
South East Forest Rescue	45
South East Queensland Catchments	DR114
Spatial Industries Business Association	58
Standards Australia	DR135
Suncorp Group	28, DR127
Sunshine Coast Council	53, DR149
Surf Life Saving Australia	14#
Tasmanian Government	51, DR155
Thom, Prof. Bruce	DR128#
Torres Strait Regional Authority	DR152
Trowbridge, John; Minto, Jim and Berrill, John	DR164

(Continued next page)

Table A.1 (continued)

<i>Participant</i>	<i>Submission number</i>
Urban Development Institute of Australia	DR137
Victorian Centre for Climate Change Adaptation Research	56
Victorian Coastal Council	70
Victorian Local Governance Association	3
Water Services Association of Australia	52, DR147
Webb, Dr Bob	DR141#
Weller, Richard	DR165
Wentworth Group of Concerned Scientists	4#
Western Australian Farmers Federation	26
Western Australian Government	DR81
Western Australian Local Government Association	DR111
Western Suburbs Regional Organisation of Councils	DR119
Wondu Business and Technology Services Pty Ltd	DR89
Yarra Ranges Shire Council	DR144

^a A hash (#) indicates that the submission includes attachments. An asterisk (*) indicates that the submission contains confidential material NOT available to the public.

Table A.2 Public hearings

Participant

Sydney, 10 July 2012

Insurance Council of Australia
Byron Preservation Association
Coastal Residents Incorporated
Australian Psychological Society
Water Services Association of Australia
Gosford City Council
Property Council of Australia
Professor Bruce Thom
NSW Business Chamber
Richard Weller
Standards Australia

Melbourne, 16 July 2012

Suncorp
Yarra Ranges Council
Climate and Health Alliance
South East Councils Climate Change Alliance
Australian Building Codes Board
Australian Institute of Architects and Australian Sustainable Built Environment Council
National Climate Change Adaptation Research Facility
Uniting Care Australia
Bureau of Meteorology
Dr Garry Middle

Canberra, 18 July 2012

Housing Industry Association
CSIRO
Australian Chamber of Commerce and Industry
Sustainable Business Australia
Catchment to Coast Consultants
Dr Bob Webb

Adelaide, 20 July 2012

South Australian Department of Environment, Water and Natural Resources
South Australian Local Government Association
Professor Wasim Saman
South Australian Research and Development Institute

Table A.3 Meetings

Participant

Australian Capital Territory

Attorney-General's Department

AusAID

Australian Building Codes Board

Australian Industry Greenhouse Network

Australian Local Government Association

Australian Property Institute

Bureau of Meteorology

Climate Risk

CSIRO

Department of Agriculture, Forestry and Fisheries

Department of Climate Change and Energy Efficiency

Department of Defence

Department of Immigration and Citizenship

Department of Infrastructure and Transport (via phone)

Department of Resources, Energy and Tourism

Department of Sustainability, Environment, Water, Population and Communities

Department of the Prime Minister and Cabinet

Geoscience Australia

The Treasury

Tasmania

Antarctic Climate and Ecosystems Cooperative Research Centre

Clarence City Council

Forestry Tasmania

Tasmanian Government (inter-departmental meeting)

New South Wales

Infrastructure Partnerships Australia

Institute of Actuaries of Australia

Insurance Council of Australia

Investor Group on Climate Change

National Sea Change Taskforce

Lake Macquarie Council (via phone)

NSW Farmers' Association

NSW Government (inter-departmental meeting)

Professor Bruce Thom

Swiss Re

Sydney Coastal Councils Group

South Australia

South Australian Local Government Association (via phone)

(Continued next page)

Table A.3 (continued)

Participant

Victoria

Australian Conservation Foundation
Australian Energy Regulator
Business Council of Australia (via phone)
Municipal Association of Victoria
Risk Frontiers
Victorian Coastal Council
Victorian Government (inter-departmental meeting)
Victorian Local Governance Association (via phone)
Wellington Shire Council (via phone)

Western Australia

Adaptive Futures
Local Government Insurance Services
Pastoralists and Graziers Association
Western Australian Farmers Federation
Western Australian Government (inter-departmental meeting)
Western Australian Local Government Association (via phone)

Queensland

Brisbane Airport
CSIRO Climate Adaptation Flagship
Gold Coast City Council
Local Government Association of Queensland
Maranoa Regional Council (via phone)
National Climate Change Adaptation Research Facility
Queensland Office of Climate Change
South East Queensland Council of Mayors

New Zealand

Canterbury Earthquake Recovery Authority
Christchurch City Council
Earthquake Commission
Environment Canterbury
Local Government New Zealand
New Zealand Ministry of Civil Defence and Emergency Management
New Zealand Ministry for the Environment
New Zealand Treasury

Table A.4 Roundtables

<i>Participant</i>	<i>Organisation</i>
Sydney — 7 February 2012	
Nicholas Scofield	Allianz
Duncan Anderson	Attorney-General's Department
John Trowbridge	Centre for International Finance and Regulation
Andy Kollmorgen	Choice
Peter McCarthy	Institute of Actuaries of Australia
Tim Andrews	Institute of Actuaries of Australia
David Wellfare	Insurance Australia Group
George Karagiannakis	Insurance Australia Group
Karl Sullivan	Insurance Council of Australia
Cameron Hick	Munich Re
Anthea McClintock	NSW Department of Trade and Investment
Richard Tooth	Sapere Research Group
Annabelle Butler	Suncorp
Nicole Gamerov	Swiss Re
Jerome Davidson	The Treasury
Melbourne — 14 February 2012	
Adrian Beresford-Wylie	Australian Local Government Association
Jennifer Bennett	Central NSW Councils
Rosa Gagetti	City of Port Adelaide Enfield
Andrew Paul	Clarence City Council
Bruce Thom	Coasts and Climate Change Council
Shelley Franklyn	Darwin City Council
Lalage Cherry	Department of Climate Change and Energy Efficiency
David Corkill	Gold Coast City Council
Tracy Taylor	Goulburn Broken Greenhouse Alliance
Jennifer Scott	Ku-ring-gai Council
Dorean Erhart	Local Government Association Queensland
Sally Rice	Moira Shire Council
Jarrod Filosa	Mornington Peninsula Shire Council
Ben Morris	Municipal Association of Victoria
Bob Savage	North Burnett Regional Council
Kent Boyd	Parkes Shire Council
Joanne Ludbrook	Peron Naturaliste Partnership
Melanie Bainbridge	Western Australian Local Government Association
Melbourne — 15 February 2012	
David Prestipino	Attorney General's Department
Sugi Sivarajan	Australian Energy Regulator
Terry Rossitto	Brisbane Airport Corporation
Mark Rogers	Colonial First State
Jo Mummery	Department of Climate Change and Energy Efficiency
David Mitchell	Department of Infrastructure and Planning (NSW)
Debra Robertson	Department of Infrastructure and Transport
Tom Garrish	Department of Transport (Victoria)

(Continued next page)

Table A.4 (continued)

<i>Participant</i>	<i>Organisation</i>
Garth Crawford	Energy Networks Association
Anna Brakey	Independent Pricing and Regulatory Tribunal (NSW)
Jonathan Kennedy	Infrastructure Partnerships Australia
Ilya Zak	Infrastructure Partnerships Australia
David O'Toole	Office of Environment and Heritage (NSW)
Claudio Battilana	Victoria Managed Insurance Authority

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