Australian Government

Department of Climate Change and Energy Efficiency

THE ROLE OF REGULATION IN FACILITATING OR CONSTRAINING ADAPTATION TO CLIMATE CHANGE FOR AUSTRALIAN INFRASTRUCTURE:

Report for the Department of Climate Change and Energy Efficiency

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TABLE OF ABBREVIATIONS

Abbreviation	Definition
ABCB	Australian Building Codes Board
ACCC	Australian Competition and Consumer Commission
ACCCA	Australian Centre for Climate Change Adaptation
ACMA	Australian Communications and Media Authority
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
Alliance Guidelines	Policy for Alliance Contracting and a Practitioner's Guide to Alliance Contracting
Basin Plan	Murray-Darling Basin Plan
BBC	Building Better Cities Program
BCA	Building Code of Australia
BMP	Bushfire Management Plan
COAG	Council of Australian Governments
DBCDE	Department of Broadband, Communications and the Digital Economy
DMIA	Demand Management Innovation Allowance
DMIS	Demand Management Incentive Scheme
EAAP	Energy Adequacy Assessment Projection
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ESD	Ecologically Sustainable Development
IPCC	Intergovernmental Panel on Climate Change
MCE	Ministerial Council on Energy
National PPP Guidelines	National Public Private Partnership Guidelines
NBN	National Broadband Network
NCCAF	National Climate Change Adaptation Framework
NCCARF	National Climate Change Adaptation Research Facility
NEL	National Electricity Law
NEM	National Electricity Market

Abbreviation	Definition
NER	National Electricity Rules
NPPPG	National Public Private Partnership Guidelines
NSP	Network Service Provider
NWI	National Water Initiative
PASA	Projected Assessment of System Adequacy
PPPs	Public Private Partnerships
PSC	Public Sector Comparator
PTSV	Public Transport Safety Victoria
RIS	Regulatory Impact Statement
SEPPs	State Environment Protection Policies
Telecommunications Act	*Telecommunications Act 1997* (Cth)
TCP	Transport Co-ordination Plan
WICA	*Water Industry Competition Act 2006* (NSW)
WSUD	Water Sensitive Urban Design

EXECUTIVE SUMMARY

Infrastructure plays a critical role in Australia. It supports economic activity, links people to services, helps improve productivity and enhances our lives. Notably, the initial investment in infrastructure is typically significant. In addition, major infrastructure often has a long lifespan. Therefore, it is imperative that our infrastructure is designed, built, operated and maintained in a way that enables it to withstand current as well as future impacts, including climate change.

The vulnerability of our infrastructure to climate change and its effects will depend upon a variety of factors, including the type of infrastructure in question, its location, design, age, relative usage and the particular climate change risks to which the infrastructure might be subject. Furthermore, resilience of infrastructure to the effects of climate change will depend, at least in part, upon the applicable regulatory framework and the extent to which that framework fosters adaptation to climate change by reducing or eliminating the risk of harm or damage or hinders adaptation to climate change by failing to protect infrastructure from the impact of climate change, now or in the future.

This Report contains an examination of the regulatory frameworks affecting some of Australia's most important infrastructure to determine the extent to which these frameworks constitute barriers to adaptation or facilitate effective adaptation. The objectives underlying these frameworks, the regulatory approaches, focus and available tools are, for the most part, distinct. Consequently, there is also some variation in the extent to which these frameworks are capable of facilitating or hindering adaptation to climate change. Nevertheless, all regulatory frameworks considered in this Report include elements that could facilitate adaptation to climate change, although all regulatory frameworks considered also include elements that may hinder adaptation to climate change.

In summary, elements of the regulatory frameworks that could hinder adaptation to climate change include:

- Lack of explicit or implicit recognition of the need to adapt to climate change
- Regulatory framework only applies to new infrastructure and does not apply to existing infrastructure
- Lack of harmonisation and fragmentation of approach within jurisdictions and between jurisdictions
- Inadequate, inconsistent or outdated information regarding climate change risks
- Inability to review regulations or standards with sufficient frequency
- Implementation is ineffective
- Compliance is too difficult or too costly
- Enforcement mechanisms are weak or too costly to pursue

The regulatory frameworks contained a range of tools that could be particularly useful in facilitating adaptation to climate change, including:

- Performance-based standards, which provide flexibility to respond to the uncertain effects of climate change.
- Technical standards or guidelines for new and existing infrastructure to ensure that such infrastructure is designed, constructed and operated in a way that is resilient to climate change risks.

- Codes of practice, which could be used to ensure that climate change risks are accounted for as part of ongoing management and operation of existing infrastructure.
- Infrastructure management plans and associated service delivery plans that are periodically reviewed to ensure that climate change effects are addressed as they evolve over time.
- Licences, approvals and accreditation, which can be made conditional on adequate assessment and management of climate change risks.
- In-built risk assessment processes, which provide an opportunity for climate change risks to be included in existing regimes for risk assessment.
- Computer-based modelling tools to assist targets of regulation with assessment of climate change risks and, therefore, compliance with adaptive management regulation.
- Fitness for purpose obligations that could be used to ensure that infrastructure has been designed to cope with current and future climate change risks.
- Third party access to infrastructure, which provides an opportunity to diversify infrastructure that may, in turn, increase resilience.
- Market mechanisms, which can flexibly and dynamically account for climate change risks in determining the most efficient allocation of resources affected by climate change with limited government intervention.
- Incentives to drive changes in practices to better account for climate change risks.
- Mandatory disclosure about infrastructure performance and climate change risks to motivate entities to assess risks and provide information to consumers/users about those risks.
- Stakeholder engagement in the design and implementation of regulation to foster support for climate change action.

The challenge that climate change presents for Australia's infrastructure and associated services cannot be overstated. There is a risk that existing regulatory frameworks might 'lock in' maladaptive action, which could compromise the short, medium and long-term resilience of our infrastructure. A new approach is needed to ensure that effective responses to climate change are embedded in relevant regulatory frameworks so that our infrastructure and associated services are resilient to climate change as we move into the future.

Designing a regulatory framework that effectively facilitates adaptation of Australia's infrastructure to climate change is a complex and challenging exercise. Such a framework will need to address the risks that climate change poses for such infrastructure, not just in the short to medium term, but also for the duration of the life of the infrastructure. Additionally, the framework will need to address the considerable uncertainties associated with climate change, including the location, nature, timing and severity of climate change impacts or events that may occur. Finally, the framework will need to be compatible with regimes that are currently in place for the regulation of infrastructure.

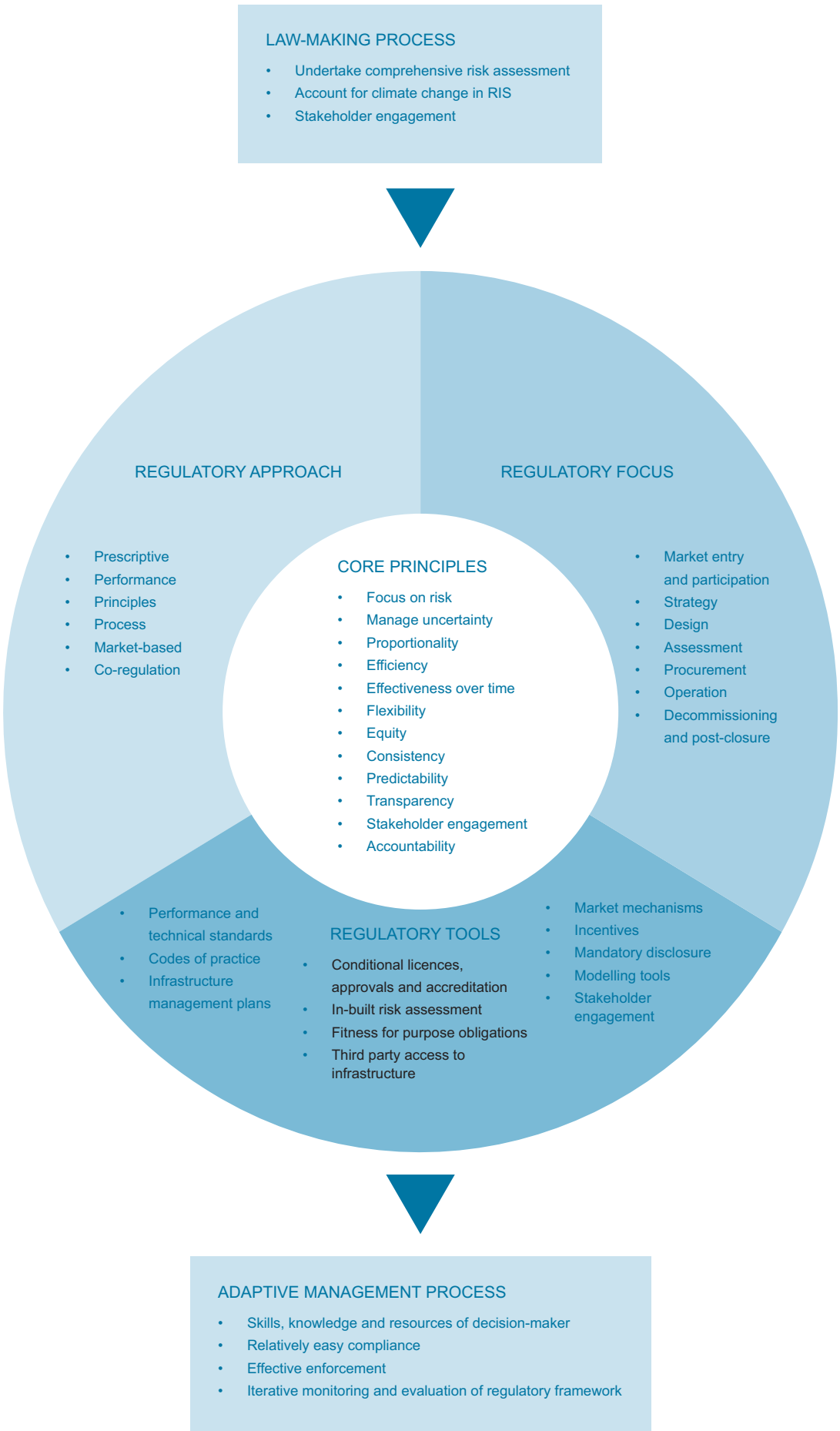
In order to account for the diversity of infrastructure and associated regulatory frameworks as well the spectrum of climate change impacts that might materialise, any framework for adaptation to climate change must necessarily centre around core principles, which will help to guide the way in which regulatory frameworks are designed, implemented and applied in practice. These core principles must be complemented by a careful consideration of elements of the broader framework within which the principles for adaptive regulation are applied to maximise the effectiveness of regulatory responses to climate change. They must also be combined with a law-making process and implementation mechanisms that effectively account for the impact of climate change. This framework is summarised overleaf.

Regulatory responses to climate change will need to address the particular risks that arise in relation to the various types of infrastructure and associated services.

DESIGNING THE REGULATORY FRAMEWORK

ELEMENTS OF THE REGULATORY FRAMEWORK

IMPLEMENTING THE REGULATORY FRAMEWORK



In this regard, it is critical that risks are neither over-estimated nor under-estimated to ensure that the regulatory response matches the true level of risk, rather than being excessive or inadequate. More intrusive regulatory intervention is justified when the overall risk is greatest, whereas less interventionist tools are preferable where the overall risk is relatively low.

As yet, a comprehensive identification and assessment of climate change risks has not been undertaken for the spectrum of Australia's infrastructure. This is understandable given the significant costs and resources required to undertake a comprehensive and useful assessment of the risks. Nevertheless, this assessment is an essential and indispensable precursor to the design of regulatory responses. Ideally, the assessment would be undertaken with the involvement of regulators so that the particularities associated with specific regulatory frameworks can be addressed during the risk assessment phase. Furthermore, the body that is best placed and resourced to undertake the risk assessment should be made responsible to do so, which, in some cases, will be private businesses operating in a particular sector.

Another area of further work relates to addressing the risks posed by climate change to existing infrastructure. Existing infrastructure is likely to be significantly more vulnerable to the impact of climate change than new infrastructure. Yet, most existing regulatory regimes apply to new infrastructure. In the future, serious consideration will need to be given to ways in which existing infrastructure can be made more resilient to climate change and how 'retreat' strategies may be supported by regulation. This will require consideration of property rights, constitutional provisions, insurance, risk sharing, government funding and new regulatory instruments.

Dealing with the uncertainty regarding climate change effects – particularly, the relatively unlikely yet catastrophic climate change events – through regulation is another area for further work. Consideration will need to be given to whether regulatory frameworks can be amended to mandate identification and assessment of these events (as well as the more certain and less catastrophic events) in relation to the design, construction, management, operation and use of infrastructure. It will also be necessary to determine whether, from a legal and practical perspective, regulation can be used to require infrastructure to be capable of responding to these events, even though the likelihood of occurrence is relatively low.

The various levels of government have a role to play in facilitating adaptation to climate change through law-making, policy development and implementation of adaptation regulation in relation to infrastructure and associated services. Notably, the review and amendment of regulatory frameworks to ensure that infrastructure and associated services are capable of responding to the impact of climate change entails a significant reform agenda, which will require leadership at a national level. The federal government is ideally positioned to provide such leadership given its ability to capitalise on economies of scale and its considerable fiscal powers. The federal government would be best placed to provide much-needed guidance and up-to-date information, promote best practice and ensure consistency and equity across the country.

Based on the fact that most of the pre-existing regulatory frameworks affecting infrastructure and associated services have already been developed by the state and territory governments, this level of government would be best placed to modify existing regimes. The States and Territories might also play an important role in tailoring state/territory policy frameworks that could be used to facilitate adaptation to climate change to ensure that they are consistent with any national framework that might be adopted. Local governments are closer to citizens than the other levels of government. Therefore, councils would be best placed to implement national and state/territory policies aimed at addressing the impact of climate change at a local level.

Consideration could also be given to establishing a national body to assist the federal, state, territory and local governments with the practical and effective implementation of climate adaptation polices and regulation. Such a body could have members appointed by state, territory and local governments as well as the federal government.

CHAPTER 1: INTRODUCTION

A. Purpose of the Report

1.1 The purpose of this Report is to examine the regulatory frameworks affecting some of Australia's most important infrastructure to determine the extent to which these frameworks constitute barriers to adaptation or facilitate effective adaptation. The Report will focus on regulatory frameworks affecting the built environment, particularly land use planning, environmental assessment and building standards. It will also address the regulation of pricing, performance and reliability of essential services provided by physical infrastructure – particularly, electricity, water, transport, communications and waste. The Report will also review the regulatory context for contractual arrangements pursuant to which major infrastructure projects are now undertaken, including public private partnerships. Finally, the Report will set out principles to underpin adaptive regulation to address climate change and make recommendations for appropriate further areas of work.

1.2 Australia's infrastructure includes the physical structures and associated services that are needed for the operation of our society, such as our buildings, water, electricity, transport, communications and waste management. Infrastructure supports economic activity, links people to services, helps improve productivity and enhances our lives.

1.3 Apart from the critical role that infrastructure plays in society, the initial investment is typically significant. In addition, major infrastructure often has a long lifespan. Therefore, it is imperative that our infrastructure is designed, built, operated and maintained in a way that enables it to withstand current as well as future impacts, such as climate change.

1.4 Climate change poses significant challenges for owners, operators and users of infrastructure. Higher concentrations of greenhouse gases in the atmosphere leading to climate change have been linked to a broad range of physical phenomena in Australia, including higher temperatures, lower rainfall and drought, sea level rise and flooding, bushfires and increased frequency and intensity of extreme weather events such as storms and cyclones. The vulnerability of our infrastructure to climate change and its effects will depend upon a variety of factors, including the type of infrastructure in question, its location, design, age, relative usage and the particular climate change risks to which the infrastructure might be subject.

1.5 Resilience of infrastructure to the effects of climate change will depend, at least in part, upon the applicable regulatory framework and the extent to which that framework fosters adaptation to climate change by reducing or eliminating the risk of harm or damage. In some cases, existing regulatory frameworks may support adaptation to climate change. However, in other cases, regulatory frameworks may hinder adaptation to climate change or result in maladaptation.

1.6 Regulation can play an important role in facilitating adaptation to climate change. Addressing regulatory barriers and constraints to adaptation and fully exploiting opportunities that may exist to achieve effective adaptation will help to make our built environment and essential infrastructure more resilient – and, therefore, less vulnerable – to the effects of climate change.

B. Key climate change risks

1.7 Identification, recognition and assessment of the climate change risks to which infrastructure may be exposed is a critical first step in determining whether the applicable regulatory frameworks adequately respond to those risks. More specifically, a necessary precursor to evaluating regulatory frameworks to determine whether they support or hinder adaptation to climate change is a clear understanding of the relevant climate change risks. Ideally, the regulatory response(s) should be commensurate with the risks. Furthermore, the regulatory framework should be capable of responding to climate change risks as they evolve over time.

1.8 This section of the Report summarises the key climate change risks and projections for climate variables that are likely to have an impact upon infrastructure and associated services in Australia. More details are provided in Appendix A to the Report.

(i) Global climate change effects

1.9 The work of the Intergovernmental Panel on Climate Change (**IPCC**) provides important context for climate change risks in Australia. The IPCC is the leading international body for the assessment of climate change. Its main objective is to provide the world with a clear scientific view on the current state of knowledge regarding climate change and its potential environmental and socio-economic impacts.

1.10 The IPCC 4th Assessment Report provides a comprehensive overview of global climate change risks. It concluded that warming of the climate system is unequivocal, that emissions of greenhouse gases have grown since pre-industrial times, and that most of the increase in global temperatures since the mid-20th century is very likely due to the increase in man-made greenhouse gas concentrations.[1] As well as influencing average temperatures, greenhouse gases are affecting temperature extremes, increasing the risk of heat waves, changing wind patterns, raising sea levels and having an impact on biological systems.[2]

1.11 The IPCC found that temperatures would continue to increase in this century even with mitigation of greenhouse gas emissions. The IPCC projected an average temperature increase of about 0.2°C per decade for the next two decades. After that, temperature projections and other climate impacts, such as sea level rise, increasingly depend on the specific emission scenarios that might prevail.

1.12 The IPCC projected a range of temperature increases based on six 'SRES scenarios'[3] of greenhouse gas emission trajectories until 2100, each reflecting a different level of emissions. The IPCC gave a 'likely range' of temperature change for each of the scenarios, ranging from 1.1°C to 2.9°C for the B1 scenario (the lowest emission scenario) to 2.4°C to 6.4°C for the A1F1 scenario (the highest emission scenario).

1.13 Climate science is a rapidly moving field. Since the IPCC 4th Assessment Report was released in 2007, new scientific developments have occurred that indicate climate impacts may be even greater than previously thought. Key examples of cases where the impacts may be worse than previously projected by the IPCC are sea level rise and the loss of Arctic sea ice.[4] Recent projections indicate that sea level rise may well exceed 1 metre by 2100 with a possible upper limit of 2 metres.[5]

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1 International Panel on Climate Change (**IPCC**) Working Group 1, *Contribution to the Fourth Assessment Report of the IPCC*: *The Physical Science Basis, Summary for Policy Makers* (2007) pp. 2,5, 10 .
2 IPCC, Climate Change 2007, Synthesis Report, p. 30.
3 SRES relates to scenarios identified in the IPCC Special Report on Emission Scenarios (2000). They are B1, A1T, B2, A1B, A2 and A1FI and represent scenarios resulting in around 600, 700, 800, 850, 1250 and 1,550 ppm CO_2 –e respectively.
4 W. Steffen, *Climate Change 2009, Faster Change and More Serious Risks* (2009) p. 1.
5 I. Alison et al, *The Copenhagen Diagnosis, Updating the World on the Latest Climate Science* (University of New South Wales, 2009) p. 7.

1.14 Long term feedbacks in the climate system, including dynamic processes in polar ice sheets and natural carbon sinks, may have irreversible impacts. The very unpredictability of climate change and the associated impacts is partly what makes it so dangerous. As Professor Will Steffen, one of Australia's leading climate science experts, has said:

> [C]limate change is not proceeding only as smooth curves in mean values of parameters such as temperature and precipitation. Climatic features such as extreme events, abrupt changes and the nonlinear nature of climate system processes will increasingly drive impacts on people and ecosystems.[6]

(ii) Key climate change effects in Australia

1.15 There may be considerable variation in the specific impacts of climate change at the regional and local levels. The IPCC highlighted the following impacts on Australia:[7]

- By 2020, significant loss of biodiversity is projected to occur in some ecologically rich sites, including the Great Barrier Reef and the Wet Tropics.
- By 2030, water security problems are projected to intensify in southern and eastern Australia.
- By 2030, production from agriculture and forestry is projected to decline over much of southern and eastern Australia due to increased drought and fire.
- By 2050, ongoing coastal development and population growth in some areas of Australia are projected to exacerbate risks from sea level rise and increases in the severity and frequency of storms and coastal flooding.

1.16 The IPCC also found that altered frequencies and intensities of extreme weather, together with sea level rise, are expected to have adverse effects on natural and human systems and that global warming could lead to some abrupt and irreversible impacts.[8]

1.17 A technical report prepared by the CSIRO and the Bureau of Meteorology in 2007 provides additional insights into likely future climate change effects in Australia.[9] The Technical Report contains projections for a number of climate variables such as temperature, precipitation, sea level rise, extreme wind events and sea surface temperature. This Report contains CSIRO's projections for 2030, 2050 and 2070. For some climate change variables, probability distributions have been assigned by the CSIRO, while others are more uncertain. Some of the most important projections in the Technical Report are:

- *Temperature*: Australian average temperatures have risen by 0.9°C since 1950, with significant regional variations. By 2070, the warming projections range from 2.2 to 5.0 °C for the high emissions scenario. There is a significant regional variation with less warming in the south and north-east and more inland.[10] Substantial increases in the frequency of very hot days over 35°C are projected for most parts of the country.
- *Precipitation*: There is significant uncertainty regarding precipitation projections based on climate modelling. Considerable research is being undertaken regarding the potential links between climate change and the decline in rainfall in southern Australia. The evidence is now strong for a climate change link to the drying in south-west Australia and there is some evidence of a climate change influence on the decline of rainfall in south-east Australia.[11]

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6 Ibid.
7 IPCC, above fn 1, p. 50.
8 IPCC, above fn 2, p. 52–53.
9 CSIRO and the Bureau of Meteorology, *Climate Change in Australia Technical Report* (Canberra, 2007).
10 CSIRO and the Bureau of Meteorology, above fn 9, pp. 53–58.
11 CSIRO, *Climate variability and change in south-eastern Australia: A synthesis of findings from Phase 1 of the South Eastern Australian Climate Initiative* (SEACI, 2010), p. 1–2.

- *Rainfall intensity*: CSIRO modelling projects strong increases in precipitation intensity this century with longer dry spells and more intense rainfall events.[12] These events will occur throughout the year in the north, and in the summer and autumn in the south.
- *Solar radiation, humidity and evaporation*: CSIRO projects increases in solar radiation in southern Australia. Small decreases are projected in relative humidity for most of Australia. Annual evapotranspiration from soil, vegetation and water surfaces is projected to increase.[13]
- *Drought*: Drought is projected to increase over most of Australia, but particularly over south-west Australia. The frequency and intensity of agricultural drought is influenced not only by decreasing rainfall, but also by increasing temperatures and evaporation. Climate simulations show up to 20% more drought months over most of Australia by 2030, with up to 40% more droughts by 2070 in eastern Australia and up to 80% more in south-west Australia.[14]
- *Wind speed*: There is variation between different climate models regarding the impact of climate change on wind speed. Depending upon the level of emissions, higher wind speeds are projected for 2070 of up to 15% in some regions.
- *Fire weather*: The number of days when the Forest Fire Danger Index is very high or extreme is likely to rise substantially.[15]
- *Tropical cyclones*: Studies indicate a likely increase in intensity of tropical cyclones, but a possible decrease in their total number.[16]
- *Sea Level rise*: Actual sea level rise is currently tracking at or near the upper limit of IPCC projections.[17] Current projections indicate that sea level rise may well exceed 1 meter by 2100.[18] There is regional variability in sea level rise. Global climate models indicate that sea level rise on the east coast of Australia may be greater than the global mean sea level rise.[19] Sea level rise will be exacerbated by storm surges that will enable inundation to penetrate further inland.[20] A modest increase in sea level rise is likely to cause a large increase in the frequency of extreme sea level events associated with high tides and storm surges.[21]
- *Marine changes*: By 2030, the CSIRO projects that sea surface temperatures will rise between 0.6 – 0.9°C in the southern Tasman Sea and north-west shelf of Western Australia and 0.3 – 0.6°C elsewhere. Temperatures will continue to rise beyond these levels depending on the emissions scenario. Increases in ocean acidity are also expected with the largest increases in the high to mid-latitudes.[22]

12 CSIRO and the Bureau of Meteorology, above fn 9, p. 73.
13 CSIRO and the Bureau of Meteorology, above fn 9, p. 80.
14 CSIRO and the Bureau of Meteorology, above fn 9, p. 83 citing F. Mpelasoka, K. Hennessy, R. Jones, B. Bates, *Comparison of suitable drought indices for climate change impacts assessment over Australia towards resource management* (Royal Meteorological Society, 2007).
15 CSIRO and the Bureau of Meteorology, above fn 9, pp. 90–91.
16 CSIRO and the Bureau of Meteorology, above fn 9, p 102.
17 W. Steffen, above fn 4, p. 8.
18 I. Alison et al, above fn 5, p. 9.
19 CSIRO and the Bureau of Meteorology, above fn 9, p. 92.
20 CSIRO and the Bureau of Meteorology, above fn 9, p. 94.
21 W. Steffen, above fn 4, p. 12.
22 CSIRO and the Bureau of Meteorology, above fn 9, pp. 98 and 100.

(iii) Climate change and uncertainty

1.18 While global warming is unequivocal, there are many aspects of climate change that are uncertain. Confidence regarding likely outcomes for key climate change variables is higher for some variables (e.g. temperature) than for others (e.g. precipitation) and is generally greater for larger areas and longer time periods. Some of these uncertainties are associated with the science and some with the impact of other variables in the future, such as the rate of economic growth and the level of greenhouse gas emissions. In most cases, it is therefore preferable to consider a range of greenhouse gas emission scenarios and climate change estimates.

1.19 Key uncertainties associated with climate change projections include:[23]

- Climate sensitivity to CO_2 concentrations;
- Strength of feedbacks in the climate system, such as cloud feedbacks, ocean heat uptake and carbon cycle;
- Interactions with other climate drivers (e.g. El Niño –Southern Oscillation);
- Aerosol impacts on the temperature and precipitation;
- Future changes in Greenland and Antarctic ice sheet mass affecting sea level rise;
- Low-probability/high impact (extreme) events and the cumulative impacts of smaller events;
- Locational specificities of climate change impacts;
- Greenhouse gas emissions in the future and the trajectory of carbon mitigation;
- Population growth and economic growth; and
- Adaptive capacity of various species, including humans

1.20 In light of these uncertainties, policy makers and regulators need to be aware that even the upper bounds of current projections may be conservative. The CSIRO and Bureau of Meteorology Technical Report (2007) confirmed this:

> [I]t must be borne in mind that, in particular, the upper limits of warming presented here …are conservative. There is a significant possibility that warming may occur in excess of these values, particularly later in the century, although the likelihood of this occurrence is impossible to estimate at this stage.[24]

1.21 The uncertainties associated with climate change – both in the short and long term – make the design of regulatory responses to address the effects of climate change particularly complex and challenging. In order to achieve effective adaptation to climate change, these responses must somehow account for the range of uncertainties that exist, including addressing relatively certain and predictable changes, relatively uncertain and unpredictable changes, progressively worsening changes, complex feedback mechanisms, extreme events and differences in climatic impacts across locations.

1.22 It is probably fair to say that, as yet, regulatory frameworks for Australia's infrastructure have not had to respond to as fraught and confounding a challenge as climate change. The serious consequences that may ensue for our infrastructure and associated services highlights the need for responsive regulatory frameworks. Some of these consequences are discussed in the next section of the Report.

23 IPCC, above fn 2, p. 73.
24 CSIRO and the Bureau of Meteorology, above fn 9, p. 46.

C. Impact of climate change on infrastructure

1.23 Climate change will have direct impacts on infrastructure, although the specific consequences of particular climate change risks for infrastructure and associated services will depend upon a variety of factors, including:

- Type and location of infrastructure
- Nature of climate change risk
- Likelihood/certainty of occurrence
- Impact and downstream consequences

1.24 As yet, a comprehensive identification and assessment of climate change risks has not been undertaken for the spectrum of Australia's infrastructure. As mentioned earlier in this Report, such an assessment is a critical first step in determining whether the regulatory frameworks applicable to the various types of infrastructure and associated services are capable of responding to current and future climate change risks.

1.25 Set out below are the main climate change risks for each of the types of infrastructure and associated services under consideration in this Report, with an analysis of each of the factors listed in paragraph 1.23 above. These tables utilise the analysis contained in a report entitled *Infrastructure and Climate Change Risk Assessment for Victoria* prepared for the Victorian Government in 2007[25] together with information contained in the CSIRO and the Bureau of Meteorology's 2007 Technical Report.[26]

25 CSIRO, Maunsell Australia Pty Ltd, Phillips Fox, *Infrastructure and climate change risk assessment for Victoria*, Report to the Victorian Government, 2007.
26 CSIRO and the Bureau of Meteorology, above fn 9.

(i) Built environment

1.26 There are a range of climate change effects that may affect the stability, operation and, potentially, the ongoing viability of buildings and the broader built environment. However, built assets are spread over a variety of areas. Therefore, the specific effects may vary depending upon where particular buildings are located. In general terms, the main vulnerability of the built environment to climate change is from extreme events, such as bushfires, storms and floods, although increased temperatures and drought will also have an impact on buildings. Buildings in coastal areas will also be particularly vulnerable to sea level rise and storm surges, as shown in Table 1 below.

Table 1. Impact of climate change on the built environment

Risk Scenario	Climate variable	Impact	Consequences	Likelihood	Region	Risk[27] 2070
Degradation and failure of foundations	Increase in temperature and heatwaves Decrease in rainfall Increase in evaporation	Degradation of foundations caused by ground movement with drying soils	Failure of foundations Increased maintenance and building costs Higher insurance costs Impact on property prices Community anger	High	Southern Australia	High
Degradation and failure of building materials	Increase in temperature and heatwaves Increased solar radiation Variations in humidity	Degradation of building materials caused by solar radiation, humidity, soil movement	Failure of materials Increased maintenance and building costs Higher insurance costs Impact on property prices Community anger	High	Southern Australia	Moderate
Bushfire	Increased high bushfire risk days	Bushfire damage to buildings and settlements	Fatalities and injuries Cost of rebuilding Loss of use of buildings Increased cost of fire prevention Community anger / fracture	High	Southern Australia	Extreme

Table 1 continued

Risk Scenario	Climate variable	Impact	Consequences	Likelihood	Region	Risk[27] 2070
Storm and flood damage	Increase in extreme rainfall events Increase in extreme wind intensity	Damage to buildings and settlements due to flooding, debris, fallen trees, winds	Fatalities and injuries Cost of rebuilding Loss of use of buildings Higher insurance and maintenance costs Community anger / fracture	High	All	Extreme
Coastal flooding and storm surge	Sea level rise Increase in extreme rainfall events Increase in extreme wind intensity	Damage to buildings and settlements due to flooding, debris, fallen trees, winds	Fatalities and injuries Cost of rebuilding Permanent loss of use of flooded/at risk areas Higher insurance and maintenance costs Impact on property prices Community anger / fracture	High	All	Extreme

27 The 2070 risk identified in this and subsequent tables summarising the impact of climate change on various types of infrastructure is based on a high emissions scenario.

(ii) Supply of electricity

1.27 Demand for electricity will be affected by climate change. In particular, increased temperatures will result in warmer winters and hotter summers. This, in turn, will change the pattern of energy consumption by decreasing demand for heating in winter and increasing demand for cooling in summer. In addition, extreme events might lead to spikes in demand and increase the risk of blackouts (e.g. heatwaves and bushfires) and/or put pressure on supply capacity (e.g. storm surges and floods). Drought may constrain hydroelectric generating capacity by limiting the availability of water for cooling in some coal-fired generators, as explained in Table 2 below.

Table 2. Impact of climate change on the supply of electricity

Risk Scenario	Climate variable	Impact	Consequences	Likelihood	Region	Risk 2070
Increase in user demand and peak load days	Increase in temperature and heatwaves	Increased peak load requirements Peak load stress causing blackouts	Potential deaths from heat stress Loss of production Need to build more peak generation capacity Increased maintenance and new generation costs Increased electricity prices Community anger	High	All	Extreme
Degradation and failure of foundations and structures	Increase in temperature and heatwaves Increased solar radiation Increase in evaporation	Degradation of foundations of power transmission and generation caused by ground movement Degradation of building materials	Failure of materials Increased maintenance and building costs Higher electricity costs	High	All	Moderate

Table 2 continued

Risk Scenario	Climate variable	Impact	Consequences	Likelihood	Region	Risk 2070
Bushfire	Increased high bushfire risk days Increase in lightning strikes	Arcing and bushfire ignition from transmission lines Bushfire damage to transmission lines and generation Loss of power and blackouts	Fatalities, injuries, property damage Loss of production Increased costs associated with reducing fire risk Community anger / fracture	High	Southern Australia	Extreme
Storm and flood damage	Increase in extreme rainfall events Increase in extreme wind intensity	Damage to generation and transmission due to flooding, debris, fallen trees, winds Loss of power and blackouts	Cost of rebuilding Loss of production Higher insurance and maintenance costs	High	All	High
Water shortage	Increase in temperature and heatwaves Decrease in rainfall Higher evaporation	Lack of water to supply hydro electricity generation Lack of water to supply coal generation plants	Less reliable electricity supply Need to build additional supply and more expensive cooling systems Higher electricity prices	High	All	High

(iii) Water resources and supply

1.28 Climate change will have a significant impact on the availability and quality of water resources because of the close connection between the climate and the natural water cycle. Water supplies may increase or decrease in particular areas depending on the projected changes in temperature and precipitation. Climate change is also likely to have a physical impact on the spectrum of water infrastructure that is used to capture, store and deliver water to users, as described in Table 3 below.

Table 3. Impact of climate change on water resources and supply

Risk Scenario	Climate variable	Impact	Consequences	Likelihood	Region	Risk 2070
Water shortage	Increase in temperature and heatwaves Decrease in rainfall Increase in evaporation	Decrease in stream flow run-off into dams Increased demand for garden watering	Water supply shortage Increased cost of supply Requirement for new supply/increased conservation	High	Southern Australia	Extreme
Damage to water supply piping	Increase in extreme rainfall events Increase in temperature and heatwaves Increase in drought frequency and decrease in soil moisture	Degradation of pipes caused by ground movement and flood events	Leaks and loss of water Added replacement and maintenance costs Reduced lifespan of piping	Moderate	All	High
Bushfire	Increased high bushfire risk days	Bushfire damage to catchment and water infrastructure	Contamination of reservoirs Reduced water yield during tree regrowth Increased cost of fire prevention	High	South-east Australia	Extreme
Sewer spills	Increase in extreme rainfall events	Flood events overload capacity of sewer network	Sewage spills into drainage networks, streams and bays	High	All	High

Table 3 continued

Risk Scenario	Climate variable	Impact	Consequences	Likelihood	Region	Risk 2070
Damage to sewerage pipes	Increase in extreme rainfall events Increase in temperature and heatwaves Increase in drought frequency and decrease in soil moisture	Degradation of pipes caused by ground movement and flood events	Leaks and sewer spills Added replacement and maintenance costs Reduced lifespan of piping	Moderate	All	High
Stormwater and flood damage	Increases in extreme rainfall events Sea level rise	Serious damage to property and risk to human life Damage to water infrastructure including reservoirs and sewage treatment plants	High costs of repair and replacement High costs of preventative action	High	All	Extreme
Damage to drainage infrastructure	Increase in extreme rainfall events Increase in temperature Increase in drought frequency and decreased soil moisture	Degradation of infrastructure caused by flood events and ground movement	Added replacement and maintenance costs Reduced lifespan and effectiveness of drainage	High	All	High

(iv) Transport

1.29 There is a broad range of transport infrastructure likely to be affected by climate change, including roads, rail, ports and airports. The physical effects of climate change that could pose particular challenges for transport infrastructure and associated services include higher temperatures and increased solar radiation, rising sea levels, increasing prevalence of bushfire events and storm surges and increases in storm severity, including lightning strikes, extreme winds and heavy rainfall. These effects are described in more detail below in Table 4 below.

Table 4. Impact of climate change on transport

Risk Scenario	Climate variable	Impact	Consequences	Likelihood	Region	Risk 2070
Degradation of roads	Increase in temperature and heatwaves Increased solar radiation Increase in extreme rainfall events Increased drought frequency and decrease in soil moisture	Degradation of road surface caused by heat, solar radiation Degradation of road foundations and drainage assets by increased ground movement with drying soils followed by high ground water events Flood damage to road surface and foundations Increased landslip and embankment failure	Increased maintenance and replacement costs Short term loss of access Financial impacts on councils and road authorities Community anger / fracture	High	All	Moderate to high
Rail track movement and damage	Increase in temperature and heatwaves	Degradation and buckling of rail tracks caused by heat	Interruption to rail services Rail safety risks Increased maintenance and replacement costs	High	All	High

Table 4 continued

Risk Scenario	Climate variable	Impact	Consequences	Likelihood	Region	Risk 2070
Airports damage and service interruption	Increase in temperature and heatwaves Increased solar radiation Increase in extreme rainfall events and sea level rise Increase in extreme wind Increased high bushfire risk days	Tarmac degradation Damage and accelerated degradation of airport infrastructure Reduced visibility from bushfire smoke and dust storms Coastal airports damaged from storm surge and sea level rise inundation	Increased maintenance and replacement costs Interruption to services Potential accidents	High	All	Moderate to high
Storm and flood damage to transport infrastructure	Increase in extreme rainfall events Increase in extreme wind intensity	Damage to buildings and infrastructure due to flooding, debris, fallen trees, winds Widespread bridge damage Tunnel flooding	Cost of rebuilding Short term loss of transport and bridge access Higher insurance and maintenance costs Community anger	High	All	Moderate to high
Coastal flooding and storm surge	Sea level rise Increase in extreme rainfall events Increase in extreme wind intensity	Damage to road and rail transport infrastructure adjacent to coast Degradation and failure of tunnel and bridge structures close to coast Degradation and corrosion due to salt infiltration in groundwater Damage to ports and jetties including water overtopping of sea wall protection	Cost of rebuilding or moving roads and transport Permanent loss of use of road and rail transport in flooded/at risk areas Higher insurance and maintenance costs Community anger / fracture	High	All	High

(v) Telecommunications

1.30 Telecommunications infrastructure will be particularly vulnerable to extreme events, including bushfires, floods and storm surges, particularly above ground infrastructure. Flooding and extreme heat resulting in drought and erosion also poses a risk to underground infrastructure, including copper and optical cables. These effects are described below in Table 5.

Table 5. Impact of climate change on telecommunications

Risk Scenario	Climate variable	Impact	Consequences	Likelihood	Region	Risk 2070
Damage to network – cables, transmission towers, infrastructure	Increase in temperature and heatwaves Increased solar radiation Increase in extreme wind Increase in extreme rainfall events Increase in drought frequency Increased high bushfire risk days	Damage to transmission infrastructure by wind, lightning, storm events and bushfires Degradation of foundations of telecommunications structures caused by heat, extreme weather events and ground movement	Loss of communications in emergency situation Increased maintenance and replacement costs Disruption of services Increased service charges	High	All	Moderate
Storm and flood damage to telecommunications infrastructure	Increase in extreme rainfall events Increase in extreme wind intensity Sea level rise and storm surge events	Damage to exchange stations and infrastructure due to flooding, debris, fallen trees, winds	Cost of repair Disruption of services Higher insurance and maintenance costs	High	All	Moderate to high

(vi) Waste

1.31 Climate change has the capacity to affect waste management processes in a number of ways, particularly increased temperature and extreme events, which could affect landfill degradation rates, leachate production and composition. As explained below in Table 6, climate change could also affect on-site facilities include gas and leachate collection systems.[28]

Table 6. Impact of climate change on waste

Risk Scenario	Climate variable	Impact	Consequences	Likelihood	Region	Risk 2070
Heat impact on kerbside refuse	Increase in temperature and heatwaves Increase in evaporation	Increased evaporation of contaminants and decay of refuse	Public health and amenity potentially harmed	High	All	High
Heat impact on landfills	Increase in temperature, heatwaves and storm surges	Damage to landfill caps and liners	Potential leaching of contaminants and escape of gases	High	All	High
Storm and flood damage to waste and landfills	Increase in extreme rainfall events Increase in extreme wind intensity	Leaching of contaminants from landfills Damage to waste infrastructure Waste debris and litter blown from site	Public health and environment potentially harmed Higher insurance and maintenance costs Community anger Loss of licence to operate	High	All	Moderate
Coastal flooding and storm surge damage to waste and landfill	Sea level rise Increase in extreme rainfall events Increase in extreme wind intensity	Damage to waste infrastructure Release of contaminants from landfills subject to inundation Inland movement of coastal erosion/beach line resulting in release of contaminants from previous and existing coastal industrial land	Public health and environment potentially harmed Cost of moving infrastructure Higher insurance and maintenance costs Community anger	High	All	High

28 Annals of the New York Academy of Sciences, *New York City Panel on Climate Change 2010 Report* (2010) pp. 103–104.

(vii) Natural environment, biodiversity and ecosystems

1.32 Climate change causes shifts in baseline ecosystem conditions, including temperature, hydrological conditions, soil conditions and air quality, which affects ecosystems' equilibrium. In turn, these changes affect the natural environment and biodiversity, which may have implications for the design, operation and use of infrastructure. These effects are described in more detail below in Table 7.[29]

Table 7. Impact of climate change on the natural environment

Risk Scenario	Climate variable	Impact	Consequences	Likelihood	Region	Risk 2070
Terrestrial biodiversity impacted	Increase in temperature and heatwaves Increase in solar radiation Decrease in rainfall and increased frequency of drought Increase in evaporation and high bushfire risk days	Changed habitat conditions and species movement Species extinction	Changes to climate conditions, weed and pest infestations for primary production Damage to tourism Loss of species of national and local significance	High	All	High
Marine biodiversity impacted	Increase in temperature and heatwaves Sea surface temperature Ocean acidification	Coral bleaching and mortality	Damage to tourism Loss of species of national and local significance Increased pest species infestations impacting fisheries	High	Great Barrier Reef	Extreme

1.33 The remainder of this Report seeks to determine whether the regulatory responses to deal with adaptation to the variety of climate change risks affecting the infrastructure and services under consideration constitute barriers to adaptation or facilitate effective adaptation. In assessing the adequacy of these regulatory responses, the specific climate change effects and associated risks will be considered to determine whether the responses are indeed commensurate with the relevant climate change risks.

29 W. Steffen, A Burbidge et al, *Australia's Biodiversity and Climate Change Summary for Policy Makers 2009* (Department of Climate Change, Canberra 2009).

CHAPTER 2: OVERALL ROLE AND APPROACH TO REGULATION

2.1 Regulation is potentially an important tool to achieve adaptation to climate change. Some regulatory frameworks may already provide mechanisms to facilitate adaptation whereas other frameworks may impede adaptation.

2.2 To provide context for the examination of regulatory frameworks relating to infrastructure and associated services and the extent to which these frameworks adequately respond to the challenges posed by climate change, this section of the Report considers the role of regulation in society, particularly, the circumstances when regulatory responses may be needed and the various regulatory approaches that may be adopted.

A. Role and function of regulation in society

2.3 In general terms, regulation is a principle, rule, or law designed to control or govern conduct. Regulation can take many forms, including rules prescribed by government with which compliance is required. Law-makers and regulators tend to adopt a narrow interpretation of what constitutes regulation, confining the term to rules with which compliance is expected. For example, the federal government's definition of regulation is that it is:

> [A]ny 'rule' endorsed by government where there is an expectation of compliance, for example, primary legislation (acts), subordinate legislation (legislative or non-legislative instruments), treaties and quasi-legislation.[30]

2.4 However, in its most general sense, regulation also includes rulings and guidelines where the government seeks to influence businesses and individuals to comply but the consequences of non-compliance may not be as severe as in a strictly rules-based regime.

2.5 Compliance with regulation will necessarily entail costs for the government administering the regulation as well as the entities that are subject to the regulation. Nevertheless, regulation may be justified in spite of the costs in a variety of circumstances – namely, in cases where it is in the public interest, when market failures occur and when unmanageable risks exist. The rationale for regulation in a given case will shape the regulatory objectives, the emphasis of the regulatory regime and the approach to regulation.

(i) Public interest

2.6 Regulation can be used when it is considered necessary in the public interest. While the notion of 'public interest' is somewhat amorphous and may vary depending upon the values and broader context of the society in which the assessment of public interest is made, in general terms, it relates to an interest involving the welfare of the general public that warrants recognition, promotion, and protection through regulation.

30 Australian Government, *Best Practice Regulation Handbook* (2007) p. xiii.

2.7 Public interest regulation is useful for the prevention or minimisation of harm or for the promotion of a public good. It may relate to health, welfare, safety, property or to the environment.

2.8 An example of public interest regulation exists in the context of the transport sector, where rail operators may be required to obtain safety accreditation in order to ensure that rail infrastructure is safe and reliable.[31] Another example is regulation to facilitate effective preparation for and response to emergencies and disasters.[32] This type of regulation is likely to be particularly important for climate change adaptation.

(ii) Market failure

2.9 Regulation may also be appropriate as a mechanism to correct market failures – that is, where the allocation of goods and/or services by a free, unregulated market is inefficient. Market failures may occur in a number of circumstances.

- Market power: Markets can fail where there are too few suppliers, too few purchasers or where market participants collude to prevent free competition. Government intervention through regulation may be needed to manage the operations of entities that have the capacity to exercise market power so that incentives are aligned towards promoting the most efficient outcome. Regulation in these cases may take the form of price and quality controls. By way of example, this type of regulation applies to businesses responsible for transporting electricity from generators to industrial, commercial and residential users. The transmission and distribution of electricity are generally characterised as natural monopolies because it would be inefficient to replicate the 'poles and wires' used to supply electricity to users. To control the concentration of market power in these cases, regulation exists to ensure that prices charged for the transmission and distribution of electricity are reasonable, that investments in infrastructure are justified on an efficiency basis and that service reliability is maintained.[33]
- Externalities: An externality occurs when the activities of one entity has spill-over effects for the downstream production and/or consumption of goods and services for which no or inadequate compensation is paid. Externalities can cause market failure if pricing mechanisms do not fully account for the costs associated with these spill-over effects. Regulation may be used to ensure that these externalities are properly accounted for and the associated costs are allocated to the appropriate party. For example, legislation exists in each of the States and Territories to impose an obligation on proponents of certain projects to assess the environmental effects of the project before approval is granted to allow the project to proceed.[34] The objectives underlying these regimes are to ensure that environmental factors are properly considered in the decision-making process and to ensure that the possible adverse environmental impacts associated with a project are identified and avoided or minimised.

31 See, for example, the Victorian *Rail Safety Act 2006*, which requires accreditation of owners and managers of rail infrastructure and rolling stock by Public Transport Safety Victorian (**PTSV**). The PTSV is responsible for, among other things, the safety accreditation of rail operators in Victoria and monitoring the compliance of infrastructure (through inspections) with statutory requirements. The purpose of accreditation is to ensure that operators have the competence and capacity to manage safety risks associated with rail operations.

32 For example, Queensland's *Disaster Management Act 2003* establishes structures and policies to deal with disasters in Queensland before, during and after disaster events. It defines a disaster as 'a serious disruption in a community caused by the impact of an event, that requires a significant coordinated response by the State and other entities to help the community recover from the disruption'. The Act is complemented by the State Disaster Management Plan and a Strategic Policy framework, which describes four phases of disaster management: prevention and mitigation, preparedness, response and recovery.

33 See Chapters 6 and 6A of the *National Electricity Rules*.

34 An example is the NSW *Environmental Planning and Assessment Act 1979*, which requires an environmental impact assessment to be undertaken in relation to certain developments and major projects.

- Information asymmetry: In some cases, entities may not have access to all the information they need for their decision-making processes. This information asymmetry results in inefficiencies that could drive decisions and behaviour that would not otherwise occur if full and accurate information were available. Information asymmetries may be addressed through regulation requiring access to such information. Regulation to address information asymmetries can be found in the area of planning regulation, particularly in relation to risks posed by climate change. For example, obligations may be imposed to require information to be obtained and assessed regarding proposed development in relation to areas that may be subject to coastal inundation or bushfire hazard.[35] Another example is regulation imposing mandatory disclosure obligations on owners and landlords to prospective tenants and purchasers of the energy performance of certain commercial buildings.[36]

(iii) Management of risks

2.10 Regulation may be targeted at addressing risks that affect society, including economic, health and environmental risks. A risk assessment, which identifies and appraises the risks in question, lies at the heart of risk regulation. The regulatory response is then tailored to address the particularities of the nature and degree of risk.

2.11 The regulation of risks arising from waste facilities through environmental protection regimes, which exist in each of the States and Territories, is an example of risk regulation. Mechanisms exist under these regimes to regulate the design and construction of waste facilities to ensure that they minimise the risks to health and the environment that could arise from the operation of these facilities.[37] Regulation also exists in the States and Territories to oblige operators of major hazard facilities to demonstrate that measures have been taken to identify all foreseeable major incidents, their likelihood and consequences, and the adequacy of the measures used to minimise on and off-site risks.[38]

B. Approaches to regulation

2.12 There is a spectrum of approaches that are available to give effect to regulatory objectives ranging from traditional command and control instruments to much more flexible instruments where entities that are the subject of regulation have considerable discretion in complying with regulatory requirements.

2.13 The rationale for regulation will often play a role in determining the approach to regulation. For example, risk regulation is likely to result in prescriptive rules to address the specific risks that the regulation is designed to address. In contrast, regulation directed at addressing certain types of market failures is more likely to take the form of incentive regulation to drive behaviour that will lead to more efficient outcomes.

2.14 The regulatory approach may determine – at least in part – the extent to which adaptation to climate change is supported or impeded and, therefore, provides important context for the assessment of regulatory frameworks for infrastructure and associated services. Accordingly, this section of the Report describes the main types of regulatory approaches, including the primary advantages and disadvantages.

35 For example, in Queensland, the *State Planning Policy 1/03*: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* requires preparation of a Bushfire Management Plan (**BMP**) for development that materially increases the number of people living of working in a high severity bushfire hazard area, except for single dwellings on existing lots. A BMP may also be required for certain types of community infrastructure in either a high or medium severity bushfire hazard area. Under the policy, the BMP is required to include an assessment of the nature and severity of the bushfire hazard affecting the site; an assessment of the specific risk factors associated with the development proposal; and a plan for mitigating the bushfire risk for the proposed development.

36 *Building Energy Efficiency Disclosure Act 2010* (Cth).

37 For example, most jurisdictions specify a minimum buffer distance between a landfill site and other sensitive land uses, such as residential dwellings and surface waters.

38 See, for example, Part 3 of the *Occupational Health and Safety (Major Hazard Facilities) Regulations 2000* (Vic).

(i) Prescriptive regulation

2.15 Prescriptive regulation typically includes rules that specifically prescribe which activities can be undertaken and/or how those activities must be undertaken. This type of regulation may include prohibitions or obligations to comply with particular requirements or standards. Prescriptive rules are aimed at meeting the specific risks or objectives that the regulatory framework is designed to address. Aspects of planning regimes for the regulation of land use and development are prescriptive in nature. Specific controls apply, which regulate where and under what conditions a new development can be located or a new purpose for which land is proposed to be used.

2.16 Prescriptive approaches to regulation provide regulators and entities being regulated with certainty regarding the requirements with which compliance is expected. This approach may be particularly useful where the risks or outcomes that are sought to be controlled by the regulatory framework are clear and defined. However, the main disadvantage associated with this approach is that it is relatively inflexible and denies the entities being regulated from exercising any degree of discretion in achieving compliance with the regulatory objectives. A prescriptive approach may be more costly to administer and enforce compared with other regulatory approaches described below.

(ii) Performance-based regulation

2.17 Performance-based regulation specifies desired outcomes or objectives but does not direct the manner in which compliance is to be achieved. This regulatory approach is useful where the outcomes or objectives are clear and the manner in which they are achieved will not undermine the attainment of these objectives. Performance-based regulation is generally regarded as more flexible than prescriptive regulation.

2.18 The Building Code of Australia, which is the main instrument that regulates the construction of new buildings in Australia, is a performance-based code, although there are also prescriptive 'deemed to satisfy' provisions which supplement the performance standards. Under this regime, proponents have relative flexibility regarding the design and construction of buildings, provided that the relevant performance standards have been achieved.

2.19 Such an approach may allow compliance to be achieved at a relatively low cost compared with a more prescriptive approach, at least from the perspective of the regulator. Nevertheless, defining performance standards so that they guarantee that the regulatory objectives will be achieved is likely to be a challenging exercise. Furthermore, it may not always be clear how these performance standards can be met, both from the perspective of regulators and regulated entities. This lack of certainty may pose particular problems for smaller entities that lack experience and/or resources.

(iii) Principle-based regulation

2.20 Principle-based regulation relies upon principles as the basis for driving achievement of regulatory outcomes. Principle-based regulation is similar to performance-based regulation in the sense that it does not prescribe the specific means by which regulatory requirements are to be complied with. However, the point of departure for principle-based regulation is the fact that the principles are drafted as high-level rules that are applied as overarching requirements in a broad range of circumstances, rather than particular standards or outcomes that apply in a particular case or scenario. Furthermore, the principles are likely to be couched in qualitative terms, whereas performance-based standards may be quantitative in nature.

2.21 Many regulatory frameworks will be underpinned by principles, which help to direct the way in which the regulatory provisions are applied. For example, the principle of ecologically sustainable development lies at the heart of many planning regimes around Australia. The objective of this principle is to ensure the long-term viability of cities and towns through, among other things, ensuring efficient resource use, ecological conservation and healthy living environments. Similarly, the National Public Private Partnership Policy and Guidelines, which apply to major infrastructure procurement undertaken through Public Private Partnerships, outline the principles to be followed when a government department or agency is deciding how to procure major public infrastructure.

2.22 Principle-based regulation shares many of the advantages associated with performance-based regulation. In particular, this type of regulation is relatively flexible and may be a cost-effective way to achieve regulatory objectives. It may also allow the regulatory framework to respond to changes in the broader practical context in which it is applied. However, ambiguity regarding application of principles in the array of circumstances to which the regulatory framework applies may pose particular problems for compliance and enforcement.

(iv) Process-based regulation

2.23 As the name suggests, process-based regulation controls a process rather than dictating particular regulatory outcomes. In particular, the regulatory framework will contain requirements regarding the process that must be followed. Typically, process-based regulation will require identification of risks that might materialise, which must then be assessed and addressed through appropriate measures. The regulatory framework will usually require documentation of the process in the form of risk management plans.

2.24 Process-based regulation is particularly useful in cases where the risks that are sought to be controlled are potentially substantial but are uncertain and diffuse. Applying the same process to a variety of different situations ensures a consistent approach to the identification, assessment and management of risks. However, it also provides an opportunity for tailored solutions to be devised to respond to the specific risks that might arise in a particular case. This regulatory approach also enables industry participants to undertake the risk assessment. This is desirable where the costs and resources associated with the risk assessment are too high for the regulator to bear.

2.25 However, a process-based approach may not be advisable in cases where the risks are relatively well-known and contained. In these cases, the costs associated with requiring a risk assessment to be undertaken in every instance may outweigh the benefits. This approach also assumes that risks are capable of being identified and assessed. When risks are too amorphous and uncertain, it may be difficult for a risk assessment to be undertaken.

(v) Market-based (economic) regulation

2.26 Market-based or economic regulation comprises instruments that seek to encourage behaviour through the establishment of market signals rather than through explicit, prescriptive requirements. This is achieved by circumscribing or managing choices and decisions that sectoral participants make regarding a range of economic issues, including prices, market entry and exit, supply of information and access.

2.27 Market-based regulation is particularly useful in improving the efficiency with which society's resources are allocated. For example, the rural irrigation sector is characterised by market-based regulation, the aim of which is to ensure that water resources are allocated efficiently.[39]

39 See, for example, the Commonwealth *Water Act 2007*, which provides for the establishment of water trading arrangements in the Murray-Darling Basin.

2.28 However, the administration of this type of regulation can be costly for the regulator and the regulated, particularly if a 'heavy-handed' approach to market regulation is adopted. It may also be difficult in particular cases to strike the right balance between the degree of regulatory intervention and attainment of the desired market outcome. In some cases, the transaction costs associated with administration of and compliance with the regulatory framework may be so high that efforts to achieve a more efficient allocation of resources may be undermined.

(vi) Co-operative regulatory approaches

2.29 Co-regulation includes co-operative forms of regulation involving a combination of self-regulation and traditional command and control regulation. A co-regulation framework may involve the establishment of standards by industry participants, which are then monitored and enforced by the regulator. Unlike pure self-regulation, failure to comply with a co-regulation framework may still attract sanction. A co-regulatory regime is also less prone to industry capture compared to an entirely self-regulated regime.

2.30 Co-regulation allows industry to participate directly in the development and evolution of the regulatory framework. Such an approach also enables the burden of regulatory development to be shared between industry and the government. However, managing such an approach so as to ensure that the regulatory objectives are achieved may be challenging for both the regulator and those being regulated.

2.31 The regulatory framework for the Australian telecommunications sector provides an example of a co-operative regulatory approach. Indeed, one of the objectives underlying the *Telecommunications Act 1997* (Cth) is that the sector should be regulated in such a way that promotes the greatest practicable use of industry self regulation and does not impose an undue financial and administrative burden on industry participants.

C. Regulatory focus

2.32 Regulation can be thought of as a measure to promote, prevent or change behaviour and is particularly useful in cases where informal, non-regulatory mechanisms are not effective in achieving the appropriate or desired response. However, the precise way in which behaviour change is brought about may vary along a number of different dimensions.

2.33 One dimension relates to the type of activity which is the subject of the regulatory framework. In some cases, the regulatory focus may be on the *structure* of the sector. For example, legislation exists in each of the States and Territories relating to the structure of the electricity and water sectors to enhance competition and efficiency within these sectors. In other cases, the regulatory framework may focus on *operations* within a particular sector. For example, the manner in which new buildings are built is governed by the Building Code of Australia whereas the planning system regulates the types of development and land uses that are authorised. In yet other cases, the focus of the regulatory framework may be on *processes*. Regulation governing environmental impact assessment, which focuses on ensuring that projects have been subjected to a comprehensive assessment before approval is granted, is an example of this kind of regulation.

2.34 Another dimension that may determine the way in which a regulatory framework is constructed is the application of the regulatory framework over time. Some frameworks only apply to *prospective* activities, such as the Building Code of Australia which predominantly applies to the construction of *new* buildings. However, other frameworks may apply to activities that have occurred in the *past*, such as obligations imposed under environment protection regulation to remediate land.

2.35 The focus of a regulatory framework may be relevant to determining the extent to which a particular regulatory framework is capable of effectively achieving adaptation to climate change.

D. Implementing regulation

2.36 The effectiveness of regulation in facilitating adaptation to climate change will depend as much on how it is implemented as on the form of the regulation itself. In many cases, regulation is drawn up as a solution to a problem with insufficient attention given to its implementation. For example, planning laws and schemes may be introduced that theoretically assist climate change adaptation. However, if there are insufficient planning officers in local councils to implement the laws, or if they do not understand or support the purpose, the laws are unlikely to have a positive impact. Cost and ease of compliance and community understanding and support for the regulation will also be critical factors in determining its effectiveness.

2.37 It is also appropriate to consider the role of various decision-makers under regulation in assessing the effectiveness of the relevant regulatory frameworks. This may be the regulator itself, a delegate (such as a council planning officer) or third party assessors (such as private building surveyors under building legislation). In some cases, the regulated person or organization may have a significant decision-making role. This is particularly true in relation to risk-based regulation where the regulated person is required to identify risks and develop a system to control them. The effectiveness of regulation will, in many cases, depend on whether the decision-maker has the skills, knowledge, time and motivation to make an effective decision.

2.38 The succeeding sections of this chapter provide an overview of the regulatory frameworks affecting infrastructure and associated services in Australia. The overview highlights the underlying objectives, the regulatory approaches and focus, and decision-makers (where relevant) for each framework under consideration. The following chapter assesses the extent to which these frameworks facilitate or hinder adaptation to climate change.

E. Building

2.39 Australia's building sector is characterised by diversity in ownership and use, which is shared between private individuals, corporate entities and public bodies. Building structure, design and age is equally diverse, particularly when the spectrum of residential, commercial and public buildings is considered. Moreover, Australia's buildings are physically spread across a broad array of different climate zones, which will affect their vulnerability as well as their responsiveness to the challenges that climate change presents.

2.40 The main instrument that regulates buildings in Australia today is the Building Code of Australia (**BCA**). The BCA is a national code, which applies predominantly to new buildings. The main objective underlying this regime is to manage risks that could arise in relation to the design and construction of new buildings and it does this by ensuring minimum levels of safety, health and amenity in buildings.

2.41 The BCA is a performance-based code, although there are prescriptive 'deemed to satisfy' requirements, which meet the relevant performance standards. This approach allows for flexibility and diversity in building solutions, thereby encouraging innovative design and construction. Therefore, in theory, building industry participants can adapt to changing circumstances with minimal legislative restraint. Very large, complex buildings will often be built with almost no reliance on deemed to satisfy provisions. Alternative solutions are also commonly used in the area of fire safety in buildings and for new building products for example, polystyrene products or modular construction.

2.42 As yet, research has not been undertaken to determine the extent to which the performance based solutions are used rather than prescriptive deemed to satisfy provisions. However, anecdotal evidence suggests that most building permits substantially rely on the prescriptive provisions because it is more complex and costly to satisfy the performance based provisions. This leads to a number of problems in adaptive management to climate change, which will be discussed in the next chapter.

2.43 The BCA was first introduced into each of the State and Territories' building regimes in 1996. Despite the acknowledgement of the importance of and a commitment to harmonisation on the part of the States and Territories, the progression towards the introduction of the BCA took several decades because there were substantial differences in technical requirements between the States.

2.44 Even today, each State has retained its own amendments to the BCA, which has an impact on national uniformity. More specifically, although the BCA is a national code adopted by all States and Territories, each State and Territory can opt out of particular provisions. This is done by the inclusion of a State or Territory amendment. The Inter-Government Agreement to continue the existence and provide for the operation of the BCA[40] provides a number of measures to reduce the number of variations. For example, it was agreed that any new variations to the BCA would be restricted as far as practicable. It was also agreed that any proposed State or Territory variation must be the subject of a Regulatory Impact Statement and approved by the relevant Minister. However, variations supported by geographic or climatic peculiarities will still be made.

2.45 In addition to the substantive differences between the provisions of the BCA as they are applied in the various States and Territories, there are also significant differences between each States' schemes for administration of the building approvals process. This process is undertaken by local and state governments. In some jurisdictions, private certifiers/surveyors are also given statutory responsibility for administration of the approvals process.

2.46 Notably, there is limited regulation of existing buildings. State and Territory legislation addresses alterations and additions to existing buildings. In particular, where existing buildings are altered, generally the new or altered parts of the building must comply with the applicable standards of the day. Entire buildings may also be required to be brought into compliance with the standards of the day where renovations or additions are substantial.[41] However, this requirement is discretionary in that the permit issuer may decide in a particular case that the existing building need not be brought into full compliance with the relevant standards. Matters that the decision-maker is required to consider in the exercise of this discretion vary among the jurisdictions but can include structural adequacy, amenity, safety and spread of fire.

40 April 2006.

41 For example, see Victorian *Building Regulations 2006* (regulation 608), Qld *Building Act 1975* (section 81) and NSW *Environmental Planning and Assessment Regulations 2000* (regulation 94) where the entire building may be required to be brought into conformity with the BCA if proposed alterations together with any other alterations in the previous 3 years, represent more that half the original volume of the building.

F. Planning

2.47 Planning is the process of making decisions regarding the development, use and protection of urban and rural land, infrastructure and facilities for the present as well as for the future. The aims and objectives of planning have evolved over time, responding to the prevailing public interests and risks of the day. The original rationale for the planning system was to address particular concerns arising from urbanisation and industrialisation – namely, urban sprawl and pollution. Modern planning focused on separating incompatible land uses to ensure that such uses could occur without imposing undue burdens on others. More recently, planning has assumed a broader role to help create environmentally sustainable communities through, among other things, high density residential living, mixed development and use, and enhanced access to public transport.

2.48 Generally speaking, the development of planning policy is centralised at the state/territory government level. However, the administration of the planning system is decentralised and is undertaken by local government, for whom planning is a core function. The Commonwealth's ability to address planning issues is limited to matters regulated by international convention or treaty, as the Commonwealth relies on the external affairs power in section 51(xxix) of the Commonwealth Constitution to exercise control over actions likely, or having the potential, to impact on places of national environment and heritage significance. Nevertheless, the Commonwealth has the ability to reach agreement with States and Territories in respect of specific planning programs through the Council of Australian Governments (**COAG**) and funding arrangements as between the Commonwealth, State and Territory and local governments.

2.49 The planning system can generally be regarded as prescriptive in nature. Fundamentally, the purpose of planning is to regulate the way in which people use and develop land in order to curtail or restrict private property rights to the extent necessary to ensure that the public interest is adequately protected. It does this through the imposition of a range of controls, which regulate where and under what conditions a new development can be located or a new purpose for which the land can be used. A number of these controls can be used to respond to local conditions, including the predisposition of land to flooding, bushfires and erosion. The system also prescribes the processes to which certain proposals for new development or new use are subjected before approval to proceed is granted.

2.50 The prescriptive framework within which planning is undertaken is underpinned by a range of principles, which help guide planners in deciding whether or not a particular development should proceed by providing a framework within which the benefits of a proposed new use or development can be weighed against the disadvantages. An example is the principle of ecologically sustainable development, which includes the precautionary principle. This principle provides broad scope for consideration of new and emerging environmental impacts and natural processes in the context of new development. Planning legislation refers to other broad and relevant principles such as 'to provide for the fair, orderly, economic and sustainable use, and development of land'.[42]

2.51 The structure of planning systems is such that they have the capacity for flexibility where they are needed to respond to new circumstances, including climate change. Indeed, in the past, planning has evolved to respond to a range of physical and practical challenges. It has previously responded to the development of natural resources, environmental protection and social and economic development initiatives, such as, biodiversity conservation, affordable housing, aged care and the achievement of other social and environmental objectives.

42 Section 4 of the Victorian *Planning and Environment Act 1987*.

2.52 The pattern and scale of growth within existing settlements can be sculpted to some extent through carefully drafted planning controls and the judicious selection of planning tools. In particular, each component of the planning framework may be used to reflect the particular priorities and circumstances of the municipality. This inherent flexibility makes the planning system particularly well suited to responding to the localised effects of climate change.

2.53 However, there are limits to the ability of the planning system to respond to changing circumstances, including climate change. Like building regulation, the planning system predominantly covers new development and has limited ability to impose controls on existing development. Whilst planning can facilitate and control new development proposals, even this power is limited by the principle of existing use rights, which are outlined in the next chapter.

G. Environmental impact assessment

2.54 An environmental impact assessment (**EIA**) is an assessment of the possible impacts that a proposed project or development may have on the environment. These assessments are typically undertaken pursuant to State and Territory environmental protection legislation, although there is also a federal regime established pursuant to the *Environment Protection and Biodiversity Conservation Act 1999* (Cth).

2.55 EIA regimes have been established to identify and manage the impacts and risks to the environment that are likely to result from a particular proposed project. The regulatory framework achieves this objective through a process-oriented regime, which requires assessment of environmental risks as a pre-requisite for approval of a project. Notably, the emphasis in EIA processes as they are currently applied is to consider the likely impacts of a project on the environment. Rarely do such processes concern the assessment of the likely impacts of the environment, or changes in the environment as a result of climate change, on a project.

2.56 State policies that seek to protect the environment are the broader context within which EIA's are undertaken. For example, in Victoria, State Environment Protection Policies (**SEPPs**) exist, which aim to safeguard the environment and human activities (beneficial uses) from the effect of pollution. SEPPs encapsulate community's expectations, needs and priorities by prescribing environmental values and beneficial uses that are to be protected.

2.57 The requirement to undertake an EIA may vary from a preliminary review of environmental impacts to an extensive environmental impact statement (**EIS**). There may also be provisions for full-blown inquiries into the environmental impacts of a particular project.

2.58 The EIA process may be incorporated into the relevant planning approval process. This is the case, for example, under Part 3A or Part 4 of the *Environmental Planning and Assessment* 1979 in NSW. Typically, this type of legislation prohibits an activity or project until approval has been obtained and requires the authority from whom the approval is obtained to consider the environmental effects or impacts of the action.

2.59 Alternatively, the EIA may be required as part of a separate approval process because of the specific environmental aspects associated with a particular activity or project. One such example is under the *Environment Protection and Biodiversity Conservation Act* 1999 (Cth). Under this Act, any actions that have or are likely to have specified consequences are prohibited until an approval has been obtained and the authority from whom the approval is obtained is required to consider the relevant environmental effects or impacts of the action. An additional mechanism exists under this Act for a 'strategic environment assessment', which allows for a broader consideration of the environmental impact of a proposed development and involves a 'whole of government' approach to assessing environmental impacts. However, this type of assessment, which is initiated by the federal Minister responsible for the environment, is rarely used and may be costly and time-consuming.

2.60 An EIA is usually carried out by contractors retained by the proponent of a project that requires environmental approval. In this respect, the system is dependent upon the bona-fides of a 'self assessment'. However, public consultation and review by public authorities, which are an important part of the EIA process, together with a threat to the validity of the approval if the assessment is misleading or materially deficient, is a real incentive to undertake the assessment in good faith.

2.61 The state/territory EIA regimes are potentially highly dynamic and adaptable because the scope of assessment can be changed through project-specific determinations, guidelines, regulation, industry practice and public responses. Furthermore, the EIA regimes are continually evolving to meet the specific needs in each State and Territory. Key drivers of change are population pressures and changing demands for housing and infrastructure; the demands of particular industries – in particular mining, energy and transport; responses to climate change – in particular relating to water; international competitiveness and productivity; and ministerial pressures.

H. Electricity

2.62 In the early 1990s, Australian governments embarked on major structural reforms to establish a competitive electricity sector. These reforms have resulted in privatisation of previously government owned electricity businesses, a competitive wholesale electricity market has been established, network access regimes have been implemented and full retail competition has been introduced, or a commitment made to introduce it. The reforms are generally considered to have resulted in initially lower electricity prices. They also delivered substantial investment in generation and in networks.

2.63 The supply of electricity is now centred around the National Electricity Market (**NEM**), which is a wholesale market for the supply and purchase of electricity. Generators sell electricity into the NEM where supply is aggregated and sold to retailers for on-sale to residential and industrial customers to meet demand.

2.64 The NEM is underpinned by interconnected transmission and distribution networks in the participating jurisdictions – namely, Queensland, New South Wales, ACT, Victoria, South Australia and Tasmania[43] – which allow transportation of electricity from the generators to the customers. The high-voltage transmission lines allow electricity to be transported between interconnected electrical regions, which roughly correspond to the main demand centres within the NEM. Electricity can be imported into a region along these transmission lines when demand in the region exceeds the supply that is available from local generators. Within particular regions, electricity is transported to substations and ultimately on to residential and industrial consumers through low voltage distribution lines. The owners of the transmission and distribution lines are monopoly providers within the designated areas covered by their respective networks.

2.65 Each element of the electricity supply chain – generation, transmission/distribution and retail – is the subject of separate regulation and a distinct regulatory approach, which responds to the particular issues that exist along the supply chain.

2.66 In the case of generation, the supply of electricity through the NEM is relatively unregulated because the wholesale electricity market is considered to be an effective competitive mechanism through which wholesale prices are set. Generators are, however, subject to prescriptive technical and reliability standards to ensure that their operations do not compromise the security and reliability of the system.

43 Western Australia and the Northern Territory are too remote to warrant interconnection with the NEM.

2.67 In contrast to the competitive generation market, the supply of network services is characterised by natural monopolies. Accordingly, these businesses are subject to significant economic regulation, which is administered by a national body – the Australian Energy Regulator (AER). The main objective underlying the regulation is to ensure that network businesses do not charge exorbitant prices for their services. Rather, they are only entitled to recover efficient operating costs and earn a risk-adjusted commercial rate of return on capital required to provide the network services. The prescriptive elements of the economic regulation framework applicable to the network businesses is complemented by incentive schemes, some of which seek to encourage network service providers to only make efficient investments in new infrastructure, to consider alternatives to network infrastructure investment (such as demand side management), and to maintain service reliability.

2.68 The retail market is in the process of transitioning from one that was the subject of significant economic regulation to one that is relatively unregulated as a result of the introduction of full retail contestability. Prescriptive non-price retail regulation continues to exist, particularly with respect to the authorisation of retailers to participate in the NEM and the procedures that apply when a retailer is no longer able to service its customers. This regulation is aimed at protecting electricity consumers.

2.69 The regulatory framework is the subject of ongoing reform and continuous change to respond to current issues, including the growing proportion of renewable energy generation being supplied to the NEM and the implications more generally of climate change on operations along the supply chain. Reform of the framework is a shared responsibility among the Commonwealth, State and Territory governments through COAG, although specific changes to the regulatory framework are undertaken by the Australian Energy Market Commission (**AEMC**). In deciding whether or not to change the National Electricity Rules, the AEMC must be satisfied that the change is likely to contribute to the achievement of the National Electricity Objective – that is, 'to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to price, quality, safety, reliability, and security of supply of electricity; and the reliability, safety and security of the national electricity system'.[44]

I. Telecommunications

2.70 The telecommunications regulatory regime, in its current form, was implemented in 1997. The structural reforms implemented at this time were designed to introduce full competition to the Australian telecommunications market by establishing a regime to facilitate access to infrastructure and services provided by telecommunications providers other than the original incumbent, Telstra. Prior to the 1997 reforms, market entry into the telecommunications market was limited.

2.71 The current fixed telecommunications infrastructure is dominated by Telstra's fully deployed copper-based customer access network, which reaches virtually every premises in the country. Both Optus and Telstra also have hybrid, fibre/coaxial cable pay television networks, capable of delivering communications services which serve significant portions of the population. Other operators also have extensive fixed network infrastructure, which is generally reliant on obtaining access to parts of the Telstra network to deliver services. In addition, there are also a number of mobile networks, with each reaching a large proportion of the population. These networks are made up of mobile base stations (generally located on towers or on rooftops of buildings), connected to each other, and to the other mobile network facilities, such as switches, by a back haul network made up of fixed (copper or optic fibre) links, or dedicated microwave links. All of these networks are relatively mature.

44 Section 7 of the National Electricity Law.

2.72 The Government-owned NBN Co is in the process of deploying a fibre to the premises optic network, which will reach 93% of premises, with wireless or satellite services provided to the remaining 7%. The deployment of this network is likely to take 8 to 10 years. This network will be capable of delivering very high speed broadband services and will largely replace Telstra's copper based customer access network.

2.73 The telecommunications industry in Australia is primarily the responsibility of the Federal Government and falls under the Department of Broadband, Communications and the Digital Economy (**DBCDE**). The DBCDE is charged with setting regulatory policy.

2.74 The industry is governed by the *Telecommunications Act 1997* (**Telecommunications Act**), *Competition and Consumer Act 2010*, industry codes, industry standards and technical standards. These instruments provide a framework for regulation by the Australian Communications and Media Authority (**ACMA**) and the Australian Competition and Consumer Commission (**ACCC**) and for industry self regulation by the voluntary adoption of industry codes. ACMA's responsibilities include issuing carrier licenses, regulation of service providers, setting industry standards where codes fail or fail to be created, ensuring access to emergency call services and ensuring that carriage service providers make plans to manage natural disasters.

2.75 The regulatory framework for the telecommunications sector is an example of co-regulation. Indeed, one of the objects of the Telecommunications Act is to ensure that telecommunications is regulated in a manner that promotes the greatest practicable use of industry self regulation and does not impose undue financial and administrative burdens on industry participants. The Act provides that bodies and associations that represent sections of the telecommunications industry may develop industry codes.

2.76 Industry codes and standards can be developed on any matter that relates to a telecommunications activity. The Communications Alliance, the peak industry body, develops most of the industry codes and standards. Some of these codes need to be registered with ACMA – for example, codes affecting consumers and those relating to operations and networks. ACMA may develop mandatory standards or request an industry body to develop a code, where ACMA considers a code to be necessary or convenient to provide appropriate community safeguards, or otherwise deal with the performance or conduct of the telecommunications industry.

2.77 Under normal circumstances, compliance with industry codes is voluntary. However, ACMA does have powers under Part 6 of the Telecommunications Act to ensure compliance with registered codes. These powers enable ACMA to issue formal warnings regarding breaches and to direct industry participants to comply.

2.78 For the most part, the regulatory framework does not direct nor co-ordinate investment in telecommunications infrastructure, leaving carriers free to determine the types, use and location of infrastructure which they deploy. Moreover, the Telecommunications Act exempts low-impact and certain other telecommunications facilities from most planning and environmental impact assessment requirements under State and Territory legislation. However, for other facilities, these requirements apply.

2.79 The regulatory framework for telecommunications is relatively dynamic and adaptable as the industry tends to undergo continuous and relatively rapid change. In particular, the type of services to which participants are required to provide access and the terms and conditions on which those services are required to be provided are regularly reviewed and changed by the ACCC, with the active input of industry participants. Review of these access requirements operates on an almost continual cycle.

2.80 Furthermore, throughout the life of the telecommunications regulatory regime since 1997, the industry and the regulatory regime have been required to adapt to many changes. These include:

- Transitions to new types of technology (for example from AMPS to GSM and CDMA mobile phone technology, and subsequently to 3G mobile technologies);
- Changes in the way wholesale services are delivered, such as the introduction of unbundled local loop services, which allow competitive carriers to rent Telstra's copper access lines; and
- The introduction of new standards, such as multi-carrier pre-selection and calling number display requirements.

2.81 Generally, changes of this type have been able to be introduced to the industry in a relatively efficient manner through a combination of industry self-regulation and intervention by regulators.

J. Water

2.82 Water is a precious commodity. It is essential to sustain life, but has no substitutes. It is used for a broad range of purposes, including for agriculture, household and recreational use, industry and environmental activities. In many developed countries, including Australia, the water supplied to households, commerce and industry is fresh water that is of drinking water standard, even though a relatively small proportion is actually consumed or used in food preparation. Australia is the driest inhabited continent and climate change is likely to further exacerbate the pressure on our water resources.

2.83 There are four main aspects of regulation in the water sector that are potentially relevant to management of the impact that climate change may have on our water resources. The first relates to the *pricing* of water resources. In the urban water sector, water pricing is governed by economic regulation, which is undertaken at a local level by State and Territory-based jurisdictional regulators with the aim of ensuring that water is efficiently priced. This approach is considered necessary because the urban water sector is generally characterised as uncompetitive. In the rural water sector, the Commonwealth *Water Act 2007* provides for the establishment of arrangements to facilitate water trade in the Murray Darling Basin to ensure that water is allocated efficiently between competing uses, including consumptive and environmental uses. In this context, the market determines the price of water rather than regulation.

2.84 The second relevant aspect of water regulation relates to the *planning and management* of water resources. Water planning and management is an important tool for achieving the sustainable use of water. The jurisdictions have taken various approaches regarding water planning and management and these regimes are the subject of constant refinement. Typically, however, the water planning and management regime is underpinned by a policy document, which describes the objectives for the jurisdiction's water and how the water will be allocated and managed. These policy documents are generally given effect through statute. In relation to the Murray-Darling Basin, the Commonwealth *Water Act 2007* provides for the establishment of a water management plan – the **Basin Plan** – which will be a strategic plan for the integrated and sustainable management of water resources in the Basin. The primary objective of the Basin Plan will be to manage water resources so that sufficient water is available, environmental assets and pre-existing functions of the Basin are not compromised, while at the same time optimising social and economic outcomes.

2.85 Various legislative instruments in the States that provide for water planning and management incorporate principles of adaptive management in a changing climate. New South Wales legislation provides that the principles of adaptive management should be applied to water management.[45] In Victoria, regional sustainable water strategies must be prepared that identify threats to the reliability of water supply, ways to improve the reliability of supply and quality of water and ways to improve the environmental values and health of water ecosystems.[46]

2.86 The third relevant aspect of water regulation relates to *diversification* of water resources. Examples include use of recycled water and stormwater for potable and non-potable applications. However, the uptake of these options is still relatively limited in part because of the lack of regulatory certainty and clarity regarding fundamental issues, including ownership of these water resources, and the fragmentation of regulatory control over recycled water projects through a range of environmental, health and planning legislative and policy instruments.

2.87 The fourth relevant aspect of water regulation relates to *conservation* of water resources. There are a range of measures aimed at restricting non-residential water uses throughout Australia, including obligations on businesses to prepare and submit water-efficient management plans for approval.[47] Some programs mandate participation by businesses covered by the relevant regulatory scheme, whereas other programs are voluntary.

2.88 Supplementing these water management measures for businesses are water restrictions that apply to residential users, which are currently in place throughout many parts of Australia in response to extended periods of drought and associated water shortages. These restrictions have a legislative basis and may attract fines if they are not complied with. Water restrictions typically apply to outdoor use such as watering lawns, using sprinkler systems and washing vehicles. Restrictions are generally temporary during drought periods or when dam levels are low. Some jurisdictions have introduced permanent water saving rules, such as prohibiting the watering of paved areas, which permanently reduce water demand over time.

2.89 In addition, most jurisdictions have a tiered pricing arrangement – 'inclining block tariffs' – the primary aim of which is to encourage the conservation of water. In particular, the tiered pricing structure seeks to deter discretionary water use by imposing higher prices once the volume consumed over a certain period exceeds a particular threshold.

K. Waste

2.90 Waste consists of products or substances that have no further use or value. Waste streams in Australia comprise around 30% municipal waste, 30% industrial waste and 40% from the construction and demolition sector.

2.91 The primary method of waste disposal in Australia is through the deposit of waste at landfill sites. Landfill facilities play an important role in reducing the environmental impact of dumping waste and also as a means of recovering resources and reducing the production of waste. However, landfills may also pose a risk to the environment and to public health if they are not designed, constructed and managed appropriately. In particular, landfills may result in leachate discharges, gaseous emissions, loss of visual amenity, foul odours, and harbouring of disease-carrying pests. These risks could be exacerbated as a result of climate change impacts on landfill facilities, particularly flooding, sea level rise and extreme heat.

45 Section 5(2)(h) of the *Water Management Act 2000* (NSW).
46 Section 22C of the *Water Act 1989* (Vic).
47 These include: Environment and Resource Efficiency Plan (EREP) (Victoria), Water Savings Action Plan (WSAP) (New South Wales), Water Efficiency Management Plan (WEMP) (Queensland), Water Efficiency Management Plan (WEMP) (Western Australia), Water Efficiency Plan Program (WEPP) (South Australia).

2.92 State-based environmental protection regimes typically perform the role of addressing the environmental risks arising from landfill sites, both before they are constructed and after they are closed. Some aspects of these regimes are prescriptive, whereas other aspects are performance-based.

2.93 The construction of landfills typically require a works approval, which may prescribe certain essential features which the landfill facility must display. For example, the installation of gas capture systems are required for some landfill sites to reduce greenhouse gas emissions. The operation of landfills is also subject to a licensing regime the aim of which is to identify the performance objectives for the operation of the landfill, define operating parameters and impose mechanisms to monitor environmental performance. Landfill licensing conditions typically consist of a mix of prescriptive and performance-based measures, the latter of which require landfill operators to achieve certain environmental outcomes.[48]

2.94 Closed landfills may be subject to ongoing environmental controls through landfill aftercare management plans, which may be required under statute. Other environment protection mechanisms may be triggered – such as 'Clean-Up Notices' – if pollution emanates from a landfill facility after it has ceased operating.

2.95 In addition to regulatory mechanisms that are primarily directed at addressing risks associated with landfill waste, waste management in Australia is also characterised by a wide range of market-based regulatory instruments, which are aimed at reducing the volume of waste to landfill and encouraging recycling by properly accounting for the negative environmental and social externalities associated with waste disposal and landfill facilities. For example, most jurisdictions impose a levy on waste disposed to landfill, the primary purpose of which is to discourage waste being sent to landfill to support the achievement of waste diversion targets.

2.96 Certain prescribed or hazardous wastes are required to be treated, transported and stored in different ways than ordinary waste. In particular some hazardous wastes are banned from landfill and are required to be treated before disposal.[49]

2.97 In the past, waste management policy was predominantly focused on the harm arising from landfill facilities. Over time, waste management policy has evolved significantly, with an increasing emphasis on waste avoidance and resource recovery. However, relatively little, if any, attention has been given to the risks that the environment – particularly, climate change – may have on waste facilities. It will be necessary to determine whether existing regulatory mechanisms can be used to address these risks.

L. Transport

2.98 Australia's transport sector is characterised by its fragmented nature. Each jurisdiction regulates numerous modes of transport which, at a minimum, include roads, rail, ports and air. Within each of these transport modes, a range of regulatory roles relating to planning, funding, construction, operation and maintenance are often divided between various government departments and authorities within each jurisdiction.

48 Waste Management, Productivity Commission Inquiry, No. 38, October 2006.
49 See, for example, *Environment Protection (Industrial Waste Resource) Regulations 2009* (Vic).

2.99 Furthermore, the partial privatisation of certain transport modes within particular jurisdictions has led to an increasing number of private sector entities also engaging in the ownership and control of parts of the transport sector. While some jurisdictions have sought to coordinate the management of various transport modes through overarching transport legislation, these Acts have failed to deliver a coordinated approach.[50] In the meantime, each of the modes of transport are subject to separate regulatory frameworks.

2.100 Generally speaking, the ownership and responsibility for the management of *road* infrastructure across all Australian jurisdictions lies with the public sector. The primary focus of the regulatory frameworks for road infrastructure is the promotion of safe and efficient roads. Among other things, the relevant legislative instruments in the various jurisdictions identify the entities that are responsible for road infrastructure, set out the role, functions and powers of road authorities, and establish the general principles that apply to road management.

2.101 The functions and powers of road authorities imposed under road management legislation typically include the provision and maintenance of roads for use by the community and the design, construction, inspection, repair and maintenance of roads and related road infrastructure. In general, each jurisdiction has established performance-based regulations, which require road authorities to take all steps that are reasonably practicable to ensure the structural integrity and safety of public roads. Some jurisdictions have established additional general principles, which apply to the construction, management and ownership of road infrastructure.

2.102 Regulatory frameworks for *rail* infrastructure in the States and Territories typically include a number of core elements including the identification of rail transport corporations, which own and manage Australia's rail networks, establishment of regimes for access to rail infrastructure by transport service providers and obligations to ensure safe and reliable rail transport services.

2.103 In most jurisdictions, statutory rail corporations have been established to own, manage and operate rail infrastructure, particularly for passenger services. The responsibility for undertaking repair and maintenance work on rail infrastructure is generally governed by lease arrangements between the government owners of such infrastructure and the public or private lessees. Furthermore, each of the States and Territories has arrangements with the Federal Government for the provision of interstate and national rail services using rail infrastructure that is managed by the federal government. The ACCC regulates access by private operators to that part of Australia's rail track which is owned and operated by the Australian Rail Track Corporation (a federal government entity).

2.104 By way of complement to obligations that may be contained in bilateral lease arrangements between owners and operators of rail infrastructure, some jurisdictions also impose specific statutory obligations on rail infrastructure operators to ensure that such infrastructure is safe and reliable through safety accreditation.[51]

2.105 *Port* infrastructure exists in each of Australia's States and Territories, including a mix of major commercial ports, which are used for domestic and international trade, and smaller local or community ports. The regulatory frameworks applicable to Australia's ports typically establish port authorities, which are responsible for the management of port infrastructure, and provide for the effective management and operation of ports.

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50 For example, in New South Wales, the *Transport Administration Act 1988* sets out a number of lofty objectives including to enable the effective planning and delivery of transport infrastructure services and to coordinate the activities of those engaged in the delivery of transport services, yet the same Act also creates a number of separate statutory bodies which manage and control different transport modes in isolation. In Queensland, the *Transport Planning and Coordination Act 1994* requires the development of a transport coordination plan (**TCP**) to provide a framework for strategic planning and management of Queensland's transport resources. However, the broad objectives of the current TCP, such as 'make the most of the existing transport system' and 'care for our natural and built environment', fail to provide any real guidance for the collective regulation of the transport sector.

51 For example, Queensland's *Transport Infrastructure Act 1994* establishes as a pre-requisite to accreditation, a requirement that the railway manager or operator has an appropriate safety management system in place.

2.106 Larger commercial ports are either publicly owned and operated through statutory corporations and authorities or are privately owned and operated. The smaller community ports are generally owned and operated by local councils or by private entities. Unlike local ports, the larger commercial ports are usually subject to access and price regulation and may be subject to obligations concerning port operation. For example, under the *Victorian Port Management Act 1995*, port corporations, which are responsible for commercial trading ports must, among other things, manage and develop ports in an economically, socially and environmentally sustainable manner and facilitate the integration of infrastructure and logistics systems in the port with systems in place outside the port in a manner that is commercially sound and environmentally sustainable.

2.107 The National Ports Strategy was prepared by the National Transport Commission and Infrastructure Australia and released in January 2011. It is currently being considered for adoption by COAG. The National Ports Strategy identifies specific priorities as being central to the effective long-term management of regulation of Australia's ports, including improving efficiency, reliability, security and safety. One of the key recommendations of the National Ports Strategy is for the preparation and publication of three levels of planning documentation regarding ports – namely, at the jurisdictional level, at a regional level plan for each relevant port, and at a port precinct level. It is unclear how these plans will interface with existing infrastructure management plans that are currently required under jurisdictional regulatory frameworks.[52]

2.108 In relation to *airports*, in 1997, the Commonwealth Government commenced a process of privatising its 22 federal airports, including the major commercial and passenger airports in each of the capital cities. This was accomplished by granting long-term leases over the airport sites to private sector operators. Since 1997, there has been substantial investment in Australia's airports following privatisation to keep pace with growing demands for air travel. However, most regional airports are owned by local councils and are subject to state and local government planning controls.

2.109 The leased federal airports are regulated under the *Commonwealth Airports Act 1996*. Among other things, the *Airports Act 1996* regulates planning and development on federal airport sites. In particular, the Act imposes foreign and cross-ownership ownership restrictions on airport operator companies and requires the preparation of an Airport Master Plan, which is intended to reflect a 20 year strategic vision for the airport site, including future land uses, types of permitted development, and noise and environmental impacts. The Act also requires the preparation of Major Development Plans for significant developments and the development of an Environment Strategy, which is aimed at ensuring that all operations at the airport are undertaken in accordance with relevant environmental legislation and standards and to promote the continual improvement of environmental management at the airport.

2.110 Some airports are also subject to price and quality monitoring and access regulation under the *Competition and Consumer Act 2010*. The *Airports Act 1996* is complemented by a range of regulations, including the *Airports (Environment Protection) Regulations 1997*, the object of which is to regulate noise and pollution emanating from airports as well as to promote the improvement of environmental management practices for activities carried out at airports.

52 For example, in Victoria, Part 6A of the Victorian *Port Management Act 1995* requires port authorities to prepare environment management plans. They must also ensure that reasonable steps are taken to implement these plans. Under Queensland's *Transport Infrastructure Act 1994*, certain port authorities must prepare and submit to the Minister a port land use plan, which sets out the uses and intended uses of port land. A port land use plan must specify, among other things, the desired environmental outcomes for the land, including measures that will assist in achieving the desired environmental outcomes.

M. Major infrastructure procurement

2.111 Major infrastructure projects in Australia are generally commissioned by government for the benefit of the public, often with significant involvement by the private sector. This involvement can range from the government simply engaging the private sector to design and/or construct the infrastructure in question, to projects where the operation of the relevant infrastructure is out-sourced to the private sector, to projects where the private sector is asked to finance, design, construct and operate and maintain the relevant infrastructure for a substantial period of time.

2.112 In Australia, major infrastructure projects are typically procured using:

- Public Private Partnerships (**PPPs**) – a PPP is a long-term contract between the public and private sectors where, for example, a private sector party is granted a concession to design, construct, finance and operate infrastructure (such as toll roads where the private sector party takes demand risk), or where government pays the private sector to deliver infrastructure and related services on behalf, or in support, of government's broader services responsibilities.[53] Examples of PPP Projects, include the Victorian Desalination Plant PPP Project and the Gold Coast Rapid Transit PPP Project.
- Relationship Contracting – the character of a relationship or collaborative contract can vary substantially between a solution focused traditional contract to an alliance.[54] Generally speaking, a relationship contract focuses attention on the relationship from the outset, allocates risk meaningfully according to the relationship of the parties, aligns the parties' interests and often retains the ability to sue (except for in an alliance).[55] Examples include Victoria's Regional Rail Link Project and the Sydney Desalination Plant Project.
- Traditional Procurement – traditional procurement includes all non-PPP and non-relationship contracting such as consultancy agreements, construction contracts, design and construct contracts, engineer procure and construct contracts, supply and install contracts and operation and maintenance agreements. Examples include the design and construction of Melbourne Rectangular Stadium Project (now AAMI Park) and South West Rail Link in Sydney.

2.113 Whilst it is difficult to gain an accurate appreciation of the split between infrastructure delivery methods, it is estimated that, between 2000 and 2009, PPPs represented approximately 5% to 10% of total estimated infrastructure spend, relationship contracting represented approximately 25% to 30% of the total estimated infrastructure spend, and traditional procurement represented the remaining 60% to 70% of total estimated infrastructure spend.[56]

53 *National Public Private Partnership Guidelines – Overview*, December 2008, Section 2.1.1.

54 Common models used include, in order of increasing focus on the relationships, the new engineering contract, partnering, managing contractor, early contractor involvement and alliancing.

55 Some key characteristics of relationship contracts include (a) selection of project parties (increased interaction in tendering); (b) early contractor involvement in the project and flexibility of workscope; (c) upfront statement of purpose, principles and objectives; (d) contract management structure dealing with 'soft' issues such as an express commitment to co-operate in good faith, consultative decision making, sharing of information and early resolution of disputes; (e) alignment of commercial interests of the contractor with the project outcomes; and (f) risk allocation based on the commercial relationship of the parties and 'no blame' culture.

56 In the financial year 2008–2009 the spend on alliances in the road, rail and water sectors exceeded $32 billion, representing 29% of the total spend on infrastructure of $110 billion across the whole of Australia: Department of Treasury and Finance, Victoria, *In Pursuit of Additional Value*, October 2009, at pp. 8–9. In the period between 1996 and 2008, 217 alliance projects had been undertaken with a total economic investment of approximately $65 billion. Such expenditure far exceeds other delivery models, particularly Public-Private Partnerships, which in the period between 2000 to 2006, had undertaken 39 projects with an investment value of $16.6 billion. *Australian Financial Review*, 14 September 2009, Page 10.

2.114 There is no single, unified and consistent regulatory regime that applies to major infrastructure procurement in Australia. Rather, major infrastructure projects are subject to a variety of federal, state and local laws and regulations, international treaties[57] and a variety of non-mandatory policies and guidelines. The application of a particular regulatory framework to a specific project depends on the scope, size, location and specific issues, such as discharge to the environment. For example, a major public transport project in Victoria could be subject to legislation such as the *National Greenhouse and Energy Reporting Act 2007* (Cth), *Environment Protection and Biodiversity Conservation Act 1999* (Cth), *Environmental Effects Act 1978* (Vic), *Planning and Environmental Act 1987* (Vic), *Major Transport Projects Facilitation Act 2009* (Vic) and *Project Development and Construction Management Act 1995* (Vic).

2.115 Despite these examples of potentially applicable legislation, policies and guidelines remain the chief form of 'regulation' of major infrastructure procurement. Whilst policies and guidelines are not formally 'regulatory' in nature – there are only limited consequences of non-compliance – they are nevertheless considered to be a form of regulation for the purposes of this Report.

2.116 Examples of policies and guidelines include:

- the National Public Private Partnership Policy Framework and National Public Private Partnership Guidelines, which are published by Infrastructure Australia, a statutory body established under the *Infrastructure Australia Act 2008* (Cth) (**National PPP Guidelines**);
- the *Policy for Alliance Contracting* and a *Practitioner's Guide to Alliance Contracting* approved by the Victorian and Queensland State Governments (**Alliance Guidelines**); and
- the *Commonwealth Procurement Guidelines* issued by the Minister for Finance and Deregulation under regulation 7 of the *Financial Management and Accountability Regulations 1997* (Cth) (**Commonwealth Procurement Guidelines**).

2.117 Broadly speaking, these policies and guidelines are 'principle-based' frameworks. They provide principles for the regulation of PPP projects, alliance projects and commonwealth projects. They are also limited in application. For example, the National PPP Guidelines apply across Australia but are subject to specific State and Territory departures. Similarly, the Alliance Guidelines apply to all relevant state agencies but only to the extent specified in the relevant business case or investment decision.

N. Summary

2.118 The various regulatory frameworks affecting infrastructure and associated services that are the subject of focus in this Report adopt a variety of regulatory approaches, as summarised in Table 8 on the next page.

57 For example, the Australia-United States Free Trade Agreement (Ratified on 1 January 2005), Chapter 15 (Government Procurement) and the United Nations Convention on Contracts for the International Sale of Goods, 11 April 1980.

Table 8. Summary of regulatory approaches

	Prescriptive	Performance	Principle	Process	Economic	Co-operative
Building	✓	✓				
Planning	✓	✓	✓			
Environmental Impact Assessment			✓	✓		
Electricity	✓	✓			✓	
Telecommunications					✓	✓
Water	✓		✓		✓	
Waste	✓	✓				
Transport	✓		✓	✓		
Major Infrastructure Contracting			✓			

2.119 The focus of the frameworks also differs, as summarised in Table 9 below.

Table 9. Summary of regulatory focus

	Type of Activity			Temporal Scope	
	Structure	Operations	Processes	New Infrastructure	Existing Infrastructure
Building		✓		✓	
Planning		✓		✓	
Environmental Impact Assessment			✓	✓	
Electricity	✓	✓		✓	✓
Telecommunications	✓	✓		✓	✓
Water	✓	✓		✓	✓
Waste		✓		✓	✓
Transport	✓	✓	✓	✓	✓
Major Infrastructure Contracting				✓	

2.120 The next chapter of this Report assesses each of the regulatory frameworks, including the regulatory approach and focus, to determine the extent to which they facilitate or hinder adaptation to climate change.

CHAPTER 3: ASSESSMENT OF REGULATORY FRAMEWORKS

3.1 Climate change exposes our infrastructure to significant risks. Some infrastructure may be located in areas that are at high risk from the impact of climate change. Existing infrastructure may not have been designed and built to cope with the effects of climate change. Regimes for the operation and maintenance of infrastructure may not account for climate change. In some cases, the siting, design and operation of infrastructure may even exacerbate the effects of climate change. These risks are particularly concerning in light of the long-lived nature of infrastructure assets and the critical role that infrastructure plays in society.

3.2 This chapter assesses the regulatory frameworks applicable to key infrastructure and associated services to determine whether they facilitate or constitute barriers to effective adaptation to the relevant climate change risks. A conceptual framework has been developed to determine the capacity of regulatory frameworks to respond to the effects of climate change. This framework has been used to assess the regulatory frameworks in question.

A. Using regulation to achieve adaption

(i) Defining adaptation

3.3 A threshold issue in determining whether or not a regulatory framework is capable of responding to the effects of climate change is the definition of 'adaptation'. There is a wide variety of definitions of this term.[58] However, the essence of the notion of adaptation is captured well in the IPCC's definition of the term:

> Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.[59]

3.4 The IPCC definition of adaptation refers to a range of ways in which adaptation may be accomplished to enhance resilience or reduce vulnerability to observed or expected changes in climate. In particular, the definition implies that adaptation may be undertaken by the public or private sectors. The definition also refers to a spectrum of adaptive actions that may be taken, including actions that are taken before or after climate change risks materialise and those that are undertaken in an ad hoc fashion compared with planned, co-ordinated action.

58 Ellina Levina and Dennis Tirpak, OECD, *Adaptation to Climate Change*: *Key Terms*, COM/ENV/EPOC/IEA/SLT(2006)1, pp. 6–7.
59 IPCC, *Climate Change 2001*: *Impacts, Adaptation and Vulnerability, IPCC Third Assessment Report*, Cambridge University Press, 2001.

3.5 More specifically, 'reactive' adaptation measures are measures taken in response to climate change after the effects of climate change have materialised.[60] 'Autonomous' adaptation refers to natural or spontaneous adjustments in the face of a changing climate.[61] Autonomous adaptation is typically undertaken by individuals in response to ecological or environmental changes rather than in response to changes in policy or law.[62] 'Anticipatory' adaptation relates to deliberate action that is taken before the effects of climate change materialise.[63] Finally, 'planned' adaptation requires conscious and deliberate policy intervention.[64]

3.6 These types of adaptation are not mutually exclusive. Indeed, a mix of reactive, autonomous anticipatory and planned measures is ideal to maximise the adaptive capacity of society. Reactive/autonomous adaptation may be needed where, from a practical, political and/or cost perspective, anticipatory/planned adaptation is not feasible. On the other hand, anticipatory/planned adaptation may be required where the incremental benefit associated with the various types of reactive and autonomous adaptation that might be undertaken will not be sufficient to provide the necessary degree of resilience to the effects of climate change. In addition, anticipatory/planned measures can be used to dispense with the need for future subsequent autonomous/reactive adaptation[65] or to provide the impetus for such adaptation in the future.[66]

(ii) Role of regulation in achieving adaptation

3.7 Regulation can play a critical role in protecting and ensuring the future resilience of Australia's infrastructure and associated services from the impact of climate change. Regulation that anticipates and plans for the effects of climate change will be especially important where the risks posed by climate change are potentially irreversible or catastrophic or where the costs of prevention now through proactive measures are lower than the costs of remediation or reactive adaptation, which would otherwise become necessary in the future.[67]

3.8 Regulation may also be needed to address the effects of climate change in cases where effective adaptation is unlikely to occur in the absence of regulation – for example, if resources for autonomous adaptation are limited.[68] Regulation will also be essential if the lack of co-ordination and cohesion between various types of reactive adaptation that might otherwise occur runs the risk of resulting in maladaptation[69] and/or when relevant market signals are distorted leading to irrational, maladaptive behaviour.[70]

3.9 The regulatory response to achieve climate change adaptation may take one of two main forms – namely, adaptation laws (which are exclusively dedicated to climate change adaptation) or adaptive laws (which are capable of responding to the effects of climate change but do not exclusively focus on climate change adaptation). Adaptation laws provide a comprehensive and focused mechanism to address the effects of climate change. However, it might be difficult to craft such laws to apply across-the-board to all types of circumstances and infrastructure. In the meantime, energy might be better directed to ensuring the adaptiveness of existing laws so as to make them more agile in responding to changing physical conditions resulting from climate change.[71]

60 S Fankhauser, J B Smith, R Tol, *Weathering Climate Change*: *Some Simple Rules to Guide Adaptation Decisions*, 30 Ecological Economics (1999), 67, p. 69.
61 S Fankhauser, J B Smith, R Tol, above fn 60, p.69.
62 J McDonald, 'Mapping the Legal Landscape of Climate Change Adaptation' in *Adaptation to climate change*: *law and policy*, Editors, Tim Bonyhady, Andrew Macintosh, Jan McDonald, The Federation Press, 2010, p. 8.
63 S Fankhauser, J B Smith, R Tol, above fn 60, p. 69.
64 S Fankhauser, J B Smith, R Tol, above fn 60, p. 69 and B Smit, I Burton, R Klein, J Wandel, *An Anatomy of Adaptation to Climate Change and Variability*, Climate Change 45: 223–251, 2000, p. 239.
65 S Fankhauser, J B Smith, R Tol, above fn 60, p. 70.
66 Ibid.
67 W Easterling et al, *Coping with Global Climate Change*: *The Role of Adaptation in the United States*, The Pew Centre on Global Climate Change, Arlington, 2004, pp ii and 5 and J McDonald, above fn 62, p. 8.
68 S Fankhauser, J B Smith, R Tol, above fn 60, pp. 74 and 75.
69 F. Cimato, M. Mullan, *Adapting to Climate Change*: *Analysing the Role of Government*, Department of Environment, Food and Rural Affairs (DEFRA) Evidence and Analysis Series, Paper 1, 2010, p 56.
70 S Fankhauser, J B Smith, R Tol, above fn 60, p. 74.
71 J McDonald, *The Role of Law in Adapting to Climate Change*, WIRES Climate Change, Volume 2, March/April 2011, 283 – 295, p. 291.

(iii) Aims of regulation to address adaptation for infrastructure

3.10 In order to ensure that our infrastructure and associated services can effectively respond to the impact of climate change, regulation should achieve the following main aims:

- New infrastructure should not be located in areas that are particularly vulnerable to climate change risks.
- New infrastructure should be designed and constructed to be resilient to the impact of climate change.
- Existing infrastructure should be maintained and upgraded where necessary to ensure functional and structural integrity despite the effects of climate change.
- Where appropriate, retreat from climate change risks should be planned and managed in a proactive and sensitive manner.
- The siting, design, construction and operation of new and existing infrastructure should not exacerbate existing climate change risks.[72]
- Delivery of essential services associated with infrastructure (including, electricity, water, telecommunications and waste) should be adaptive to climate change and take account of its likely impacts.

3.11 In most cases, regulation affecting infrastructure and associated services will not have been designed to accomplish these aims. Nevertheless, there may be elements of existing regulatory frameworks that are flexible enough to accommodate them.

B. Conceptual framework for assessing regulatory responses to climate change

3.12 The conceptual framework that has been developed to assess the regulatory responses to climate change has three main components, namely:

- an identification and evaluation of the various aspects of the regulatory framework that may facilitate or hinder adaptation to climate change;
- an assessment of the degree to which the regulatory response is adequately matched to the relevant climate change risks; and
- a consideration of the extent to which the regulatory tools are being applied and implemented effectively.

3.13 Each of these elements is considered in turn.

(i) Stock-take and evaluation of regulatory tools

3.14 In assessing a regulatory framework to determine the extent to which it is capable of responding to the effects of climate change, an important first step is to undertake a stock-take of the various tools, mechanisms and processes that are established under the framework. A given regulatory framework may contain a mix of tools, mechanisms and processes that can facilitate adaptation to climate change, whereas other elements may hinder adaptation.

72 Department of Climate Change, *Review of Possible Regulatory and Policy Barriers to Climate Change Adaptation, Final Report*, 30 June 2009, p. vi.

3.15 The types of elements in a regulatory framework that may provide a foundation for effective adaptation to climate change include:

- Explicit or implicit recognition of the need to account for climate change
- Broad objectives
- Flexibility in regulatory approach, tools and decision-making processes
- Responsibility for decision-making is vested in the entity that is best placed and resourced to identify, assess and respond to risks
- Decision-making processes are informed by relevant and up-to-date information
- Compliance is practical and least cost
- Effective enforcement mechanisms exist

3.16 Elements within a regulatory framework that may hinder adaptation to climate change include:

- Failure to recognise environmental considerations, including the effects of climate change, in regulatory objectives and tools
- Rigid, prescriptive rules that do not respond to evolving risks
- Inconsistent application, leading to different approaches and outcomes
- Inadequate access to information in decision-making processes
- Compliance is difficult
- Enforcement mechanisms are inadequate

(ii) Matching regulatory response to climate change risk

3.17 Any framework for assessing the ability of regulation to effectively respond to climate change must necessarily focus on risk. Risk is generally defined as a combination of the likelihood of an occurrence and the consequence or impact of that occurrence.

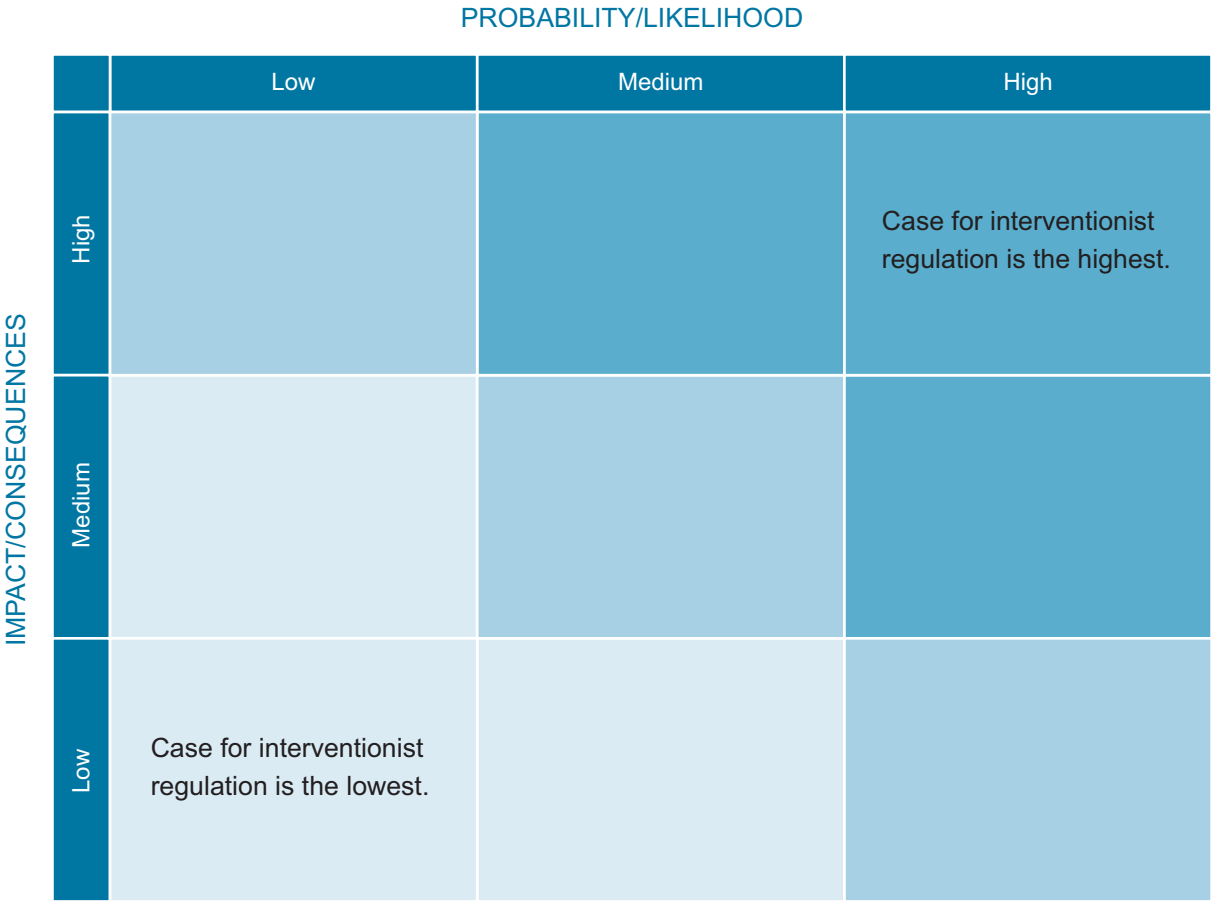
3.18 Climate change has been linked to a range of significant risks affecting a broad array of infrastructure and associated services. However, in practice, the likelihood and the consequences associated with climate change are not known with any certainty. This makes identifying the specific risks that may arise in relation to a particular type of infrastructure difficult. Furthermore, the development of an appropriate regulatory response to address uncertain risks is equally challenging. Risks may be over-estimated or under-estimated and, accordingly, the regulatory response may either be excessive or inadequate. A final complication is the fact that the risks associated with climate change are not static; they will evolve over time. An adequate regulatory response will need to be dynamic enough to keep pace with changes in the relevant risks.

3.19 An identification and assessment of the relevant climate change risks that may affect infrastructure and associated services will be a fundamental first step in determining the adequacy or otherwise of regulatory responses. As yet, a comprehensive identification and assessment of climate change risks has not been undertaken for the spectrum of Australia's infrastructure. Nevertheless, various tools are available to assist in this exercise.[73] These tools assist with the identification of risk and its consequences, analysing the likelihood of different outcomes, evaluating whether the risks are tolerable and selecting appropriate risk management action.[74]

73 Australian Standard AS/NZS 4360:2004 – Risk Management. Also see Department of Environment and Heritage, Australian Greenhouse Office, *Climate Change Impacts & Risk Management: A Guide for Business and Government*, 2006.
74 Australian Standard AS/NZS 4360:2004 – Risk Management.

3.20 In determining whether regulation can effectively manage the risks arising from climate change, it will be necessary to assess the extent to which the regulatory response is commensurate with the relevant risks. Generally speaking, intrusive regulatory intervention is justified when the overall risk is the greatest. In contrast, less interventionist tools will be preferable where the overall risk is relatively low. This is illustrated in Figure 1 below.

Figure 1. Matching regulatory response with risk impact



3.21 Ideally, a given regulatory framework should include a mix of tools that are capable of effectively responding to the effects of climate change based on the level of risk. The level of risk will vary depending upon:

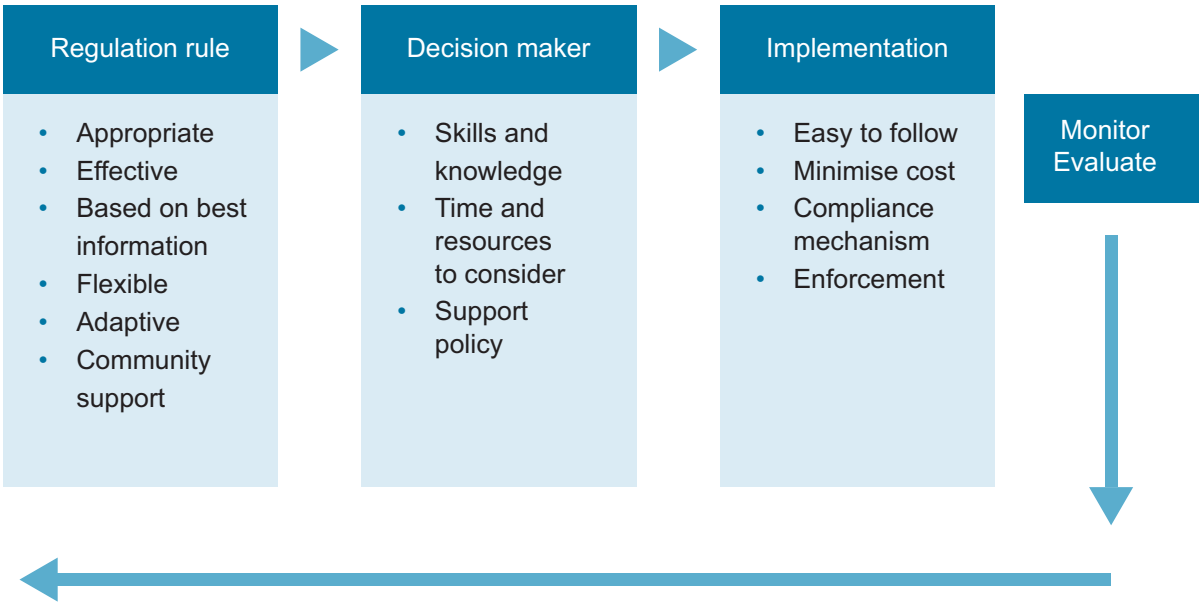
- The type, age, design and location of infrastructure
- The impact and consequences of different climate events on the infrastructure and associated services
- The likelihood of the different climate events occurring
- The resilience and behaviour of people and systems in response to climate change

(iii) Implementing mechanisms to enhance adaptation

3.22 Regulation is a tool that can be used to facilitate adaptation to the effects of climate change. However, it is unlikely to accomplish this objective if the tool is not used in appropriate circumstances and/or it is not applied in the way intended. Indeed, the implementation of regulation will often be as important as the regulation itself in combating climate change.

3.23 The underlying institutions, decision-making processes and enforcement mechanisms will all play a critical role in determining the adaptive capacity of a regulatory framework. The most adaptive regulatory framework may be undermined if institutions are resistant to change or not sufficiently equipped to deal with change[75] or where the practical implementation is overly costly or difficult. Accordingly, an adaptive management model such as the one illustrated in Figure 2 below will be an essential complement to an adaptive regulatory framework.

Figure 2. Model for adaptive management



C. Regulatory frameworks for assessment

3.24 There is a broad variety of regulatory frameworks affecting infrastructure and associated services. The objectives underlying these frameworks, the regulatory approaches and focus are distinct. Some frameworks explicitly address the effects of climate change, others implicitly address climate change and yet others do not address climate change at all.

3.25 The succeeding sections of this chapter of the Report will consider each of these regulatory frameworks to determine the extent to which they facilitate or hinder adaptation to climate change. Ultimately, it will be necessary to determine the extent to which regulatory frameworks are capable of effectively responding to climate change based on the specific risks that are likely to arise for each infrastructure category or regulatory area, once a comprehensive risk assessment has been undertaken.

75 J McDonald, above fn 62, p. 11.

D. Building

3.26 The built environment plays a fundamental economic, cultural and social role in our lives. Our residential, commercial and public buildings provide shelter and security. They affect our productivity, our health and our general well-being and amenity. Buildings are also relatively long-lived assets.

3.27 Climate change will have a significant impact on buildings. It is essential that new buildings are capable of withstanding the impacts of climate change during the life of these buildings and that existing buildings are made more resilient to these impacts for the remainder of their lives. A transformation of Australia's building stock will be needed over time, particularly in areas where climate change effects are particularly pronounced or are predicted to increase in severity and frequency in the future. However, determining the regulatory response to achieve this transformation is complex for a number of reasons.

3.28 First, the building sector is characterised by diversity in ownership and use, which is shared between private individuals, corporate entities and public bodies. This raises the question of the most appropriate model for allocating responsibility for addressing the effects of climate change. Second, building structure, design and age is equally diverse, particularly when the spectrum of residential, commercial and public buildings is considered. Such diversity presents particular challenges in devising and implementing rules that apply across-the-board to help buildings adapt to the effects of climate change. Thirdly, Australia's buildings are physically spread across a broad array of different climate zones, which will affect their vulnerability as well as their responsiveness to the challenges that climate change presents. The question arises as to whether the regulatory framework for buildings is capable of effectively responding to climate change while accounting for these complexities.

(i) Recognition of climate change in building regulation

3.29 The regulatory framework for buildings does not explicitly recognise climate change. However, the centrepiece of the framework – namely, the BCA – does contain provisions requiring buildings to be designed and built to resist various impacts to which they may be subject, including a number of physical phenomena that may be associated with climate change.

3.30 More specifically, the BCA includes amongst its performance requirements that a building or structure must remain stable and not collapse; that progressive collapse must be prevented; and that local damage and loss of amenity through excessive deformation, vibration or degradation is minimised. The BCA also lists a variety of impacts which buildings should withstand, including, wind, snow, earthquakes, rainfall, thermal effects and ground movement caused by swelling, shrinkage or freezing of the subsoil. The associated deemed to satisfy provisions provide that the resistance of a building must be greater than the most critical effect resulting from these phenomena. Furthermore, the provisions require compliance of building materials with relevant standards to ensure structural resistance.[76]

76 See Part B1 of Volume 1 (Structural Provisions) and Part 2.1 of Volume 2 (Structure) of the BCA. Volume 1 of the BCA pertains primarily to Class 2 to 9 buildings (including apartment, office and retail buildings) whereas Volume 2 pertains primarily to Class 1 and 10 buildings (houses, sheds, carports, etc).

3.31 These general requirements regarding structural stability are complemented by more specific provisions dealing with a range of physical impacts on buildings that may arise as a result of climate change, including storm surges,[77] overheating[78] and bushfires.[79]

(ii) Aspects which may facilitate adaptation to climate change

(a) Performance-based approach

3.31.1 The BCA is a performance-based code. For each aspect of construction, the BCA sets out performance requirements, which are mandatory requirements that must be met regarding the design and construction of buildings. Compliance with the performance requirements may be achieved by complying with prescriptive 'deemed to satisfy' provisions which, as the name suggests, are deemed to satisfy the performance requirements. Alternatively, the performance requirements may be met through an 'alternative solution', which must undergo an independent assessment to ensure that it meets the performance requirements.

3.31.2 The performance-based approach, which characterises the BCA, provides building sector participants with considerable flexibility to respond to the effects of climate change. In theory, the approach accommodates innovative building solutions that address climate change impacts as they become available without the need for regulatory change. A performance-based approach also offers an opportunity to deal with the uncertainty surrounding the specific impacts of climate change on buildings, which will vary from region to region, by prescribing performance requirements that account for likely changes in the physical environment.

3.31.3 However, to date, experience under the BCA suggests that many industry participants prefer to rely upon the prescriptive deemed to satisfy requirements of the BCA because these requirements provide a level of certainty regarding building outcomes and costs. This is particularly the case for less complex projects and for domestic construction. In contrast, demonstrating that an alternative solution complies with the performance requirements will require investment in reports, certificates and/or research to justify that an alternative solution meets the relevant performance requirements.

77 Part F1, Volume 1 (Damp and Weatherproofing) and Part 2.2 of Volume 2 (Damp and Weatherproofing) of the BCA contain performance requirements in relation to disposal of stormwater and entry of stormwater into buildings. In particular, surface water, resulting from a storm having an average recurrence interval of 20 years and which is collected or concentrated by a building or sitework, must be disposed of in a way that avoids the likelihood of damage or nuisance to any other property. Furthermore, surface water, resulting from a storm having an average recurrence interval of 100 years, must not enter the building. The deemed-to-satisfy provisions include requirements to comply with relevant standards regarding stormwater drainage, rooftop materials, sarking materials used for weatherproofing of roofs and walls, and glazed assemblies to help increase resistance to water penetration.

78 Section J of Volume 1 of the BCA contains a range of deemed-to-satisfy provisions that may be relevant to reducing the risk of overheating for certain classes of buildings, including in relation to insulation and air movement. In particular, the BCA contains general provisions regarding thermal construction for Class 2 – 9 buildings, which seek to ensure that buildings are adequately insulated. More specific provisions exist in relation to roof and ceiling construction, walls and floors. The BCA also contains provisions applicable to certain Class 2 and 4 buildings in relation to air movement. The relevant provisions contain a specification of the minimum total ventilation opening area required per room based on the climate zone where the building in question is located. These provisions may assist in adaptation to increased temperature and exposure to radiation. They may also help to reduce the demand for air-conditioning in a building and reduce the impact of increased temperatures on internal building materials.

79 Section C, Volume 1 (Fire Resistance) and Part 2.3, Volume 2 (Fire Safety) of the BCA contain provisions that seek to render buildings less vulnerable to fire risks. In particular, the BCA requires a building to be constructed in a way that maintains structural stability during a fire taking into account, among other things, the nature of the fire hazard. It also requires a building to be provided with safeguards to prevent the spread of fire. The BCA also contains a range of deemed-to-satisfy provisions that are relevant to reducing the exposure of buildings to bushfire risks. These include fire resistance and stability. The BCA requires any material or assembly used in a Class 2 to 9 buildings (including floor materials, floor coverings, wall and ceiling lining materials) to comply with certain specifications to increase their fire resistance. The BCA also requires that Class 2 and 3 buildings in 'designated bushfire prone areas' must comply with AS 3959. This standard was updated in 2009 to improve the ability of homes in bushfire prone areas to withstand bushfire attack. The revised standard requires additional construction measures to be incorporated into new housing located in designated bushfire-prone areas if the 'Bushfire Attack Level' exceeds a prescribed threshold.

3.31.4 Moreover, the alternative solutions are assessed by building surveyors and certifiers, who may not be aware of the implications of climate change for proposed buildings and/or are unable to obtain adequate information to account for climate change in their assessment decisions. Therefore, unless these practitioners are specifically required to account for climate change in the context of these assessments, it is possible that alternative solutions will fail to adequately respond to climate change. Guidance may also be needed to ensure consistent interpretation of performance requirements in the assessment of alternative solutions.

(b) Accounting for the physical impacts of climate change on buildings

3.31.5 As noted above in paragraph 3.30, the BCA already refers to a number of physical impacts that buildings must withstand. Notably, the impacts against which the BCA sets out to protect buildings are based on the prevailing climatic conditions and not on future expectations associated with climate change. For example, the BCA identifies pre-determined climate zones for thermal design[80] and refers to wind speeds, which buildings must be capable of withstanding.[81] These physical parameters upon which the BCA requirements are based can only be changed by an amendment of the BCA.

3.31.6 Nevertheless, despite the practical difficulties associated with amending the BCA, the effects of climate change can be relatively easily addressed through the existing framework established under the BCA whereby certain physical impacts are identified and buildings are required to be built to respond to these impacts. It will, however, be necessary, to ensure that the specification in the BCA of the physical impacts that buildings must withstand is broad enough to encompass the spectrum of climate change effects for buildings and accounts for the evolution of those effects over time.

(c) Mandatory disclosure for buildings

3.31.7 The Commonwealth *Building Energy Efficiency Disclosure Act 2010* provides for the establishment of a national mandatory disclosure scheme for owners and tenants of certain commercial office buildings in relation to the energy efficiency of those buildings. The scheme is designed to give purchasers, lessees and sub-lessees more information about the energy efficiency of large commercial office spaces they are considering acquiring or leasing. The scheme will assist these entities to consider energy efficiency in their decision-making. In turn, it is hoped that this will drive an increased uptake of energy efficiency in Australian commercial office buildings, of which there are more than 3,900, amounting to in excess of 21 million square metres of commercial office space. It has been estimated that every one 'star' increase in an office building's energy efficiency rating will result in 15% saving in energy costs per year.

3.31.8 The scheme, which started on 1 November 2010, is part of the Federal Government's National Strategy on Energy Efficiency. This strategy seeks to accelerate efforts to achieve energy efficient outcomes – including for buildings – to help reduce Australia's greenhouse gas emissions but also to reduce demand for electricity. As will be seen in a later section of this chapter, managing demand for electricity will be an important adaptation response.

80 Figure 1.1.4 of Volume 2 of the BCA identifies 'Climate Zones for Thermal Design'.
81 Table 1.1.1 of Volume 2 of the BCA identifies 'Design Wind Speed – Equivalent Values'.

(iii) Aspects which may hinder adaptation to climate change

(a) State-based deviations from the BCA

3.31.9 At present, the States and Territories have the ability to opt out of parts of the BCA through jurisdictional amendments. Efforts are currently being made to restrict the number of deviations, although variations to account for geographic and climatic differences are specifically allowed.

3.31.10 While it is necessary to ensure that building requirements respond to the particular climatic conditions prevailing in a local area, widespread deviation from the BCA could undermine efforts to achieve a national response to climate change for buildings through the BCA. This risk could be exacerbated by differences between each jurisdiction's schemes for administration of the building approvals process. Such differences could lead to variation in the way building requirements associated with developing resilience to climate change are interpreted and applied in practice.

(b) Adequacy of Australian Standards

3.31.11 The deemed to satisfy provisions of the BCA often require compliance with Australian Standards, which can be prescriptive or performance-based in nature. These standards apply to a variety of areas affecting building design and construction.

3.31.12 As yet, there is only one standard applicable to buildings that explicitly addresses the risks posed by climate change – namely, the Bushfire Standard AS 3959.[82] This was updated in 2009 to improve the ability of homes in bushfire prone areas to withstand bushfire attack. The revised standard requires additional construction measures to be incorporated into new housing located in designated bushfire-prone areas if the 'Bushfire Attack Level' exceeds a prescribed threshold. However, the market has been slow to develop products that can meet the requirements of this standard.

3.31.13 The prospect of developing new building standards that specifically address climate change risks is likely to be limited given the institutional structure of the standard-setting body – Standards Australia – and the process of development of such standards. Standards Australia is an independent, not-for-profit organisation, whose role extends beyond developing standards for buildings. Its membership includes more than 70 of Australia's industry, government and consumer organisations. Standards are developed and reviewed by volunteers from the member organisations. A consensus decision-making model applies in approving standards to ensure that the process is not captured by vested interests. However, this model necessarily means that the development and review of standards is typically a slow process. This problem is compounded by the fact that the development of new standards is prioritised depending upon the perceived 'net benefits' of the standard as well as Standards Australia's resources.

82 A new standard is currently being prepared by Standards Australia for 'Climate Change Resilience for Infrastructure and Settlements'. This standard is a world first and is likely to be adopted at a global level by International Standards Organisation.

3.31.14 There was criticism of this process during the Victorian Bushfires Royal Commission where it was stated that 'the technical content of construction requirements for buildings in bushfire prone areas was largely left to a technical committee of a non-government organisation, comprised of volunteers, working with a consensus decision making model that did not require them to complete their review within a given timeframe'.[83] In this regard, it is notable that the Bushfire Standard AS 3959 had been under review for 9 years before the review of the standard was eventually completed. The Victorian Black Saturday bushfires in 2009 finally provided the impetus to finalise the review and implement the changes necessary to make residential buildings more resilient to bushfire attack.

3.31.15 The opportunity to review existing building standards to ensure that they reflect the risks posed by climate change is also likely to be limited. Most existing standards are reviewed and updated every 7 to 10 years. The frequency of review of the standards could prevent the timely review of standards that could be helpful in responding to climate change. Standards Australia states that the process for review of standards will take into account current views and expectations regarding quality, safety and the environment. However, it is unclear whether consideration of 'the environment' includes climate change. The scope of Standards Australia's review criteria may need to be expanded to specifically include climate change. Furthermore, in order to ensure that climate change is dealt with effectively, it will also be necessary to ensure that the suite of standards that apply to the building and construction industry are considered holistically so that, in combination, they establish resilience of buildings to climate change impacts. Finally, although both the BCA and Australian Standards are essential to understand the requirements for the construction of new buildings, these documents are not available free of charge. Accessibility to these documents may need to be reviewed if they are to play a significant role in the transformation of Australia's building stock to respond to climate change.

(c) Existing buildings

3.31.16 A major limitation associated with the capacity of the existing regulatory framework for buildings to address the impact of climate change is the fact that there is a heavy emphasis on new buildings. Yet, there are many existing buildings that face significant risks posed by climate change. Moreover, older buildings are likely to be more vulnerable to climate change effects than new buildings.

3.31.17 State and Territory legislation does include triggers for the upgrade of existing building stock to conform with the BCA when existing buildings undergo major alterations or additions. In particular, where existing buildings are altered, the new or altered parts of the building must comply with the BCA. The entire building may also be required to comply with the BCA where renovations or additions are substantial.[84] State and territory legislation also creates additional triggers for bringing existing buildings into compliance with BCA. Triggers include where a building is sub-divided or where the use (that is, the classification) of the building is changed.

83 Submissions of Counsel Assisting Building in Bushfire Prone Areas (SUBM.201.001.0001 2009), Victoria Bushfires Royal Commission Letters Patent issued 16 February 2009, para. 3.44.

84 See, for example, *Victorian Building Regulations 2006* (regulation 608), Qld *Building Act 1975* (section 81) and NSW *Environmental Planning and Assessment Regulations 2000* (regulation 94) where the entire building may be required to be brought into conformity with the BCA if proposed alterations together with any other alterations in the previous 3 years, represent more that half the original volume of the building.

3.31.18 This ability to upgrade existing buildings so that they comply with the BCA could be an important mechanism to ensure resilience of older infrastructure to the impact of climate change. However, the requirement to upgrade an entire building to bring it into compliance with the BCA is discretionary. In particular, the issuer of the building permit has discretion to decide whether or not a complete upgrade is needed based on issues including structural adequacy, amenity, safety and spread of fire. Broader environmental issues, including climate change, are not specifically identified as issues that the relevant decision-maker is obliged to consider.

3.31.19 Even if the relevant provisions in State and Territory legislation were changed to require the permit issuer to consider the implications of climate change in deciding whether an entire upgrade is needed, questions remains regarding how the decision-maker will inform him or herself as to the risks of climate change and how the upgrade will be funded.

E. Planning

3.32 Planning is the process of making decisions regarding the development, use and protection of urban and rural land, infrastructure and facilities for the present as well as for the future. When it is done well, planning can help to establish and develop communities where people want to work, shop, live or visit. By facilitating the fair, orderly, aesthetic and sustainable use and development of land for housing, industry and community services, planning can help to ensure that a community's basic needs are met, such as fresh air, clean water and recreational space. Planning also has a role to play in providing access to essential infrastructure, including public transport, waste and other public facilities and in helping to protect and conserve natural and man-made resources, buildings and facilities.

3.33 Planning has, in the past, evolved to respond to a variety of physical and practical challenges and, in many ways, planning is ideally suited to combat climate change. In general terms, the objectives and core principles underlying current Australian planning regimes support the use of planning as a mechanism to tackle climate change. In addition, planning tools exist that can be adapted to deal with climate change. Moreover, by virtue of the decentralised nature of planning frameworks, they are well suited to respond to the localised consequences of climate change in a practical and effective way.

3.34 We are increasingly seeing planning being used as a way to respond to climate change. For example, under the new national urban policy – 'Our Cities, Our Future' – the federal government will provide funding to facilitate tailored local solutions to urban design and infrastructure challenges in our major cities, including to address the challenges arising from climate change. Work is also underway to develop National Principles for Climate Change, which will form an intrinsic part of a National Planning Framework for Climate Change Adaptation and Mitigation. Infrastructure Australia has indicated that funding for infrastructure may be made conditional on compliance with these principles. In addition, there are numerous instances of planning being employed at a local level to help communities that are vulnerable to the effects of climate change to adapt to the effects of climate change, particularly sea level rise and bushfires. Nevertheless, questions arise as to the effectiveness of the planning system to address the spectrum and scale of climate change risks that are likely to materialise in the future, particularly in light of the fact that the system only applies to new development rather than existing development.

(i) Recognition of climate change in the planning system

3.35 There is no consistent approach across Australia's jurisdictions regarding the use of the planning system to respond to the impact of climate change. In some jurisdictions, the planning framework explicitly acknowledges predicted impacts of climate change, but primarily only in relation to coastal hazards and sea level rise.[85] In other jurisdictions, while climate change may not be explicitly acknowledged, the framework's inherent flexibility has provided decision-makers with the opportunity to take account of climate change and its impacts.[86]

3.36 The flexibility derives in part from the breadth of objectives underlying regulatory frameworks, including fair and orderly development[87] and the sustainable use and development of land.[88] In addition, courts and tribunals around Australia have considered the impact of climate change on proposed use and development where climate change is explicitly acknowledged in the regulatory framework[89] and in cases where it is not.[90] Among the principles used by these bodies as a basis for accounting for climate change is the principle of ecologically sustainable development, which includes the precautionary principle and the principle of intergenerational equity.[91]

3.37 The flexibility of the planning system helps to facilitate adaptation to climate change. More specifically, there is scope within the system to respond to a range of different impacts and also to address the particular types of risks that might arise in different areas. However, the very flexibility that could be used to accommodate efforts to tackle climate change could also lead to a fragmented approach, thereby undermining efforts to achieve a harmonised and consistent response. This fragmentation is exacerbated by the decentralised framework for planning decisions, with responsibility for planning resting predominantly in the hands of local councils. In some cases, the flexibility may be used to adopt a comprehensive response to climate change effects. For example, Byron Shire Council in New South Wales has developed rigorous development control provisions for new development in coastal areas to give effect to its policy of 'retreat' from the hazards associated with sea level rise.[92] However, in other coastal areas around Australia, limited action has been taken.[93]

(ii) Aspects which may facilitate adaptation to climate change

3.38 There are a range of existing planning tools that could be used to address climate change. Some tools can be adopted at a strategic level to change the way in way planning decisions are made in all cases. Other tools may be used in relation to statutory planning decisions relating to specific applications for land use or development.

85 See, for example, clause 5.5 of the NSW Standard Instrument Order 2006 and clause 13.01 of the Victoria Planning Provisions.
86 See *Gippsland Coastal Board v South Gippsland SC (No 2)* [2008] VCAT 1545 where the Victorian Civil and Administrative Tribunal considered the impacts of climate change in relation to proposed development of a coastal area prior to these impacts being explicitly recognised in any Victorian planning instrument.
87 See, for example, Tasmania's Schedule 1 to the *Land Use Planning and Approvals Act 1993*; in Victoria, section 3 of the *Planning and Environment Act 1987*; in Northern Territory, section 2A of the *Planning Act 2009*.
88 See, for example, in Western Australia, section 3 of the *Planning and Development Act 2005*; in South Australia, section 3 of the *Development Act 1993*; in Victoria, section 3 of the *Planning and Environment Act 1987*; in Queensland, section 3 of the *Sustainable Planning Act 2009*; in Tasmania, Schedule 1 to the *Land Use Planning and Approvals Act 1993*; in the ACT, section 6 of the *Planning and Development Act 2007*.
89 See, for instance, *Northcape Properties Pty Ltd v District Council of Yorke Peninsula* [2008] SASC 57 and *Taip v East Gippsland SC* [2010] VCAT 1222.
90 See, for instance, *Gippsland Coastal Board v South Gippsland SC & Ors* [2008] VCAT 1545 and *Walker v Minister for Planning* [2007] NSWLEC 741.
91 These principles require decision-makers to consider the interests of the present generation (for instance, the benefits in providing housing in a particular location) whilst also considering the interests of future generations (the appropriateness of locating housing in an area at high risk from sea level rise).
92 Byron Shire Council Development Control Plan No. 12.
93 There will be a numerous reasons why, at a local level, planning controls to implement adaptation strategy will not be progressed, not least of which is a lack of information and resources to undertake such a task. See public comments made by mayors of vulnerable municipalities in Victoria such as East Gippsland and Queenscliffe.

(a) Strategic planning

3.38.1 Strategic planning provides the framework for the control and regulation of land use and development. Strategic planning involves the preparation of strategies and planning controls to guide future use and development of land. Strategic planning can involve policy development applicable to an entire State, region or municipality, development of a strategic plan applicable to a particular area known as a 'structure plan', 'master plan', or 'development plan' to anticipate and guide the future development of an area within a municipality, or the rezoning of one parcel of land to facilitate a particular development.

3.38.2 The process of strategic planning involves:

- mapping the baseline physical, environmental, social and economic characteristics of an area;[94]
- development of policy to identify areas that are suitable or unsuitable for different types of land uses and development, to indicate the way in which the area should develop over time, and to provide guidelines for the exercise of discretion in relation to future land use and development proposals;
- identifying the zones and development controls to be used to implement the policy.

3.38.3 As noted above in paragraph 3.38.2, the process of strategic planning includes an assessment of the physical particularities of the municipality or area. The process whereby the physical features of a municipality are taken into account provides an important opportunity to address the effects of climate change at a strategic level. For example, in Victoria, *Ministerial Direction No. 13 – Managing Coastal Hazards and the Coastal Impacts of Climate Change* requires planning authorities to inform themselves as to the current and future risks associated with coastal processes in considering rezoning of low-lying land for residential purposes.[95]

3.38.4 Zoning can be used to identify and restrict use and development on land vulnerable to the effects of climate change, particularly sea level rise and coastal hazards, bushfires and floods. Through special climate change zones,[96] controls can be introduced to require planning permission where it formerly was not required in areas that are particularly vulnerable to the effects of climate change. Nevertheless, it should be noted that 'back zoning' raises issues regarding existing use rights and potentially compensation, which are dealt with later in this section of the chapter.

94 For instance, in an area that may be prone to flooding, this may involve mapping the predicted nature and extent of flooding and the existing land use and development within that area and identifying the factors that influence flooding, such as drainage and layout of roads.
95 Similar requirements exist in Queensland and NSW.
96 Overlays could be used in Victoria.

3.38.5 Specific development controls could also be useful in addressing the effects of climate change. These controls could trigger approval requirements, impose setback, height or density limits and impose design criteria, such as increased floor levels in flood affected areas.[97] Existing development controls may need to be reviewed and updated to ensure that they are capable of responding to current as well as future climate change risks. For instance, the Queensland Commission of Inquiry into the 2011 floods is considering the effectiveness of the planning framework for flooding in the State. The *State Planning Policy 1/03*: *Mitigating the Adverse Impacts of Floods, Bushfire and Landslide* (**SPP 1/03**) is central to this framework. Submissions have been made to the Commission highlighting that SPP 1/03 is now eight years old and needs to be amended regularly to ensure the policy keeps pace with the State's flood characteristics. In this regard, the argument has been made that existing developments that were outside flood affected areas when the policy was first prepared are now within flood-affected areas and are, therefore, at risk.

3.38.6 At a more general level, strategic planning provides the opportunity for a council to prepare a comprehensive adaptation strategy for an entire area or precinct through the structure planning process. A structure plan provides a long-term guide for changes to land use, buildings and public spaces in a given area and, therefore, provides a good opportunity to ensure that climate change risks are addressed in the area in question and to encourage development in less vulnerable areas. Zoning or other development controls may be used to implement the structure plan. A good example is the flagship project of East Lake in the ACT, an urban renewal project driven by the ACT Government in partnership with the CSIRO. The aim of the project is to develop 'a sustainability framework and tools to transform East Lake into a sustainable and healthy urban community'.[98] Among other things, the draft Planning Report for the East Lake Precinct indicates that there will need to be adaptation measures to address more severe storm events and the increased likelihood of bushfires.[99] Structure planning could also be used to address higher urban temperatures caused by climate change and the urban heat island effect by requiring water-sensitive urban design, increased planting of vegetation and inclusion of greater areas of open public space.

3.38.7 The planning framework can also be used to reserve land to be compulsorily acquired for a public purpose, such as for a new public road or other public infrastructure. This opportunity may be important if pre-existing roads and routes of access are no longer available as a result of climate change, particularly in areas that are vulnerable to coastal hazards and sea level rise.

(b) Statutory planning

3.38.8 Statutory planning regulates specific proposals for new use and development. Notably, not all new use or development will require planning approval. For instance, residential uses are often exempt from the requirement to obtain planning permission in residential zones. Where approval is not required for new use or development as a result of planning controls, this gives rise to a legitimate assumption that use or development may proceed in that area. In these areas, there is no ability to use the planning system to apply conditions requiring climate change to be taken into account.

97 For example, Byron Shire's Coastal Erosion Lands Development Control Plan sets out the types of development that will be permitted and standards to apply to land in three 'precincts': land affected by erosion now, land affected in 50 years and land affected in 100 years. The development controls prohibit new development within 20 metres of the 'erosion escarpment'; for areas that are immediately at risk and require new buildings to be relocatable, no more than 4.4 metres in height, 4.6 metres in width and 5000 kilograms in weight. Another example is the ACT Strategic Bushfire Management Plan, which was revised by the ACT government in 2009 to adopt a number of recommendations arising out of the Interim Report of the 2009 Victorian Bushfires Royal Commission and the 2003 Coronial Inquiry into the Canberra bushfires. This Plan includes the adoption of new bushfire management zones that restrict new use and development in bushfire prone areas.

98 See CSIRO's website for more information about this project: http://www.csiro.au/partnerships/EastLakeUrbanRenewal.html.

99 ACT Planning & Land Authority, *East Lake Urban Renewal Draft Planning Report*, September 2007, pp. 52–53.

3.38.9 If, however, an approval is required for a proposed use or development of land, this enables statutory planners to assess the land's vulnerability, the appropriateness of the development proposed in light of that vulnerability, and whether the development should be refused on the basis of the precautionary principle or allowed subject to certain controls.

3.38.10 The flexibility and scope of the planning framework enables decision makers to consider and respond to climate change impacts in a number of ways in relation to specific applications for planning approval. First, conditions can be imposed to limit the life of the approval (if, for example, it is considered that an area will be unusable in the future), to impose design requirements (such as a requirement to increase levels of habitable floor space to account for increased flood levels as a result of sea level rise), or to require a contribution to the upgrade of public infrastructure to make such infrastructure more resilient to the effects of climate change.

3.38.11 Second, agreements can be entered into between planning authorities and private landholders.[100] Owners could be required under such agreements to develop and implement private hazard management plans to ensure effective response to hazards and mitigation of risks. An agreement of this kind is also useful to put future owners on notice of the future hazards affecting land, including flooding hazards associated with sea level rise. However, in considering the viability of this option to address the effects of climate change, it will be necessary to take into account the costs and resources required to establish and enforce these agreements.

3.38.12 As in the case of strategic planning, an opportunity exists in the context of statutory planning for the impact of climate change to be explicitly taken into account. For example, based on the *Ministerial Direction No. 13 – Managing Coastal Hazards and the Coastal Impacts of Climate Change*, the Victorian Civil and Administrative Tribunal has required developers to carry out a coastal hazard vulnerability assessment in order to assess the impacts of flooding and other coastal hazards on development of low-lying land in a climate change scenario (and the impacts of the development on flooding in the area) in respect of specific development proposals. Some municipalities within Victoria are also taking this approach to inform their decision-making.[101] However, this type of assessment is costly and time-consuming and some may argue imposes an undue financial burden on small developers.

(c) Stakeholder engagement

3.38.13 The way in which planning decisions are made may also enhance the effectiveness of the system in addressing the impact of climate change. More specifically, the planning system provides for community engagement and stakeholder consultation through, for example, the opportunity for third parties to be involved in decision-making in respect of strategic and statutory planning decisions.

3.38.14 In all jurisdictions, residents of the local area must be notified of applications for proposed new uses and developments and proposals to amend the planning instruments that affect the area. Public participation is encouraged through broader public exhibition of such proposals in State-wide newspapers and, more recently, on the websites of decision-makers.

3.38.15 The nature and degree of stakeholder engagement provided for under the planning system helps to secure community support for planning decisions that are aimed at addressing the effects of climate change.

100 This option was noted by the Victorian Coastal Climate Change Advisory Committee in its Issues and Options Paper, February 2010 and by various Victorian planning panels. See, for example, the Panel reports for Amendment C48 to the Wellington Planning Scheme and Amendment C68 to the East Gippsland Planning Scheme.

101 Geelong City Council is one example.

(iii) Aspects which may hinder adaptation to climate change

(a) Existing use and development

3.38.16 The scope of strategic and statutory planning to address climate change is limited in an important respect – namely, that planning instruments regulate prospective or future use and development. In most jurisdictions, planning instruments cannot regulate existing uses on land.[102] This limitation constitutes a significant impediment to the use of the planning system to facilitate adaptation to climate change.

3.38.17 So-called 'existing use rights' protect the use of existing buildings and works connected with the existing use. In essence, existing use may continue uninterrupted by changes in a planning instrument. For instance, if a planning instrument were amended to prohibit new residential uses (new houses on land) in a particular area, this could not prevent people from continuing to live in existing houses in that area. The rationale for this principle is that development approvals are akin to a property 'right' or 'interest', sometimes referred to as an 'accrued right', and legislation is not to be construed as taking away a right accrued under legislation unless that intention is expressed in unequivocal terms.[103]

3.38.18 Existing use rights limit the effectiveness of planning tools that may be used to facilitate adaptation to climate change. For example, the use of back zoning to curtail development in areas that are vulnerable to the effects of climate change will have no effect on use or development for which there are existing use rights.

3.38.19 Furthermore, compensation may be payable in some jurisdictions if the use of back zoning in areas where there are existing use rights has a negative impact on the value of land to which these existing use rights relate. For example, Queensland's *Sustainable Planning Act 2009* includes a mechanism for compensating owners of interests in land when they are adversely affected by changes to the planning framework. An owner may be entitled to claim compensation if a change to the planning system to address the effects of climate change (for example, through back zoning) reduces the value of the owner's land or if a development application has been made under a superseded planning scheme. In contrast, the Victorian regime does not contain compensation rights equivalent to those that exist in Queensland. This means that back zoning can occur in Victoria without the need to compensate existing holders of existing use rights whose interests may be devalued as a result of the back zoning.

3.38.20 The only method of removing existing development from land is through public acquisition, either voluntarily or through compulsory measures. Planning instruments can 'reserve' land for public purposes, triggering the ability of a statutory authority to acquire land compulsorily for that public purpose. Legislation outside the planning system can also confer the ability to acquire land for a public purpose on a public authority. For instance, water authorities in some jurisdictions have powers to acquire easements over land for the purposes of development of sewer and stormwater pipelines.

102 The ACT is an exception. In the ACT, the ability to use land is controlled through leasing provisions.
103 This principle derives from the common law and is now codified in statutory interpretation legislation applicable in each of the jurisdictions.

3.38.21 Compulsory acquisition is usually exercised to acquire land for construction of new, significant pieces of infrastructure, such as road, rail, sewerage, water or electricity infrastructure. However, the Victorian State Government is also considering acquiring land affected by the 2009 Black Saturday Bushfires, being land in areas of 'unacceptably high bushfire risk'.[104] To implement that policy, the State Government could introduce planning controls to reserve vulnerable land, giving the Government the option to acquire the land and have a say in any use or development application in the future. This would be a relatively new and untested approach to natural hazards and it will remain to be seen whether it can be successfully implemented. The cost of acquisition will mean that it is really an option of last resort that can only be practically used where a particularly important objective is to be pursued and where the necessary funds are available.

(b) Inconsistent information

3.38.22 The availability of clear and consistent information regarding predicted climate change effects will be critical to decision-makers in the planning sector because planning decisions made now will affect the way our communities look many years into the future. However, as yet, climate change information that has been developed for the purposes of the planning system has been prepared largely on a jurisdiction-by-jurisdiction basis, without meaningful co-ordination at a central level.

3.38.23 For instance, in some jurisdictions, a planning benchmark has been adopted for sea level rise. The sea level rise planning benchmark is useful and necessary because it provides a consistent basis upon which to assess vulnerability to flooding when considering a particular development or rezoning proposal in coastal areas. However, there is some variation in sea level rise projections among the jurisdictions.[105] In some ways, the variation in sea level projections as reflected in the planning benchmarks is unsurprising given the localised effects of climate change, which may vary depending upon a range of factors, including the composition and form of the coastline. Nevertheless, the risk of allowing individual jurisdictions to determine the planning benchmark for themselves is that the planning benchmark could underestimate the impact of sea level rise in some jurisdictions and, potentially, overestimate it in others.

3.38.24 Studies are currently being undertaken around the country to assess vulnerability to the effects of climate change. For example, studies are underway to assess the vulnerability of Australia's coastal areas to coastal hazards associated with climate change.[106] However, for the most part, the various vulnerability assessments are not being undertaken in a co-ordinated fashion.

104 Recommendation 46 of the Victorian Bushfire Royal Commission recommends that 'The State develop and implement a retreat and resettlement strategy for existing developments in areas of unacceptably high bushfire risk, including a scheme for non-compulsory acquisition by the State of land in these areas.'

105 The Queensland State Government has adopted planning benchmarks in the Queensland Coastal Plan 2011, as follows: for land not already subject to a development commitment, a sea level rise of 0.8 m is predicted by 2100; for land already subject to a development commitment the following projected sea level rise needs to be accommodated for the life of the relevant asset: 2050 – 0.3 metres; 2060 – 0.4 metres; 2070 – 0.5 metres; 2080 – 0.6 metres; 2090 – 0.7 metres; 2100 – 0.8 metres. In other jurisdictions: Victoria has adopted a planning benchmark of 0.8 metre sea level rise by 2100; NSW has adopted a planning benchmark of 0.4 metres by 2050 and 0.9 metres by 2100; Tasmania has not identified any specific sea level projects. Rather, assessment of the risk of coastal hazards is based on a 1% annual exceedance probability – that is, the probability of a high sea-level event having a 1% chance of occurring once or more in any one year.

106 For instance, there are a number of programs being undertaken around Australia to map coastal vulnerability to the effects of climate change scenario, namely : the Future Coasts program run by the Victorian Department of Sustainability and Environment; in Tasmania, see Chris Sharples, *Indicative Mapping of Tasmanian Coastal Vulnerability to Climate Change and Sea Level Rise*: *Explanatory Report*, 2006 2nd edition, which was partially funded by the Commonwealth Government; in Queensland, a mapping project of climate change on the Queensland coast has been undertaken; in NSW, high resolution terrain mapping of the NSW Central and Hunter coasts for assessments of potential for climate change impacts has been undertaken and a CSIRO report has been prepared, which maps climate change vulnerability for Sydney coastal councils. In addition, in 2009, the federal government released the *Climate Change Risks to Australia's Coasts*: *a first pass national assessment report*, which identified significant climatic risks in coastal areas. A supplement to this report was released in 2011.

3.38.25 There remains a need for consistent hazard vulnerability assessment and data for coastal vulnerability, bushfire risk, reduced rainfall (long term drought affected areas), increased flooding, and urban heat. Such information will help to ensure that planning decision-makers have accurate information regarding current and likely future climate change risks. Whilst the planning system should continue to provide flexibility to decision-makers to allow them to account for the particularities of climate change effects in different areas, ideally, this information should be compiled centrally to ensure consistency.

(c) Identification of areas prone to climate change

3.38.26 The identification of areas that are vulnerable to particular climate change effects is an important first step to the development and application of planning controls to mitigate climate change risks. However, there is some variation among jurisdictions regarding who and how these areas are identified. This could undermine efforts to devise a consistent and comprehensive strategy to address climate change.

3.38.27 For example, in the relation to areas that are vulnerable to bushfires, in Queensland, such areas are identified by councils in their planning schemes pursuant to SPP 1/03. Guidelines have been prepared to guide councils in the identification of these areas. In comparison, the identification of bushfire prone areas in New South Wales is undertaken by the Commissioner of the Rural Fire Services under section 146 of the *Environmental Planning and Assessment Act 1979*. The Commissioner identifies what constitutes a bushfire prone area. Each council then prepares a map, which locates bush fire prone areas within a particular locality. These maps also identify bush fire hazards and associated buffer zones. The projects underway to map areas vulnerable to climate change risk will help to determine appropriate planning controls to match the relevant climate change risk.

(d) Fragmentation of decision-making and lack of capacity of decision-makers

3.38.28 As previously mentioned, the planning system is characterised by its flexibility to respond to current land use and development challenges. However, this flexibility coupled with the decentralised framework for planning decisions means that action to address climate change may be compromised by local politics and/or a lack of support and leadership. The capacity of a particular council to effectively address climate change may also be affected by an absence of skills and adequate resources that may be required to properly account for the impact of climate change at both the strategic and statutory levels. This may lead to fragmented and inconsistent decision-making across jurisdictions and municipalities

F. Environmental impact assessment

3.39 An environmental impact assessment is an assessment of the possible impact that a proposed project may have on the environment. Notably, the EIA process does not prescribe a particular outcome for a proposed project. Rather, the primary purpose of the assessment is to ensure that, in deciding whether or not to approve a particular project, the relevant decision-maker is made aware of and properly considers the associated environmental impacts before a final decision is taken. In addition, the EIA process can be used to identify and apply measures to avoid or minimise the impact of the project on the environment.

3.40 An EIA necessarily occurs before a project is implemented and, therefore, can be used to dictate certain aspects of the project so that it better responds to relevant environmental concerns. The fact that the regime has been established specifically to respond to environmental risks indicates that it could be an important tool to respond to the effects of climate change.

(i) Recognition of climate change in the context of environmental impact assessment regimes

3.41 EIA regimes are aimed at identifying and managing the impact and risks to the environment that are likely to result from a particular proposed project. At present, these regimes focus predominantly on the impact of the project on the environment rather than the impact of the environment on the project, such as, as a result of climate change.

3.42 While there is no explicit recognition of climate change in the context of these regimes, the EIA system in the various States and Territories is potentially dynamic and adaptable. In particular, the scope of an EIA can be changed through guidelines, industry practice and by project-specific determinations and public responses in the case of particular projects. Furthermore, the principle of ecologically sustainable development, which underpins most EIA regimes, could be used as a basis for accounting for the effects of climate change. Moreover, there are a number of instances where climate change has already been considered in the context of an EIA process, although this approach has been largely confined to New South Wales and the ACT.[107] Ideally, however, consideration of climate change should be undertaken in a consistent and a comprehensive way for all projects, particularly those that are sited in areas that may be vulnerable to the effects of climate change.

(ii) Aspects which may facilitate adaptation to climate change

(a) Access to information about risks

3.42.1 EIA regimes are process-oriented. In particular, they provide a mechanism whereby project proponents are required to identify the environmental risks that may arise in relation to the project and to demonstrate how the project responds to those risks.[108] The various regulatory frameworks provide guidance about what the EIA should contain.[109] However, the framework is necessarily flexible to account for variations in the types of projects that may be proposed. Furthermore, the EIA process requires consideration of both the possible and likely impacts of the project on the environment.

3.42.2 This mechanism to gather and assess information regarding environmental risks could be particularly useful in relation to climate change. Specifically, as part of the EIA process, project proponents could be required to identify and assess the current and likely future impacts of climate change on the project. In the context of this process, project proponents could be required to consult relevant authorities that may have information about the risks, such as local councils.

3.42.3 Nevertheless, the assessment process can be burdensome. Generally speaking, the broader the assessment requirements and the larger the project, the more burdensome the requirements. In some cases, the approval process takes longer than the construction of the project. Therefore, if the EIA process is to be used to address the impact of climate change, it will be necessary to strike a balance between the level of information that is truly needed to assess the resilience of a project to climate change effects and the likely costs and resources that providing such information is likely to entail.

107 See, for example, projects relating to electricity transmission infrastructure in the ACT (East Lakes 132kV Substation, Subtransmission Line and Cable Routes), residential development in NSW (Barangaroo) and roads in the ACT (Kings Highway Southern Deviation).
108 See, for example, section 46B of *Development Act 1993* (SA).
109 See, for example, the Victorian *Ministerial Guidelines for Assessment of Environmental Effects*, published by the Department of Sustainability and Environment, June 2006.

(b) Triggers for assessment

3.42.4 An EIA will normally be triggered either automatically under a particular planning regime[110] or where a project is likely to have a particular impact on the environment that exceeds a prescribed threshold.[111]

3.42.5 The existence of a trigger to determine whether or not an EIA is required could be used to determine whether or not an assessment of climate change is necessary in the context of the EIA. For example, a climate change assessment might be required as part of an EIA depending upon the site of the proposed project (that is, whether it will be sited in an area vulnerable to climate change risks) and the scale, importance and likely life of the infrastructure (the larger, more significant projects might be better candidates for a climate change assessment than smaller projects).

(c) Flexible process

3.42.6 The requirement to undertake an EIA may vary from a preliminary review of environmental impacts to an extensive environmental impact statement. The specific requirement that is imposed in the case of a particular project can be tailored to address the level of environmental risks that are likely to arise in relation to the project.

3.42.7 This flexibility is an effective way to respond to the uncertainty and variability associated with climate change impacts, both in temporal and geographical terms. Therefore, the EIA requirement imposed for a particular project could be adapted according to whether or not a proposed project will be sited in an area that is likely to be vulnerable to climate change effects and to address the probability of specific climate change effects intensifying over time.

(d) Conditional approval

3.42.8 The EIA process may be used to impose conditions on project proponents to ensure effective management of the environmental risks.[112] In particular, as a condition of approval, project proponents may be required to prepare and implement environmental management plans, which are aimed at managing, mitigating or avoiding environmental risks. These types of plans could be used to plan for and manage the risks arising from climate change.

(e) Decision-making process

3.42.9 The general approach in each of the jurisdictions is to require an EIA before approval is granted. Typically, the EIA is prepared by contractors retained by the project proponent. The relevant authority relies upon the contractor's assessment in reaching its decision.

3.42.10 This mechanism is a useful way of imposing responsibility for the assessment on the entity that is best placed and resourced to identify and assess the environmental risks. In addition, the incentives underlying the regime are such that the contractors are motivated to prepare an assessment that is accurate and comprehensive. In particular, the regimes provide for public consultation and third party rights to review decisions of the approval authority. These aspects of the regulatory frameworks help to provide a strong incentive to prepare accurate assessments.

110 See, for example, Part 3A or Part 4 of the *Environmental Planning and Assessment 1979* (NSW).
111 One example is the *Environment Protection and Biodiversity Conservation Act 1999* (Cth).
112 See, for example, section 134 of the *Environment Protection and Biodiversity Conservation Act 1999*.

3.42.11 Existing mechanisms in EIA regimes requiring project proponents to undertake an assessment of climate change risks could be complemented with a broader review of the strategic implications of project development for the environment, bearing in mind the likely impact of climate change. A mechanism that could be employed to achieve this objective exists under the *Environment Protection and Biodiversity Conservation Act 1999* in the form of an integrated 'strategic environment assessment'.[113] This type of assessment allows for a 'whole of government' approach to assessing environmental impacts under a policy, plan or program. It allows relevant authorities and entities to confer during the early stages of planning to ensure environmental issues, including matters of national environmental significance, are considered from the outset and at a regional level. It also allows for groups of projects to be allowed or disallowed depending upon the prevailing risks, which dispenses with the need for individual EIAs for each project that may be contemplated in the area in question.

3.42.12 However, it is notable that, at present, only matters of national environmental significance can be considered under the *Environment Protection and Biodiversity Conservation Act 1999*, including in the context of strategic environment assessments. Climate change is not explicitly listed among those matters. This perceived 'gap' in the legislative framework was identified in the Report of the Independent Review of the *Environment Protection and Biodiversity Conservation Act 1999* (October 2009).[114]

(iii) Aspects which may hinder adaptation to climate change

(a) Projects assessed on basis of current rather than future environment

3.42.13 Objectives underlying EIA regimes focus on preservation and restoration of the current environment. This approach assumes that the environmental context within which a project may be undertaken is static and that the human impacts are reversible.[115] The main implication of this approach is that projects are assessed in light of today's environment, without regard to what the environment of the future might look like.

3.42.14 Climate change undermines the basis for this approach. In particular, climate change will have permanent and irreversible consequences for the physical environment. Furthermore, climate change will result in continuous changes to the environment, many of which will be unpredictable in terms of their location, scale and intensity. Therefore, it is inappropriate to assess the inter-relationship between projects and the environment on the basis that, all things being equal, the environment will be unchanging.

3.42.15 Accordingly, in order to accommodate the impact of climate change within existing EIA regimes, it will be necessary to review the underlying objectives and assumptions of relevant decision-makers to ensure that the regimes can keep pace with the dynamism of the physical environment that is likely to be associated with climate change.

113 See Part 10 of the *Environment Protection and Biodiversity Conservation Act 1999*.
114 Australian Government Department of the Environment, Water, Heritage and the Arts, *The Australian Environment Act – Report of the Independent Review of the Environment Protection and Biodiversity Convention Act 1999*, October 2009, p. 100.
115 R Kundis Craig, '"Stationarity is Dead" – Long live Transformation: Five Principles for Climate Change Adaptation Law', 34 *Harvard Environmental Law Review*,2010, 9, p. 35.

(b) Focus on impact of development on the environment

3.42.16 EIA regimes predominantly focus on the impact of a project or activities on the environment rather than the impact of the environment on the project.[116] In other words, these regimes predominantly consider the outward impact of the environment on the project rather than the inward consequences of the physical environment for the project.

3.42.17 To the extent that this outward focus is entrenched as a matter of law and practice, this could undermine efforts to use the EIA process as a mechanism to consider the effects of climate change. If the impact of climate change on a project were to be considered in the context of the EIA process, it would be necessary to ensure that the focus of the regulatory frameworks is bi-directional, including consideration of both the inward and outward environmental impacts associated with the project.

(c) Limited scope of EIA processes

3.42.18 Another significant limitation associated with the use of EIA processes to address the effects of climate change is the restricted scope of application of these processes. First, EIA regimes only apply to new, proposed development. Second, these regimes only apply to a limited range of projects for which the environmental risks are considered to be elevated.

3.42.19 For example, in New South Wales, environmental impact assessment processes under the NSW *Environmental Planning and Assessment Act 1979* are only triggered in respect of:

- 'development' under Part 4, depending on the requirements for the particular type and location of the proposed development within applicable state-wide or local environmental planning instruments;
- 'major projects' under Part 3A that satisfy relevant criteria in a state-wide environmental planning instrument or are declared to be such by the Minister.[117] The form of environmental impact assessment required by Part 3A is determined by the Director General, having regard to relevant guidelines and the need to assess key issues raised by public authorities in respect of the application;
- 'activities' which do not require consent under Part 4 or approval under Part 3A and which would otherwise effectively fall outside the planning regime (Part 5). In approving an activity under Part 5, the determining authority must 'examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity'. If there is likely to be a significant effect, then an EIS is required.

3.42.20 The scope of projects and activities to which EIA regimes apply may need to be changed to ensure that projects that are likely to be vulnerable to the effects of climate change are covered.

116 For example, section 40 of Queensland's *Environment Protection Act 1994* notes that the purposes of an EIS include to assess 'the potential adverse and beneficial environmental, economic and social impacts of the project'.

117 Part 3A is to be repealed and replaced in the near future. However, a number of pending applications already lodged under Part 3A will continue to be assessed under its provisions.

G. Electricity

3.43 Australia's National Electricity Market is a wholesale electricity market, which allows for trade between electricity suppliers (generators) and purchasers (retailers) in Australia's eastern and south eastern States and Territory. It is the product of a comprehensive program of reform for the electricity supply industry, which commenced during the 1990s and was aimed at increasing competition, enhancing efficiency and delivering more choice and better prices for electricity consumers.

3.44 Until now, the NEM and the accompanying regulatory reforms have fared quite well in achieving their objectives. The reforms are generally considered to have resulted in lower electricity prices, at least initially. They have also delivered substantial investment in generation and in networks.

3.45 However, there is evidence of a tightening supply/demand balance in the wholesale market, with forecasts of potential supply shortfalls in the short to medium term and rising energy prices. The situation is likely to be exacerbated by climate change. The main climate change risks to Australia's electricity supply framework are increased user demand and peak load days as a result of increased temperatures and heatwaves, and damage to electricity infrastructure from extreme weather events and bushfire. There is also a risk to electricity supply from water shortages, which will have an impact upon hydroelectricity and on water needed for cooling coal-fired generation.

3.46 Some of the effects of climate change have already been felt in the NEM. Unprecedented heatwaves have driven up demand and placed pressure on generating capacity. Drought has constrained hydroelectric generating capacity and has limited the availability of water for cooling in some coal-fired generators. In addition, transmission and distribution network infrastructure has been compromised as a result of bushfires and floods. These challenges were not anticipated at the time the regulatory framework was constructed.

(i) Recognition of climate change in the electricity regulatory framework

3.47 The regulatory regime for the NEM was developed as a co-operative scheme between the participating jurisdictions, namely, South Australia, Victoria, New South Wales, Queensland, the ACT and Tasmania. The lead legislation was the *National Electricity (South Australia) Act 1996*, which contained a schedule that became the National Electricity Law (**NEL**). The NEL is applied in each participating jurisdiction through application statutes.

3.48 Section 7 of the NEL defines the National Electricity Objective, which underpins the regulatory framework for the supply of electricity in the NEM. It is defined as follows:

> To promote efficient investment in, and efficient use of, electricity services for the long term interests of consumers of electricity with respect to price, quality, reliability and security of supply of electricity and the safety, reliability and security of the national electricity system.

3.49 There is no mention of climate change in section 7 of the NEL. Nor is there a broader reference to environmental considerations. Rather, the emphasis is on efficiency, security of supply and reliability.

3.50 Nevertheless, there is a recognition in the regulatory framework that environmental effects may affect the supply of electricity. For example, under the National Electricity Rules (**NER**), which are given effect under the NEL, the NEM is normally operated by the market operator – the Australian Energy Market Operator (**AEMO**) – in a manner that takes account of 'credible contingency events'. Credible contingency events are events that are considered by AEMO to be reasonably possible in light of the surrounding circumstances. The system is not usually operated to accommodate 'non-credible contingency events', which are considered to be less likely than credible contingency events, such as multiple generating unit failures. Under the NER, AEMO may re-classify a non-credible contingency event as a credible contingency event if 'abnormal conditions' make the occurrence of a non-credible contingency event reasonably possible. 'Abnormal conditions' are defined as conditions posing added risks to the power system, including severe weather conditions, lightning, storms and bushfires. Once a non-credible contingency is reclassified as a credible contingency, the operating parameters for the power system are altered to take account of these 'abnormal conditions'.

3.51 The 'abnormal conditions' identified in the NER include physical phenomena that might be associated with climate change. Under the current regulatory framework, the occurrence of such abnormal conditions is treated as relatively rare. However, these events are likely to be more frequent and less 'abnormal' as the effects of climate change become more entrenched.

(ii) Aspects which may facilitate adaptation to climate change

(a) Supply of electricity

3.51.1 Climate change is likely to increase demand for electricity, particularly during periods of extreme heat. The structure of the NEM encourages investment in additional generation and, consequently, transmission infrastructure, to address demand increases.

3.51.2 Under the NER, generators sell electricity through the NEM, which is a wholesale spot market where changes in supply and demand determine wholesale electricity prices. Generators submit offers to AEMO to supply certain amounts of electricity at particular prices every five minutes. AEMO then accepts the offers– starting from the lowest priced bid – until demand is met. The price paid for all electricity supplied during each five minute interval is the highest bid accepted by AEMO for that period.

3.51.3 Supply and demand are instantaneously matched in real-time through a centrally co-ordinated dispatch process. Spot prices are quickly transmitted to market participants so that supply and demand offers can be made on the basis of timely, transparent and market-based information. The dynamic nature of the spot market means that prices can quickly respond to a tightening in the supply-demand balance. Regions with potential generation shortages will, therefore, exhibit rising prices.

3.51.4 In theory, spot price movement can provide signals for future investment in generation and transmission infrastructure in the NEM to meet growing demand. As the capacity of available generation to meet demand reduces, the spot price will increase and new generation and network capacity may be attracted into the market.

3.51.5 The supply of electricity through the NEM is relatively competitive and prices are mostly unregulated. A price cap does exist under the NER.[118] However, it is quite high, well above the average spot price, and is typically only reached a few times a year during periods of extreme demand. The price cap helps to encourage investment in 'peaking plant', which is used to meet demand during these periods of extreme demand. Peaking plant is usually only profitable when high demand results in high prices that are well above the average.

118 See Rule 3.9.4 of the National Energy Rules.

(b) Demand management

3.51.6 Climate change is likely to place increasing pressure on existing sources of generation, particularly in cases of extreme heat and blackouts caused by heatwaves, bushfires and floods. The structure of the spot market under the NER may have the effect of curbing demand in these cases. In particular, supply scarcity and corresponding high prices may encourage consumers to reduce their demand. However, the likelihood of this response depends upon the availability of appropriate price information and suitable metering for consumers.

3.51.7 Demand side response to supply constraints is also more directly encouraged under the regulatory framework. In particular, a demand management incentive scheme (**DMIS**) exists for network service providers (**NSPs**) to encourage them to adopt strategies to address growth in demand as an alternative to network investment. Successful demand management mechanisms can defer, or even remove, the need for network augmentation to deal with demand in extreme events when electricity requirements are at a maximum.

3.51.8 The DMIS includes a demand management innovation allowance (**DMIA**), which is provided on a use-it-or-lose-it basis, and is in addition to any allowances for capital expenditure or operating expenditure for demand management projects approved by the regulator for an NSP pursuant to the economic regulatory framework applicable to NSPs, details of which are set out in the NER and discussed in more detail below. The DMIS also allows recovery of foregone revenue as a result of reductions in the quantity of energy sold due to approved DMIA expenditure.

3.51.9 While NSPs have indicated that innovation funding under DMIA is an important incentive to undertake demand management, the view has been expressed that the money that is made available for demand management by the AER is not sufficient.[119] Furthermore, it is unclear how effective the DMIS and DMIA are to motivate increased investment in demand management options in favour of network investment if demand management could compromise the ability of NSPs to comply with their broader regulatory obligations to ensure quality and reliability of supply to their customers.

(c) Information about climate change risks

3.51.10 The possible increased incidence of supply constraints in the NEM as a result of climate change makes the availability of current and accurate information all the more essential.

3.51.11 There is a range of sources of information that are specifically provided for under the regulatory framework that may be useful to predict and address supply constraints that could arise as a result of climate change, including:

- Short and medium term Projected Assessment of System Adequacy (**PASA**) reports. These reports, which are prepared by AEMO, indicate the adequacy of supply in the short term (7 day forecast) and medium term (2 year forecast). They include identification of any days on which low reserve or lack of reserve conditions are forecast to apply.
- Energy Adequacy Assessment Projection (**EAAP**): An EAAP, which is also prepared by AEMO, provides information on projected response times to address supply constraints in the NEM that may affect reliability. In preparing the EAAP, AEMO must consider water conditions such as normal rainfall and drought, material restrictions on the supply of a significant fuel source and other limits on a fuel source for a major form of generation. The EAAP covers a two year time-frame.

119 Australian Energy Market Commission, *Review of Demand-Side Participation in the National Electricity Market, Final Report*, 27 November 2009, p. 27.

3.51.12 It will be essential that the regulatory framework is flexible enough to respond to information regarding climate change risks if that information indicates that a supply constraint is imminent. More specifically, the regulatory tools and the ease with which they can be applied should correspond to the risks that climate change may pose to security of supply.

(iii) Aspects which may hinder adaptation to climate change

(a) Regulatory objectives and decision-making processes

3.51.13 The regulatory objectives underlying the NEM, as set out in section 7 of the NEL, could constitute an obstacle to effective adaptation of the regulatory framework for the supply of electricity to climate change. The focus on efficiency, security and reliability of supply in section 7 means that these criteria will have predominant weight in the context of regulatory decisions. Based on the current regulatory objectives, the extent to which climate change can be taken into account in decisions relating to investment in network infrastructure and demand management under the regulatory framework will depend upon whether a link between climate change and security and reliability of supply can be clearly established.

(b) Security of supply

3.51.14 When demand in a NEM region exceeds supply and all other means to satisfy demand have been taken, AEMO can instruct NSPs to disconnect customers from the NEM, resulting in a 'blackout' for those customers. So-called load-shedding has been used in the past by AEMO to address shortages in supply in cases of extreme heat or when bushfires have prevented importation of electricity from other NEM regions.

3.51.15 While load shedding may protect power system security in the short-term, it does not address an equally important objective underlying the NEM – namely, reliability of supply. Furthermore, load shedding may impose enormous costs on the economy, largely through the reduced productivity and possible loss and damage caused when electricity supply is curtailed. A more effective mechanism to deal with supply shortages may be needed to deal with extreme events, such as those associated with climate change to avoid these costs.

3.51.16 One option would be a greater uptake of embedded generation through co and tri-generation facilities.[120] Embedded generators are directly connected to the distribution network and do not have access to the transmission network. Embedded generation is a form of demand management because it can be used to substitute consumption of electricity from the NEM. Nevertheless, grid connection is maintained for embedded generators to import any shortfall in electricity supply that may arise.

120 Co-generation is the simultaneous production of electricity and heating using a single fuel source. The heat that would otherwise be wasted in the production of electricity is captured and utilised to produce steam, which is used, in turn, for heating and cooling. Co-generation is sometimes known as combined heat and power production (CHP). Tri-generation is the simultaneous production of mechanical power (often converted to electricity), heat and cooling from a single heat source such as fuel or solar energy. As in the case of co-generation, waste heat from the power generation process is harnessed and re-used. Tri-generation is sometimes referred to as combined cooling, heating, and power generation (CCHP).

3.51.17 Despite the benefits for demand management and security of supply that embedded generators offer, there are numerous regulatory and practical requirements that may deter uptake of co and tri-generation. These requirements include obtaining approval from the relevant distribution businesses to connect to the grid, the technical standards with which embedded generators must comply and the registration charges that may be payable by larger embedded generators for connection to the grid. These barriers will need to be addressed to encourage the uptake of embedded generation in the future.

(c) Economic regulation of network infrastructure

3.51.18 The supply of electricity transmission and distribution services by NSPs is considered a 'natural monopoly' because large economies of scale are required. Accordingly, revenue and pricing for these services is regulated by the AER. In general terms, NSPs may only recover efficient operating costs and earn a risk-adjusted commercial rate of return on capital required to provide the relevant network services. NSPs must periodically apply to the AER to assess their revenue requirements pursuant to a detailed regulatory process, which is prescribed by the NER.

3.51.19 The regulatory framework is predominantly focused on capital investment in new infrastructure. The framework aims to ensure that only efficient investment in network infrastructure is undertaken. At the start of each regulatory period of 5 years, the AER approves an investment forecast for each network. The AER can also approve contingent projects. Individual investment projects are additionally required to satisfy the regulatory test, which aims to identify the most efficient method to meet an identified need. In addition, to encourage efficient investment in network infrastructure and to avoid 'gold plating', the AER uses incentive schemes, which permit network businesses to retain the returns on any underspending against their investment allowance.

3.51.20 The current structure of the economic regulation framework applicable to NSPs favours investment in network infrastructure. More specifically, the in-built incentives in the regulatory framework encourage NSPs to augment their network assets because the revenue or prices they are entitled to gain are related to their asset base. The larger the asset base, the greater the revenue or prices the NSPs are authorised to recover.

3.51.21 Accordingly, the regulatory framework effectively encourages investment in new capital infrastructure at the expense of demand management options. The bias of the regulatory framework against demand management is further entrenched by virtue of the fact that the regulatory test does not require demand management options to be considered prior to network augmentation options.

3.51.22 In addition, the motivation for NSPs under the regulatory framework to undertake capital investment deters NSPs from using operating expenditure to mitigate climate change risks by, for example, clearing easements for network lines to reduce bushfire risk. Nevertheless, the operating expenditure objectives, which govern forecast operating costs that can be claimed by NSPs, accommodate action that could be taken to address climate change risks. In particular, the objectives include maintaining the reliability and security of supply and of the network infrastructure.[121] These objectives are broad enough to allow costs to be recovered by NSPs for activities related to the operation and maintenance of existing network infrastructure to ensure that they are more resilient to the effects of climate change.

121 See Rule 6.5.6 of the NER for distribution businesses and Rule 6A.6.6 of the NER for transmission businesses.

H. Telecommunications

3.52 The telecommunications sector in Australia is playing an increasingly important role in our society. The impact of emerging telecommunications technologies has been profound and telecommunications infrastructure – in the form of the copper, fibre, mobile towers – is playing a critical role in achieving this cultural transformation.

3.53 Telecommunications infrastructure may be vulnerable to the effects of climate change – particularly storms and extreme events, flooding, bushfires and intense heat. Assessing the extent to which the regulatory framework applicable to telecommunications infrastructure addresses the possible impacts of climate change presents certain challenges given the current state of flux of the industry particularly in respect of the Federal Government's plans for the National Broadband Network (**NBN**) and associated telecommunications reforms, which are discussed in greater detail below.

(i) Recognition of climate change in the regulatory framework for telecommunications

3.54 Climate change and its effects are neither explicitly nor implicitly accounted for in the regulatory framework for telecommunications. Furthermore, it is notable that the NBN network has not been designed with climate change issues in mind. The significant absence of environmental and climatic consideration in the design of the regulatory framework raises questions as to how robust it is likely to be as climate change effects are felt.

(ii) Aspects which may facilitate adaptation to climate change

(a) Access regime

3.54.1 The telecommunications regulatory regime, first implemented in 1997, introduced full competition to the Australian telecommunications market by facilitating access to Telstra's infrastructure. Under this regulatory regime, the ACCC was made responsible for regulating competition in the telecommunications industry and, in particular, issues associated with access by other carriers to Telstra's network. The ACCC's major functions in relation to the telecommunications industry are regulation of anti-competitive conduct and administration of the telecommunications access regime.

3.54.2 Access to Telstra's network, which has been facilitated by the reformed access arrangements, has encouraged other carriers to invest in and develop their own networks, leading to more diversity in the types of and ownership of telecommunication infrastructure built in Australia. Expansion and diversification of telecommunications infrastructure is critical to ensure its resilience to the impact of climate change. In particular, the more expansive the network of telecommunications infrastructure and the more varied the types of infrastructure used, the less likely that particular climate change events or effects will render vast swathes of critical telecommunications infrastructure unusable at the same time.

(b) Carrier licences

3.54.3 The Telecommunications Act generally requires owners of telecommunications infrastructure to hold a carrier licence. Carriers are subject to carrier licence terms and ongoing conditions.

3.54.4 Section 63 of the Telecommunications Act provides that the Minister may, by written instrument, declare that each carrier licence is subject to certain conditions. This Ministerial discretion is not limited and may be used to impose any condition on the carrier licence. For example, pursuant to section 63, the Minister may require a carrier to comply with a designated Disaster Plan. A Disaster Plan is a strategy for coping with a disaster or a civil emergency and is prepared by the federal or state/territory Governments. The power to require compliance with a Disaster Plan appears to be a dormant power. However, this power could be revived and used to ensure that carriers address the impact of climate change in the development and management of telecommunications infrastructure as a condition of their licences.

3.54.5 In applying for a carrier licence, the applicant must submit a range of information to the ACMA, the sector regulator. This information must include a general description of the network and technology that is proposed to be used to supply carriage services to customers and a diagram of the proposed network configuration. Prospective carriers could also be required to submit information to ACMA regarding the measures that have been taken to ensure the resilience of telecommunications infrastructure owned and operated by the carrier against the impact of climate change.

(c) Technical regulation

3.54.6 Scope exists under the regulatory framework for telecommunications infrastructure to impose requirements on carriers to comply with technical requirements that seek to build resilience into new and existing infrastructure. In particular, ACMA is responsible for technical regulation in the telecommunications sector, including through the setting of standards. ACMA may delegate its standard-setting function to the peak industry body, the Communications Alliance Ltd.

3.54.7 Technical standards are generally made to protect the integrity of the network, safety of persons, to give access to emergency calls and ensure interoperability between the network and customer equipment. ACMA has established around 35 current telecommunications technical standards. Technical standards could be established that identify how particular types of telecommunications infrastructure must be designed and built to ensure that it is capable of withstanding the impacts of climate change.

3.54.8 The regulatory framework also provides an opportunity to require carriers to assess the impact of climate change in planning, designing and constructing new infrastructure through the development of relevant industry codes. Under section 118 of the Telecommunications Act, ACMA may request an industry body to develop a code in cases where ACMA considers a code to be necessary or convenient to provide appropriate community safeguards or otherwise deal with the performance or conduct of the telecommunications industry. If the industry body fails to create the requested code, ACMA may create mandatory industry standards under section 123 of the Act.

3.54.9 Under normal circumstances, compliance with industry codes and standards is voluntary. However, ACMA does have powers under Part 6 of the Telecommunications Act to ensure compliance with registered industry codes and standards. These powers enable ACMA to issue formal warnings regarding breaches and to direct industry participants to comply.

3.54.10 Maintenance of telecommunications infrastructure is also governed by the Telecommunications Act. Schedule 1, Part 6 of the Telecommunications Act requires carriers to continuously inspect facilities and take all remedial action that is reasonably required. This Schedule could be amended to ensure that maintenance activities address evolving climate change risks. Furthermore, under Schedule 3 of the Telecommunications Act, the Minister can make a code of practice setting out conditions to be complied with by carriers in relation to, amongst other things, the installation and maintenance of facilities.

(iii) Aspects which may hinder adaptation to climate change

(a) Design of the National Broadband Network

3.54.11 The current rollout by the federal government of its fibre optic national broadband network, is one of the most significant infrastructural deployments in the telecommunications industry. The NBN optic network will reach 93% of premises, with wireless or satellite services provided to the last 7%. The deployment of this network is likely to take 8 to 10 years. This network will be capable of delivering very high speed broadband services and will largely replace Telstra's copper based customer access network.

3.54.12 However, the NBN network has not been designed with climate change issues in mind and will not be significantly different to the current copper infrastructure in relation to climate change considerations.

3.54.13 There is some argument that the NBN network, with its high speed internet connectivity, may facilitate online communications and, in turn, reduce travel and carbon emissions. Nevertheless, in contrast to the current copper network, the NBN telephony equipment at the customer premises requires power from the electricity grid or a backup battery to operate in instances of power outages. This is concerning as the incidence and duration of power outages may increase with climate change events.

(b) Lack of central co-ordination of new infrastructure

3.54.14 The regulatory framework does not direct nor co-ordinate investment in telecommunications infrastructure, leaving carriers free to determine the types, use and location of infrastructure which they deploy. This could mean that the mix of telecommunications infrastructure that is available is not adequate to provide the degree of resilience to climate change impacts that might be required.

(c) Ability to deviate from planning and environmental impact assessment laws

3.54.15 The Telecommunications Act authorises licensed telecommunications carriers to install certain facilities with immunity from some state and territory laws, including planning laws. The Act also offers immunity from most environmental assessment and protection laws for installation or maintenance of these facilities. The most common of these are known as 'low-impact' facilities that are specified in the *Telecommunications (Low impact Facilities) Determination* 1997 and its amendment of 1999.

3.54.16 Low-impact facilities include small radio-communications antennae and dishes that are designed to be unobtrusively erected on existing towers or buildings, underground cables, public telephones, telecommunications pits in footpaths and co-located facilities. The maximum height of a low-impact facility is generally 6.5 metres. One commonly installed low-impact facility is 5.8 metres high. By contrast, mobile phone towers are generally 25 to 30 metres in height.

3.54.17 The Low-impact Facilities Determination defines where these facilities may be installed based on zoning considerations. For example, a facility that is deemed low-impact in a rural or industrial zone may not be low impact if it is installed in a residential area. A facility in an area of environmental significance, such as a World Heritage area or an area on the Register of the National Estate, cannot be designated a low-impact facility. However, the Determination does not restrict the location of low-impact facilities based on climate change risks.

3.54.18 The ability to avoid compliance with planning and environmental laws means that certain telecommunications facilities may be constructed in areas that are particularly vulnerable to climate change risks without having to go through the same assessment processes as other infrastructure. This could mean that telecommunications facilities could be built in areas subject to sea level rise and flooding and in bushfire prone areas.

I. Water

3.55 Climate change poses significant risks to water and wastewater management. The greatest risk, particularly in southern Australia, is likely to be water supply shortages. Other risks include damage to piping and other infrastructure from increased temperatures, bushfire, extreme weather events and flooding. The sewerage system faces risks of corrosion and damage from more concentrated sewage as well as risks of sewage spills from flood events. Increases in storm intensity, which will be exacerbated by sea level rise in some areas, pose risks of flooding, damage and pollution for stormwater management and drainage for which water authorities and local councils are responsible.

3.56 There are a number of options available to facilitate adaptation to the effects of climate change in the water sector. These options fall into the following main categories:

- protection and improvement of water and wastewater infrastructure;
- better management of water supply and demand, including diversification of water sources and water conservation;
- approaches to foster water-sensitive cities, including through stormwater harvesting, flood mitigation, water-sensitive urban design and ecosystem services from water.

3.57 These options are regulated in different ways and, to some extent, the applicable regulatory framework will determine their relative success in achieving effective adaptation to climate change.

(i) Recognition of climate change in the regulatory framework for water

3.58 Climate change and its impacts lie at the heart of a number of regulatory frameworks affecting water, particularly those relating to water supply. Furthermore, climate change has been a driver for major regulatory reform in the sector.

3.59 For example, the Commonwealth's *Water Act 2007* provides for the development of the Basin Plan to address unsustainable use of water in the Murray-Darling Basin. The Basin Plan, which is in the process of being developed, is a strategic plan for the integrated and sustainable management of water resources in the Basin. It will seek to address the legacy of past over-allocation in the Basin and will also take account of the impact of climate change in the future. In fact, the *Water Act 2007* specifically requires an identification in the Basin Plan of the risks to the condition or continued availability of the Basin water resources and climate change is among the particular risks that must be considered. The Basin Plan will be developed to manage water resources so that sufficient water is available, environmental assets and pre-existing functions of the Basin are not compromised, while at the same time optimising social and economic outcomes.

3.60 At a state/territory level, water authorities may be specifically required to develop and implement programs for assessing, monitoring and continuously improving the water authorities' sustainability performance, including responding to climate change.[122] There are also a number of jurisdictional initiatives to increase water efficiency and enhance water conservation that are predominantly aimed at addressing the risks that climatic conditions can pose to water resources.

(ii) Aspects which may facilitate adaptation to climate change

(a) Protection of infrastructure through licensing

3.60.1 Owners and operators of most of Australia's major water infrastructure are government instrumentalities. Existing regulatory frameworks do not specifically require them to assess and address the risks that climate change might pose to such infrastructure.

3.60.2 Nevertheless, the licensing system could be used to achieve this objective. At present, licences for entities responsible for bulk water management and supply include conditions relating to operational standards, water quality, customer protection, environmental performance and catchment protection.[123] Obligations could also be included in these licences requiring the licensee to undertake the necessary assessments and upgrade works to ensure that water infrastructure is resilient to the effects of climate change. Compliance with licence conditions can be ensured through periodic auditing. This function is typically undertaken by the relevant jurisdictional regulator.[124]

(b) Water planning and management

3.60.3 Regulatory processes that already exist for the planning and management of water resources are an existing mechanism that can be used to achieve sustainable use of water. These processes require consideration of best available science and water use values to develop measurable objectives to manage water resource systems equitably and sustainably. The jurisdictions have taken various approaches regarding water planning and management. These regimes are the subject of constant refinement.[125]

3.60.4 Typically, the water planning and management regime is underpinned by a policy document, which describes the objectives for the jurisdiction's water and how the water will be allocated and managed.[126] These policy documents can be used to specifically account for the current and future impact of climate change on water resources.

3.60.5 The water planning and management regime may also be set out in legislation, requiring water planners to take into account a range of factors, including threats to the reliability of supply. For example, the Victorian *Water Act 1989* requires the Water Minister to ensure sustainable water strategies are carried out to:

- identify threats to the reliability of supply and quality of water for both environmental and consumptive uses in the region; and
- to identify ways to improve and set priorities for improving the reliability of supply and quality of water, including managing demand for water and investing in infrastructure for the supply of recycled water.[127]

122 See, in particular, the Statement of Obligations for the urban water authorities in Victoria, made under the *Water Industry Act 1994* (Vic).
123 See, for example, Part 2 of the *Water Industry Act 1994* (Vic) and the Statement of Obligations for the urban water authorities in Victoria.
124 See, for example, clause 16 et seq. of the *Water Industry Regulatory Order 2003* (Vic) made under the *Water Industry Act 1994* (Vic).
125 Mark Hamstead, Claudia Baldwin, Vanessa O'Keefe, *Water allocation planning in Australia – Current practices and lessons learned*, Waterlines Occasional Paper No 6, April 2008 for the National Water Commission.
126 See, for example, Government of South Australia, *Water for Good*: *A plan to ensure our water future to 2050*, June 2010.
127 Sections 22, 22B and 22C of the *Water Act 1989* (Vic).

3.60.6 Under the Victorian regime, sustainable water strategies must be established every ten years. A long term water resource assessment, which determines whether there has been any decline in the long term availability of surface water or groundwater, must be carried out every 15 years. These types of provisions establish a useful framework to ensure that state water planners adapt their strategies to changed water supply as a result of climate change, provided that they are reviewed and updated regularly enough to respond to evolving climate change risks.

(c) Water conservation, water efficiency and restrictions

3.60.7 Water conservation is a critical response to declining water supply at a time of climate change. During recent periods of very low water inflows in most Australian capital cities, reductions in water demand exceeding 40 per cent per capita were achieved. One way to promote water conservation is by giving water users better information about the water efficiency of appliances and products. Under the NWI, the Commonwealth Government and the States have legislated to implement the Water Efficiency Labelling Scheme (WELS), which requires mandatory labelling and minimum standards for agreed appliances.

3.60.8 A significant regulatory response to drought conditions and low water inflows in the past has been water restrictions. These are regulations made under state/territory laws that compulsorily restrict water use. Water restrictions are staged depending on the seriousness of the drought and threat to security of supply. The most common type of restriction is limitation or prohibition of outdoor water use in gardens. Some jurisdictions have also introduced permanent water saving rules, such as requiring hoses to be fitted with a trigger nozzle that apply at all times.[128] Commercial customers who use large amounts of potable water may also be required to develop a water management plan to improve the efficiency of their water use.[129]

3.60.9 Water restrictions have been criticised for being too costly to the community.[130] However, they have been relatively successful in enabling Australian cities to cope with very substantial falls in water availability. It is likely that some form of water restrictions will be part of the portfolio of regulatory responses to climate change. The severity of restrictions required will depend on the success of alternative strategies that may be adopted to meet water supply shortfalls and variability.

(d) The Water Market

3.60.10 The water market has been critical in enabling irrigators in rural areas to adapt to the severe drought in the Basin for the decade to 2011.

3.60.11 The NWI identified a number of legislative and regulatory improvements that needed to be made in order for a national water market to operate effectively. These included clear and nationally compatible water access entitlements and progressive removal of barriers to trade in water. As a result of trading arrangements established under the Commonwealth's *Water Act 2007*, water has been able to move to those who value and need it most.

3.60.12 While progress in implementing the NWI has been somewhat slower than hoped, most of the impediments to trade have been or are in the process of being removed. It is now possible to consider how a water market may assist in better managing future water shortfalls in urban areas as well.

128 See, for example, the Permanent Water Saving Rules, Victoria.
129 Ibid.
130 Productivity Commission, *Australia's Urban Water Sector Draft Report*, 2011, Australian Government Canberra.

(e) Water sensitive cities and mechanisms to achieve water-sensitive urban design

3.60.13 Increasingly, water planners are embracing the concept of the water sensitive city, which aims to ensure that cities make use of diverse sources of water such as stormwater harvesting and become more resilient to the impacts of climate change. In addition, with better water and town planning, cities can become more resilient to floods and sea level rise and improve the urban micro-climate and the health of waterways. A key way of achieving this is through 'green infrastructure', such as urban vegetation, wetlands and other uses of water in the landscape.

3.60.14 An associated concept is Water Sensitive Urban Design (**WSUD**), which aims to minimise the impact of urbanisation on the natural water cycle and captures the notion that the design of our urban environments can be done in such a way to achieve water conservation objectives. The principles of WSUD can be applied to the design of a single building, a whole subdivision and even an entire precinct or region. The objectives underlying WSUD include reducing potable water demand, minimising wastewater generation and harvesting urban stormwater.

3.60.15 WSUD can assist in adapting to climate change and, particularly, in adapting to reduced rainfall and higher temperatures. Reduced rainfall in most urbanised parts of Australia makes it desirable for cities to seek more diverse sources of water supply. Diversity of water supply increases resilience to climate change and lowers the risk attached to relying on traditional dams. Stormwater harvesting and local water recycling supported by WSUD are potential new water sources. Stormwater harvesting in wetlands, ponds and aquifers can also assist with flood protection, which is an increased risk under climate change.

3.60.16 WSUD also reduces the urban heat island effect through wetlands and vegetation water treatment systems, which have the effect of lowering local temperatures. This is likely to be particularly important in the urban environment where climate change temperature increases on top of urban heat island impacts of up to 4 degrees are likely to result in significant health risks.

3.60.17 As yet, WSUD is not entrenched in all Australian planning systems. Clause 56.07 of the Victorian Planning Provisions, entitled Integrated Water Management, is an example where it has. That clause requires developers to meet specific objectives that are contained in the Urban Stormwater Best Practice Environmental Guidelines. These guidelines include a toolbox that is designed to indicate to developers if they have met the required objectives for stormwater management and helps them to do so. This type of practical model could be used in other circumstances to assist developers and other businesses to comply with regulatory frameworks for climate adaptation.

3.60.18 In addition, other tools exist in several jurisdictions throughout Australia to facilitate WSUD through the development process. One example is BASIX – or the Building Sustainability Index – which was introduced by the NSW Government. BASIX sets targets regarding energy and water to enhance the sustainability of buildings. In addition to encouraging energy efficiency, BASIX also helps to ensure that homes are more water efficient. BASIX-compliant homes have rainwater tanks, which can be plumbed to the toilet and laundry, as well as providing water for the garden. These homes typically have efficient shower heads and tap fixtures, reducing water use and costs and use of indigenous or low water use species for landscaping.

(f) Access regimes

3.60.19 Up until now, there has been limited direct competition for supply of water and wastewater services to customers. Apart from the implications that this has for consumer choice and quality of supply, the absence of competition may stifle opportunities to develop alternative water sources.

3.60.20 Third party access regimes, which facilitate access to monopoly infrastructure, could be used to encourage development of alternative water sources. In 2006, the New South Wales Government introduced the *Water Industry Competition Act 2006* (**WICA**) with this objective in mind.[131]

3.60.21 While WICA does not guarantee access to sewerage infrastructure to third parties, it does regulate sewer mining disputes and has helped to drive sewer mining projects in New South Wales. Despite the existence of an access regime of the kind developed in New South Wales, there are still some significant barriers to the entrance of new participants into the sector. For example, an issue that has arisen is that access to the infrastructure may be undermined if the right of access does not come with a corresponding right to bulk water resources. This issue has not yet been resolved given uncertainty regarding ownership of water through the urban water cycle.[132]

3.60.22 Third party access regimes for the water sector are relatively undeveloped in the other jurisdictions, but have been under consideration. In Queensland, the Queensland Competition Authority has published pricing principles for third party access.[133] However, as yet, an access regime has not been developed. In 2009, the jurisdictional regulator in Victoria – the Essential Services Commission – completed a review of a state-based access regime for water and sewerage for Victoria.[134] No action has been taken to establish a third party access regime following completion of the review.

(iii) Aspects which may hinder adaptation to climate change

(a) Planning and investment in water infrastructure

3.60.23 Planning and investment in water infrastructure is centralised in most jurisdictions.[135] This has resulted in investment in large, lumpy and expensive infrastructure projects, such as desalination plants, which now exist in each of the main population centres.

3.60.24 While these forms of alternative supply may prove necessary and useful in time, a more decentralised approach may be preferable from a cost and efficiency perspective. In particular, augmentation of existing water sources could take the form of distributed alternative supplies, including stormwater and recycled water. Such investment could be undertaken on an incremental basis in conjunction with pursuit of the larger, centralised options.

131 This Act is described as an Act 'to encourage competition in relation to the supply of water and the provision of sewerage services and to facilitate the development of infrastructure for the production and reticulation of recycled water'.
132 National Water Commission, *URBAN WATER in Australia*: *future directions*, April 2011, p. 28.
133 Urban Water Pricing Principles, 1 September 1999.
134 State-based access regime for water and sewerage inquiry, 2009.
135 National Water Commission, *URBAN WATER in Australia*: *future directions*, April 2011, p. 20.

3.60.25 However, existing regulatory frameworks for alternative water sources may deter investment in distributed water supply option. The governance arrangements for recycled water projects, including stormwater projects, are typically complex. This is a result, at least in part, of the fact that a multitude of legislative instruments may apply to a single project. Regulation relating to planning, environment, water quality and health may apply concurrently to a given project. Complexity may also arise in relation to uncertainty regarding access and ownership of the water resources that are sought to be recycled and used. Consolidation, harmonisation and clarification of regulatory obligations will be needed to overcome these obstacles.

(b) Economic regulation and pricing

3.60.26 In all jurisdictions, wholesale and retail water prices are determined on a periodic basis through a regulated process overseen by the jurisdictional regulator. The authorised prices are based on the entities' projected capital expenditure, operational expenditure and asset management requirements. Water entities prepare water plans or submissions, which are then used as the basis for the regulatory determinations. The basis upon which these core documents are prepared by the water entities and the principles according to which they are assessed may hinder effective adaptation to climate change.

3.60.27 In particular, the assessment of the water plans and submissions by water entities are typically guided by a range of regulatory principles, which focus predominantly on efficiency, rather than sustainability.[136] Furthermore, the focus in the water plans is more on the short to medium term rather than the long term. Obviously, if effective adaptation to climate change is to be accomplished in the water sector, account must be taken of climate change effects that are likely to materialise in the foreseeable as well as distant future.[137] Moreover, effective incentives may be needed to encourage water businesses to pursue efficiency improvements and to actively promote the sustainable use of water resources.

3.60.28 Current economic regulation and pricing regimes may also act as a barrier to distributed supply using stormwater harvesting and local recycling. The value of co-benefits, including avoided infrastructure costs (for example, new water supply and distribution infrastructure) and environmental benefits (such as reduced stormwater pollution and flood mitigation) may not be fully accounted for in the context of these regimes. At a time of climate change, there is real value in deploying a diversified portfolio of water sources that includes stormwater harvesting. However, the current system of economic regulation does not normally allow consideration of these co-benefits and, accordingly, such projects may be unviable based on existing criteria.

136 Notably, section 14A of the *Independent Pricing and Regulatory Tribunal Act 1992* (NSW) sets out the methodology for setting prices for government monopoly services, including water. That section refers to the need to maintain ecologically sustainable development by appropriate pricing policies that take account of all the feasible options available to protect the environment. However, no mention is made of the impact of the environment on water resources.

137 Paul Liggins, *Economic regulation of the Australian water sector: past, present and future*, Deloitte Energy & Resources, March 2010, p. 2.

3.60.29 Another barrier to adaptation that exists in the context of current regulatory arrangements relates to water pricing. Most jurisdictions have a tiered pricing arrangement, the primary aim of which is to encourage conservation of water. In particular, the tiered pricing structure seeks to limit discretionary water use by imposing higher prices once the volume consumed over a particular period exceeds a particular threshold.[138] However, the regulatory frameworks pursuant to which the tariffs are designed typically do not require consideration of environmental factors and externalities. Furthermore, it is unclear whether the inclining block tariffs that exist in most jurisdictions provide adequate signals to consumers so as to provoke significant behaviour change in the form of reduced consumption.

3.60.30 Currently, urban water prices are set to reflect the cost of infrastructure and not the value of the water resource itself,[139] so variable water charges are low. A substantial part of a customer's bill is for the fixed costs of the water authority, so there is little monetary incentive for water conservation. There is no scope in current pricing arrangements for consumers to decide the value they place on a more reliable service or, conversely, whether they would be comfortable with paying less for a less reliable service. Some commentators have argued that this has led to long-term restrictions on water use when drought overtakes the supply arrangements instead of using market signals to dictate consumption patterns.[140]

J. Waste

3.61 Until now, the consideration of the implications of climate change for the waste sector has focused almost exclusively on emissions and mitigation associated with the operation and management of waste facilities. However, some potentially significant adaptation issues also arise for such facilities, particularly landfills.

3.62 Landfill facilities can be operational for many years. Furthermore, they may still have implications for the physical environment after closure. Climate change has the potential to have an impact upon waste management facilities, particularly landfill sites, although the nature and extent of impact will largely depend upon where the site is located. Contaminants may also leach from landfills that are vulnerable to flooding or sea level rise or as a result of extreme rainfall events. Increases in temperature and heatwaves may have an impact on kerbside refuse, thereby increasing odour and decay.

(i) Recognition of climate change in the context of waste regulation

3.63 The primary objective underlying regulatory frameworks around Australia for the management of landfill facilities is to manage the environmental and health risks arising from these facilities.[141] Even though the various regulatory frameworks explicitly consider the impact of a landfill facility on the local environment, there is limited consideration of the impact of the environment on these facilities, including as a result of climate change. Indeed, the emphasis in existing frameworks is predominantly on controlling the design, construction and operation of these facilities to minimise risks caused by landfill facilities, rather than the addressing the risk to landfill facilities from other causes, including climate change.

138 Total Environment Centre, *Urban Water Regulation In Australia, A Comparison Of Regulation, Pricing And Transparency Mechanisms In Major Australian Cities*, July 2007, p. 12.

139 See Ministerial Advisory Council for the Living Melbourne, Living Victoria Plan for Water, *Living Melbourne, Living Victoria Roadmap*, Victorian Government 2011, p. 16.

140 Paul Liggins, *Economic regulation of the Australian water sector: past, present and future*, Deloitte Energy & Resources, March 2010, p. 4.

141 For example, waste facilities are primarily regulated by the *Protection of the Environment Operations Act 1997* in NSW; the *Environment Protection Act 1970* in Victoria, the *Environmental Protection Act 1994* in Queensland, the *Environmental Protection Act 1986* in Western Australia.

3.64 Nevertheless, the regulation of landfill facilities around Australia is characterised by the use of best practice performance standards that are aimed at protecting the environment. These standards are typically applied through guidelines that apply to the siting, design, construction and operation of landfill facilities.[142] The guidelines identify best practice in the industry. These are dynamic documents, which can be changed with relative ease to reflect changes in practices and standards. They provide clear direction to owners and operators of landfill facilities without being unduly prescriptive. The use of guidelines, which are a relatively flexible regulatory instrument, coupled with reliance on generic performance standards, provides some scope for addressing climate change at various stages of the life of a landfill facility.

(ii) Aspects which may facilitate adaptation to climate change

(a) Siting

3.64.1 Clearly, the location of landfill sites will have an impact on their vulnerability to the effects of climate change. Planning legislation in the various States and Territories applies to the siting of new landfill facilities.

3.64.2 Most jurisdictions specify a minimum buffer distance between the landfill site and other sensitive land uses, such as residential dwellings and surface waters.[143] The use of buffers may be effective in minimising the impact on local infrastructure and residents of leachate leakage in the case of storm surges and as a result of sea level rise and the intensification of odours and emissions in the case of extreme heat.

3.64.3 Guidelines also exist to guide the appropriate siting of a landfill.[144] Typically, these guidelines indicate that a preliminary investigation of all possible landfill sites should be conducted to identify those sites with the best potential to be developed for landfilling in a manner that poses the minimum risk to the environment. Ideally, the examination of possible sites for landfill facilities would include consideration of the risks that the environment – particularly, climate change – poses to the landfill facility.

3.64.4 In addition, strategic planning can be used to identify future locations for waste facilities. The strategic planning process will be used to locate landfill facilities in infrastructure corridors, growth areas, precincts and hubs. However, it is possible that this process can also be used to ensure that landfill facilities are not located in areas where they will be unduly exposed to climate change risks.

(b) Design and operation

3.64.5 The regulation of the design and operation of landfill facilities is also largely governed by guidelines. The guidelines will usually require a comprehensive environmental assessment to gain an understanding of the existing environmental conditions at the site and to ensure that the landfill design (including the site layout and the design of the liner and leachate collection system) responds to that environment.[145] At present, such an assessment usually includes consideration of the impact of the landfill on the air, groundwater, surface, water and noise environments. However, this assessment could be extended to include consideration of the impact of the environment and climate change on the design of the landfill facility.

142 See, for example, Victoria's *Best Practice Environmental Management – Siting, Design, Operation and Rehabilitation of Landfills*, Publication 788.1, September 2010 and New South Wales' *Environment Guidelines*: *Solid Waste Landfills*, 1996.
143 Productivity Commission, *Waste Management*, Inquiry No. 38, October 2006, p. 178.
144 See, for example, section 3 of the Guidelines produced by Queensland's Department of Environment and Resource Management, *ERA 60 – Waste disposal Landfill siting, design, operation and rehabilitation*.
145 See, for example, sections 2, 4 and 5 of South Australia's EPA Guidelines on *Environmental management of landfill facilities (municipal solid waste and commercial and industrial general waste)*, January 2007.

3.64.6 The guidelines will also normally require implementation of a landfill management plan.[146] Such a plan will be primarily aimed at managing environmental and public health risks that could arise from the operation of the landfill facility. The scope of such a plan could also be used to mitigate risks that could arise from climate change.

(c) Closed landfills

3.64.7 Most of the landfills needed to serve urban and rural areas in Australia have already been built. Effective ways to minimise the climate change risks posed to landfill facilities – such as siting and design – are, therefore, not available for these facilities. Nevertheless, regulation exists to control risks arising from landfill facilities that have been closed. This regulation could potentially be used to address climate change risk post-closure.

3.64.8 Closure and post-closure regulation is designed to ensure that long-term environmental impacts associated with landfill facilities are acceptable. This is achieved through aftercare management plans, which are required for former landfills. To guard against long-term environmental risk, closure and post-closure requirements can include:

- rehabilitation practices — a financial assurance may be required from the original operator to cover potential problems;
- restrictions on after-use;
- landfill caps to divert surface water to avoid the formation of leachate; and
- environmental monitoring and management — groundwater, surface water, leachate and landfill gases may be required to be monitored and managed until the long-term risk is deemed acceptable.[147]

3.64.9 These types of requirements can be imposed on landfills up to 30 years after the site has closed. This framework could be ideal for addressing climate change risks that arise in the future in relation to landfills that have already closed.

(d) Landfill levies

3.64.10 Landfill levy schemes are one of the major instruments in waste management policy. Landfill levies are currently being used to pursue objectives such as landfill diversion targets and generating revenue to fund waste policies. Different levies apply to municipal, commercial and industrial and prescribed industrial wastes deposited onto land at licensed facilities. The landfill levy structure typically reflects the difference in the magnitude of environmental risk posed by the different waste streams. In the future, landfill levies could be used to fund changes that are needed to landfill facilities to ensure that they are protected against the physical risks posed by climate change.

(iii) Aspects which may hinder adaptation to climate change

(a) Existing landfills

3.64.11 Most waste facilities that are needed to serve urban and rural communities have already been established. Decisions regarding siting and design were taken at the time of their establishment without regard to the risks that could be posed by climate change. Regulatory frameworks for waste facilities cannot undo decisions taken in the past that could render such facilities vulnerable to the effects of climate change.

146 See, for example, section 13 of South Australia's EPA Guidelines on *Environmental management of landfill facilities (municipal solid waste and commercial and industrial general waste)*, January 2007.
147 See, for example, section 5 of Tasmania's *Landfill Sustainability Guide*, 2004.

K. Transport

3.65 Climate change is likely to pose significant challenges for owners, managers and users of Australia's transport infrastructure, including roads, rail, ports and airports. Risks include degradation of roads from heatwaves and extreme rainfall events, buckling of rail tracks caused by extreme heat, and damage to ports and airports from storms and sea level rise. At a minimum, the effects of climate change may require additional maintenance and repair. At worst, some types of infrastructure may become permanently unusable and will need to be replaced.

3.66 The collective consequences of a climate change event could wreak havoc for the logistics supply chain if one or more types of infrastructure along the supply chain are concurrently affected. Apart from the practical difficulties that climate change presents, it may lead to considerable additional costs for owners and operators of transport infrastructure. It may also lead to liability if the risks of climate change are foreseeable but have not been addressed and a climate change event leads to injury, loss or damage.

3.67 Tackling these challenges in a holistic manner is likely to prove difficult in the transport sector given the particularities associated with each mode of transport, variations in terms of ownership, management and use, and the absence of single regulatory framework that applies across the board to all types of transport infrastructure.

(i) Recognition of climate change in relation to the regulatory frameworks for transport

3.68 Most of the regulatory regimes applicable to the various types of transport infrastructure do not explicitly recognise the risks posed by climate change. However, the *Victorian Transport Integration Act 2010* now includes as an objective that 'the transport system should actively contribute to environmental sustainability by ... preparing for and adapting to the challenges presented by climate change'.[148]

3.69 There are also a few of examples where the environment is specifically acknowledged in the context of regulatory regimes. For example, under the Victorian *Port Management Act 1995*, port corporations, which are responsible for commercial trading ports must, among other things, manage and develop ports in an economically, socially and environmentally sustainable manner and facilitate the integration of infrastructure and logistics systems in the port with systems in place outside the port in a manner which is commercially sound and environmentally sustainable. The Victorian regime is unique among jurisdictional regulatory frameworks for port regulation in that it expressly requires that account be taken of environmental considerations by port authorities in the management of port infrastructure, although the impact of climate change is not specifically identified.[149]

3.70 Even in the case of those regulatory regimes where the environment is acknowledged, the extent to which the relevant regulatory frameworks address the interface between the infrastructure and the environment is limited. Furthermore, the focus is typically on the impact of infrastructure on the environment rather than the possible consequences of the physical environment on the infrastructure. Explicit recognition of the impact of climate change in the relevant regulatory frameworks could facilitate the use of existing tools within these frameworks (which are discussed in more detail below) to address the effects of climate change.

148 Section 10 of the *Transport Integration Act 2010* (Vic). This section was introduced by section 73 of the *Climate Change Act 2010* (Vic).

149 Another example exists in the context of the regulatory regime for airports. The *Airports Act 1996* (Cth), which regulates planning and development on federal airport sites, is complemented by a range of regulations, including the *Airports (Environment Protection) Regulations 1997* (Cth) whose object is to regulate noise and pollution emanating from airports as well as to promote the improvement of environmental management practices for activities carried out at airports.

(ii) Aspects which may facilitate adaptation to climate change

3.71 Opportunities already exist within regulatory frameworks applicable to each of the types of transport infrastructure to address climate change. It will be important to ensure that the manner in which these existing tools are used is tailored to address the specific climate change risks that might arise in relation to the various types of transport infrastructure.

(a) Roads

3.71.1 The discussion paper on the National Land Freight Strategy recognises the impact that climate change may have on land freight transport[150] and notes the importance of accounting for the impact of climate change on road transport.[151] Nevertheless, the discussion paper states that it is unclear to what extent freight planning documents consider the impact of climate change on physical infrastructure or on demand patterns.[152]

3.71.2 The regulatory frameworks for road infrastructure in Victoria and Queensland provide for the development of road management plans, which could prove an important tool in addressing climate change for new roads as well as for existing roads.

3.71.3 For example, the *Road Management Act 2004* (Vic) empowers – but does not oblige – road authorities to develop a 'road management plan'. The primary purpose of road management plans is to establish good asset management practices focused on delivering the optimal outcomes for the available resources, having regard to the applicable policies and priorities. Through road management plans, individual road authorities may determine standards and policies for managing public roads that are under their control.[153]

3.71.4 It is conceivable that, in jurisdictions where road management plans are currently provided for, in the future, they could expand beyond standards and performance targets that are aimed at minimising the impact of road infrastructure on the environment to include those that accommodate the impact of climate change on road infrastructure. Ideally, such specific standards and performance targets are developed in such a way that the latest climate change science is taken into account.

3.71.5 Codes of road practice could also prove a useful mechanism to accommodate the effects of climate change and could serve as an important complement to road management plans. The *Road Management Act 2004* (Vic) empowers the Minister to make a Code of Practice for a road authority or class of road authorities. Among other things, a Code of Practice may establish benchmarks of good practice in relation to the performance of road management functions by road authorities, those that develop new road infrastructure as well as providers of public transport services. However, under the existing regulatory framework, it is notable that a Code of Practice cannot impose obligations on these parties nor can they direct how any matter or thing is to be done.

150 Infrastructure Australia, *National Land Freight Strategy Discussion Paper*, February 2011, p. 25.
151 Infrastructure Australia, above fn 150, p. 62.
152 Infrastructure Australia, above fn 150, p. 27.
153 Under the *Transport Infrastructure Act 1994* (Qld), a 'roads implementation program' must be developed and must include performance targets for road transport infrastructure. In the most recent roads implementation program for the period 2009/2010 to 2013/2014, reference was made to environmental management initiatives adopted by Queensland's state government, which formed the context for prospective road works. Such environmental management initiatives included conservation of ecologically significant areas, conservation of heritage listed sites (including protecting significant trees) and road landscaping and amenity activities.

3.71.6 A Code of Practice for Road Management Plans was issued in 2004 in Victoria. It provides that road management plans may establish the standard or target condition to be achieved in the maintenance and repair of different types of road infrastructure. The Code of Practice further provides that the road management plan may set out details of the applicable management system, the purpose of which is to discharge the relevant entity's duty to inspect, maintain and repair. In determining appropriate standards for road management, the Code states that a road authority should consider a range of factors, including: environmental factors and any other relevant risk factors; the type of road infrastructure, the volume and nature of public road usage; community expectations; and the resources available, and the competing demands for these resources.

3.71.7 Depending upon the type, location and usage of road infrastructure, 'relevant risk factors' could include the physical effects of climate change. Moreover, accounting for 'community expectations' may involve consideration of and response to such effects to ensure that road infrastructure is capable of withstanding these effects and is fit for purpose. Road authorities will need to be equipped with the skills and resources to make the necessary assessments to ensure that the climate change risks are adequately addressed in these cases.

(b) Rail

3.71.8 In most jurisdictions, statutory rail corporations have been established to own, manage and operate rail infrastructure, particularly for passenger services. The responsibility for undertaking repair and maintenance work on rail infrastructure is generally governed by lease arrangements between the government owners of such infrastructure and the public or private lessees. Consequently, it is probable that we will see leases being used as a vehicle to ensure repair and maintenance work to address the effects of climate change in the future.

3.71.9 More specifically, in the future, it is possible that the performance obligations included in agreements of this kind will explicitly require lessees to address the effects of climate change in the management and operation of rail infrastructure. These agreements could also be used to allocate responsibility to the manager or operator of the rail infrastructure for climate change risks resulting in injury and damage to property arising from disrepair or infrastructure deterioration.

3.71.10 By way of complement to obligations that may be contained in bilateral lease arrangements between owners and operators of rail infrastructure, a number of jurisdictions also impose statutory obligations on rail infrastructure operators to ensure that such infrastructure is safe and reliable through safety accreditation. In particular, the *Rail Safety Act 2006* (Vic) requires accreditation of owners and managers of rail infrastructure and rolling stock by Public Transport Safety Victoria (**PTSV**). The PTSV is responsible for, among other things, the safety accreditation of rail operators in Victoria and monitoring the compliance of infrastructure (through inspections) with statutory requirements. The purpose of accreditation is to ensure that operators have the competence and capacity to manage safety risks associated with rail operations. Similarly, the *Transport Infrastructure Act 1994* (Qld) establishes as a pre-requisite to accreditation, a requirement that the railway manager or operator has an appropriate safety management system in place.

3.71.11 Depending upon the type, location and age of rail infrastructure, safety and reliability of rail services may be compromised if the effects of climate change are not adequately accounted for. Accordingly, in the future, safety accreditation may be used to ensure that climate change risks are addressed in the context of the management and operation of rail infrastructure. Adequate monitoring and enforcement mechanisms will be needed to ensure that rail safety keeps pace with climate change effects as they evolve over time.

3.71.12 The statutory regime could also include specific obligations requiring those involved in the design, supply and installation of rail infrastructure to ensure that the infrastructure is safe and fit for purpose, including in the context of physical conditions arising as a result of climate change. For example, the *Rail Safety Act 2008* (NSW) requires that any person who designs, commissions, manufactures, supplies, installs or erects rail infrastructure or rolling stock must ensure, so far as is reasonably practicable, that the infrastructure is safe if it used for a purpose for which it was designed, commissioned, manufactured, supplied, installed or erected. When coupled with effective enforcement mechanisms, fitness for purpose obligations of this kind could provide an important incentive for those supplying infrastructure, and components thereof, to ensure that they are capable of withstanding current and future climate change impacts. These types of provisions could be invoked in cases where newly installed rail infrastructure does not account for the effects of climate change and thereby renders the infrastructure unsafe and/or unfit for purpose.

(c) Ports

3.71.13 Part 6A of the *Port Management Act 1995* (Vic) contains a useful tool that could be useful in adapting to climate change for port infrastructure. Specifically, it requires port authorities to prepare environment management plans. Authorities must also ensure that reasonable steps are taken to implement these plans.

3.71.14 The Act sets out in some detail what is required in environmental management plans. Among other things, these plans must identify the nature and extent of environmental hazards, specify the measures and strategies to prevent the hazards and set out how tenants, licensees and service providers will be involved in the implementation of the environment management plan. In addition, the relevant Minister can provide guidance or direct port authorities on how the environment management plans should be developed, as well as the content and implementation of the plans.

3.71.15 The Act also provides for regular audits of the management plans to ensure they are adequate. The plans need to be certified by an environmental auditor and may be the subject of audits to ensure that they are adequate and meet the Act's requirements.

3.71.16 Environment management plans, and the compliance framework which supports them, could be an effective mechanism through which the effects of climate change could be addressed. The monitoring and auditing regime will help to ensure that the plans are updated regularly so that they respond to the changing physical environment.

3.71.17 More generic port management plans could also be used to ensure that account is taken of the impact of climate change on port infrastructure, such as those provided for in the context of the Queensland regime. Under the *Transport Infrastructure Act 1994* (Qld), certain port authorities must prepare and submit to the Minister a port land use plan, which sets out the uses and intended uses of the port land. A port land use plan must specify, among other things, the desired environmental outcomes for the land, including measures that will assist in achieving the desired environmental outcomes. The purpose of plans of this kind could be extended to include reference to measures that are needed to respond to the effects of climate change. Once again, it will be important for these plans to be updated regularly to respond to climate change impacts.

3.71.18 The National Ports Strategy was prepared by the National Transport Commission and Infrastructure Australia and released in January 2011. The Strategy is currently being considered for adoption by COAG. This Strategy could provide additional opportunities to address the impact of climate change. Among other things, the Strategy recommends planning documentation to be prepared at a jurisdictional level covering all relevant ports, at a regional level for each relevant port, and at a port precinct level. This documentation was recommended to have an outlook horizon of a minimum of 15–30 years and be reviewed within a 5-year period. The Strategy suggests inclusion of a sustainable development plan for major new developments.

(d) Air

3.71.19 Under the *Airports Act* 1996, a Master Plan must be prepared for each airport and updated every five years. The purposes of these plans include to establish the strategic direction for efficient and economic development at the airport over the planning period of the plan, to reduce potential conflicts between uses of the airport site, and to ensure that uses of the airport site are compatible with the areas surrounding the airport. The Act further provides that a Master Plan must contain an assessment of environmental issues that might reasonably be expected to be associated with the implementation of the Plan.

3.71.20 Climate change was specifically identified in the list of environmental issues that might reasonably be expected to be associated with project implementation in the 2008 Master Plan for Melbourne Airport. However, the assessment focused exclusively on mitigation of greenhouse gases through energy efficiency rather than addressing the physical impacts of climate change on airport infrastructure and the need to adapt to those physical impacts. Ideally, in the future, Master Plans should specifically identify and assess the impact of climate change on airport infrastructure and include an adaptation strategy to respond to these impacts. In order to address climate change effectively, the Master Plans should be reviewed regularly, preferably, more frequently than every 5 years.

3.71.21 The *Airports Act 1996* also requires preparation of an Environment Strategy for each airport, the purpose of which is to ensure that all operations at the airport are undertaken in accordance with relevant environmental legislation and standards. Recent plans have included targets to reduce energy and water consumption. However, these strategies have not as yet been used to anticipate and respond to the impact of climate change. Like the Master Plans, in the future, it would be desirable to identify and assess the impact of climate change on airport infrastructure in the Environment Strategy for airports.

(e) Liability

3.71.22 An important issue that could motivate adaptation to climate change in the transport sector is the way in which liability is addressed under the relevant regulatory frameworks.

3.71.23 Certain regulatory regimes impose liability on entities for failing to account for particular risks. For example, the *Transport Infrastructure Act 1994* (Qld) envisages the possibility that port owners and operators could be held liable in negligence for failing to maintain a port in 'good condition to a standard appropriate to its use'. The Act provides that a '[port] facility is taken, for the purposes of all adverse civil proceedings in relation to death, injury, damage or loss, to be solely owned, occupied and under the management, control and responsibility of the manager.' This emphasises the importance of accounting for the possible effects of climate change in operating and managing port facilities.[154]

3.71.24 These types of liability provisions will provide significant motivation for relevant entities to ensure that they account for and reasonably respond to foreseeable climate change related risks that might otherwise cause loss or damage to users of the relevant transport infrastructure.

(iii) Aspects which may hinder adaptation to climate change

(a) Regulatory fragmentation

3.71.25 A significant barrier to effective adaptation to climate change for transport infrastructure is the degree of regulatory fragmentation. Different regulatory frameworks apply to the various types of infrastructure. The approaches and tools available in the context of these frameworks also differ. Legislative instruments that have been adopted in the various jurisdictions to co-ordinate management of transport infrastructure have not, as yet, delivered a truly co-ordinated approach.[155]

3.71.26 While there are particularities associated with these types of infrastructure that warrant different regulatory approaches and substantive provisions, there are some common issues that could be best addressed through over-arching or co-ordinated legislation that applies across the sector, particularly in relation to climate change. The existing legislative instruments that have been established to co-ordinate management of transport infrastructure could be re-visited to determine the extent to which climate change could be addressed for all types of infrastructure.

L. Major infrastructure procurement

3.72 The Australian infrastructure sector is large and diffuse. Broadly defined, infrastructure includes transport (both fixed and rolling), communication (including broadband), facilities for the provision, generation, transmission or distribution of utilities such as electricity, gas and water, and facilities for the provision of essential services, such as prisons, hospitals and schools. The infrastructure sector extends beyond physical assets to encompass areas such as major information technology procurements and asset-related services such as operation, maintenance and support services.

154 Another example is the *Road Management Act 2004* (Vic), which addresses civil liability that might be imposed on road authorities for acts and omissions relating to the development and upkeep of road infrastructure.
155 See, for example, the *Transport Administration Act 1988* (NSW) and the *Transport Planning and Coordination Act 1994* (Qld).

3.73 The sector can be broken down into public and private infrastructure, with private infrastructure being that which is owned solely by private entities for their own purposes. Public infrastructure is generally defined to include infrastructure constructed, owned operated and maintained primarily for the benefit of the public. Major infrastructure projects in Australia are generally commissioned by government for the benefit of the public, often with significant involvement by the private sector.

3.74 Decisions about Australia's public infrastructure, including how they are designed, constructed and operated, could have significant and long-term consequences for our resilience to climate change. Therefore, it will be important in the future to build in responsibility for adaptation to climate change into contracts with private operators that are commissioned to construct, operate and maintain public infrastructure. Such contracts will need to respond to the specific types of risks to which the infrastructure that is being procured may be subject.

3.75 There are a variety of instruments that may apply to procurement of public infrastructure, including the National PPP Guidelines, the Alliance Guidelines and the Commonwealth Procurement Guidelines. These guidelines are 'principle-based' frameworks in that they provide principles for the regulation of PPP projects, alliance projects and projects undertaken by the Commonwealth, respectively. The National PPP Guidelines are the focus of assessment here because they most obviously illustrate how adaptation to climate change may be accomplished through the procurement process for public infrastructure.

(i) Recognition of climate change in relation to the regulatory framework for major infrastructure

3.76 The National PPP Guidelines do not explicitly account for adaptation to climate change and the effects of climate change. However, they provide a principle-based framework for PPP projects, which include value for money (as tested by the Public Sector Comparator, which is discussed below), public interest, optimal risk allocation, output orientated specifications, transparency and disclosure of processes and outcomes, accountability and responsibility, and fair and equitable engagement of the private sector.

3.77 As will be explained further below, these principles are flexible and broad enough to allow climate change to be considered in the context of procurement decisions about public infrastructure. More specifically, the principles allow a response to climate change to be developed that is tailored to the particular infrastructure that is being procured.

(ii) Aspects which may facilitate adaptation to climate change

3.78 Major infrastructure can be designed to adapt to and respond to climate change. The technical requirements and specifications for major infrastructure projects are not fixed or prescribed. They can be performance or output based.[156] This allows each particular project to specify measures to address climate change and the risk of extreme climate change events. For example, these measures may include mandating design safety or redundancy factors to build additional resilience in the infrastructure.

3.79 Various aspects of the National PPP Guidelines could be used to ensure that the risks posed to particular types of public infrastructure are accounted for in the procurement process and that, where possible, technical resilience is built into such infrastructure. These aspects are discussed further overleaf.

156 The 'Output Specifications' in PPP Projects define outputs and performance levels in relation to the construction and services for the project, and outlines the government's minimum design, functional, technical and equipment requirements for the project. The Output Specifications aim to ensure that the requirements are expressed, as far as possible, in output terms and not in prescriptive input terms. The rational for this approach is that prescribing a solution based on inputs may result in result in a viable alternative solution and potential risk allocation being discounted too early in the process. It also discourages innovation.

(a) Public Sector Comparator

3.79.1 The Public Sector Comparator (**PSC**) lies at the heart of the National PPP Guidelines. It is an estimate of the hypothetical whole-of-life cost of a project if the project had been delivered by the government. It takes into account the potential impact of risks on the costs and revenues associated with a project over its life. It is expressed in terms of the net present cost (or value) to government over the life of the proposed contract period. The purpose of the PSC is to provide governments with a quantitative measure of the value for money it can expect from accepting a private sector proposal to deliver the project compared to delivery by the public sector.

3.79.2 The PSC does not expressly account for climate change or adaptation to climate change. However, the risk assessment underpinning the PSC is sufficiently broad and flexible to allow climate change information to be incorporated as it comes to light during the project development phase and the tender process.

3.79.3 The PSC includes a comprehensive and realistic pricing of all quantifiable and material project risks. These risks are identified and valued and then classified as either transferred risk (allocated to the bidder) or retained risks (retained by government). Relevantly, this includes an assessment of the market risk,[157] legislative and government policy risk,[158] tax risk,[159] interest rate risk[160] and residual value risk.[161]

3.79.4 Climate change will increase these risks, and, hence increase the PSC. Climate change may reduce revenue (for example, by reducing traffic flows in the case of construction of a toll road), increase operating costs, increase the cost of complying with new regulations and result in a lower realisable value of the asset at the end of the term. These risks can be mitigated through a number of means, including increasing the output specification by building in more redundancy and obtaining insurance coverage, if the project is insurable.

(b) Discount rate

3.79.5 Whilst the discount rate methodology does not explicitly address climate change, it is sufficiently adaptable to incorporate climate change risks during the tender process.

3.79.6 A discount rate is used to convert projected cash flows into a present value to enable comparison of competing bids. It reflects the time value of money and the premium that is required by investors to compensate them for the systematic risk inherent in the project. Converting future cash flows into equivalent present cash flows allows value for money to be measured between bids on a consistent basis.

3.79.7 Only systematic risks are reflected in the discount rate. A systematic risk is a market-wide risk that affects the asset and cannot be reduced by diversification. The discount rate depends on the relative level of systematic risk that is transferred to the private sector. As more systematic risk is transferred to the private sector, a higher rate of return is justified. Hence, the discount rate will increase where more systematic risk is transferred.

3.79.8 Systematic risks include demand risk and residual value risk. Climate change impacts will increase these risks. If the private party accepts part of the climate change risk, the discount rate will be higher.

157 Market risk includes the risk that demand for a service will vary from that initially projected, or that the price for a service will vary from that initially projected, so that the total revenue derived from the project over the project term will vary from initial expectations.
158 Legislative and government policy risk is the risk that government will exercise its powers and immunities including, but not limited to, the power to legislate and determine policy, in a way which negatively impacts, or disadvantages the project.
159 Tax risk is the risk that changes in the taxation framework may impact on the financial assumptions underlying the project.
160 Interest rate risk is the risk of adverse interest rate movements.
161 Residual value risk is the risk that there will be a lower realisable value for the underlying asset at the end of the project term.

(c) Modifications

3.79.9 The modification regime allows the government to make modifications to the project (that is, changes in the physical works, facility or project activities) throughout the term of a project (typically 25 to 30 years). The modification regime also includes a mechanism for appropriate reimbursement, which could include a sharing mechanism for modifications which can be predicted with some certainty.

3.79.10 This regime allows the government to react to developing climate science and modify or vary parts of the project to ensure that the infrastructure is capable of adapting to evolving climate change risks. For example, future climate science may increase the expected rise in sea level and require a road or bridge to be re-designed accordingly. Using the modification principles, the government may direct the road or bridge be raised to account for sea level rise and the private party may be obliged to undertake the re-design and modified construction.

(d) Uninsurability

3.79.11 The 'uninsurable risk' principles allow for account to be taken of future changes in the insurance market. Generally, an 'uninsurable risk' occurs where insurance is not available in the recognised international insurance market or where the insurance premium payable for insuring that risk is at such a level that the risk is not generally being insured against in the international insurance market. A typical uninsurable risk regime provides for a notice and negotiation mechanism to determine the best course of action to minimise the impact of an uninsurable risk if it materialises (for example, self-insurance or change in scope). This means that if insurance becomes unavailable or uneconomical in the future for a particular infrastructure project due to risks posed by climate change, the principles set out a mechanism for the parties to resolve uninsured risks.

(e) Fitness for purpose

3.79.12 The fitness for purpose warranty principles require the private party to ensure that the infrastructure is fit for the intended purpose specified or reasonably inferred from the project documents. The fit for intended purpose obligation is determined by taking into account the conditions likely to be encountered at the site. The scope of the fit for intended purpose warranty depends on the project and, critically, the objectives stated in the project documents. If the project objectives are clearly specified, the fit for intended purpose warranty may be sufficiently broad to take into account climate change risks.

(iii) Aspects which may hinder adaptation to climate change

(a) Status and scope of application

3.79.13 It is important to recognise that the National PPP Guidelines are just that – guidelines. They do not have legislative force and, therefore, cannot be enforced in instances of non-compliance.

3.79.14 Moreover, the scope of application of the National PPP Guidelines is limited. For example, corporations owned by the Queensland Government that provide communication technology projects and projects of 'state significance' in New South Wales are not covered. In addition, the National PPP Guidelines do not apply to local government. Finally, the National PPP Guidelines only apply to new infrastructure. They are not designed to apply to existing infrastructure.

(b) State-based variations

3.79.15 The National PPP Guidelines are intended to apply to PPP projects undertaken by all state and territory governments as well as the federal government. This is reflected in the objectives of the National PPP Guidelines 'to provide a framework and streamlined procedures for applying PPPs across Australia'.[162] However, the lack of a binding legal framework for the National PPP Guidelines has led to deviations by the States and Territories.[163] There may also be project-based variations. These variations could undermine the use of the National PPP Guidelines as a single, consistent, national regulatory framework through which resilience to climate change impacts for infrastructure can be achieved.

(c) Life of the infrastructure

3.79.16 Notably, the development of the PSC under the National PPP Guidelines has inherent limitations because it requires costs and revenues to be forecast over the life of the project, rather than the life of the asset. This means that the risks accounted for in determining the overall value of a project under the National PPP Guidelines do not include those risks that could arise when the project has come to an end for the private contractor and the asset has passed back to the government.

M. Useful regulatory tools to facilitate adaptation to climate change

3.80 This chapter has identified aspects of existing regulatory frameworks applicable to infrastructure and associated services that hinder adaptation to climate change. In summary, some important obstacles to effective adaptation to climate change include:

- Lack of explicit or implicit recognition of the need to adapt to climate change
- Regulatory framework only applies to new infrastructure and does not apply to existing infrastructure
- Lack of harmonisation and fragmentation of approach within jurisdictions and between jurisdictions
- Inadequate, inconsistent or outdated information regarding climate change risks
- Implementation is ineffective
- Enforcement mechanisms are weak or too costly to pursue

3.81 This chapter has also identified a broad array of regulatory tools that could be used to facilitate adaptation to climate change. Set out below in Table 10 is a summary of the regulatory tools that have been identified in the various regulatory frameworks under consideration which could be particularly useful in achieving adaptation to climate change. Table 10 also identifies the ideal circumstances in which these tools could be applied to maximise effectiveness of adaptation to climate change.

162 The National PPP Policy Framework, December 2008, Section 2.1.

163 For example, in respect of certain risks and contractual issues, the Commercial Principles for Social and Economic Infrastructure provide for the adoption of a 'menu type methodology where jurisdictions have the flexibility to choose between a number of defined approaches for dealing with a particular risk, or contractual issues…'

Table 10. Summary of useful regulatory tools

Tool	Current Application	Usefulness for Climate Change Adaptation	Ideal Circumstances for Use
Performance standards	• Buildings • Waste	Provides flexibility to respond to uncertain effects of climate change	Performance standards may be particularly useful where it is impossible to define the nature, scope and intensity of climate change risks, especially when the standards apply to a broad range of infrastructure. To maximise their effectiveness, performance standards should be clearly defined, easily applied and effectively enforced.
Technical standards	• Buildings • Telecommunications • Major infrastructure procurement	Can be used to establish standards for new and existing infrastructure to ensure that it such infrastructure is designed, constructed and operated in a way that is resilient to climate change risks	Technical standards are particularly useful for long-lived infrastructure for which complex issues regarding design and operation might arise. Prescriptive technical standards may be needed to effectively respond to these issues. It will be necessary to ensure that the technical standards are constantly revised to ensure that they keep pace with evolving climate change risks.
Codes of practice	• Transport • Telecommunications	May be useful to ensure that climate change risks are accounted for as part of ongoing management and operation of existing infrastructure	Codes of practice are typically not mandatory. Therefore, the use of codes to address climate change risks are ideally suited to sectors where the degree of voluntary compliance is relatively high and/or where it is in the entities' interests to comply.

Table 10 continued

Tool	Current Application	Usefulness for Climate Change Adaptation	Ideal Circumstances for Use
Operation and management plans	• Planning • Electricity • Water • Waste • Transport	A requirement can be imposed to require future plans to specifically account for climate change risks	Plans that account for climate change risks could be useful for a large range of infrastructure categories. They will be most effective in cases where a regulatory framework continues to apply to the infrastructure after it has been constructed, thereby providing regulatory oversight to ensure that the plans are dynamic, keep pace with climate change risks and are effectively implemented.
Conditional licences/ approval/ accreditation	• Planning • Environmental impact assessment • Electricity • Telecommunications • Water • Waste • Transport	Licences, approval or accreditation can be made conditional on adequate assessment and management of climate change risks	The use of conditions to require assessment of climate change risks in relation to licences, approval or accreditation is most viable in the context of regimes where licensing, approval or accreditation regimes already exist. Ideally, mechanisms to monitor and enforce such conditions should also exist.
In-built risk assessment	• Environmental impact assessment • Major infrastructure procurement	Provides an opportunity for climate change risks to be included in existing regimes for risk assessment	Regimes that already have a mechanism to identify, assess and respond to risks could include consideration of climate change risks. The obligation to identify and assess climate change risks should ideally be imposed on entities that are best able to do so from a practical and cost perspective.
Fitness for purpose obligations	• Transport • Major infrastructure procurement	May be used to ensure that infrastructure has been designed to cope with current and future climate change risks	Fitness for purpose obligations are useful in relation to relatively certain and foreseeable climate change risks. These obligations can be imposed to ensure that the design, construction and installation of infrastructure takes account of these risks. They will need to be complemented by effective enforcement mechanisms.

Table 10 continued

Tool	Current Application	Usefulness for Climate Change Adaptation	Ideal Circumstances for Use
Access to infrastructure	• Electricity • Telecommunications • Water	Provide an opportunity to diversify infrastructure, which may increase resilience	Enhancing access to infrastructure will be useful in cases where access is currently restricted. An access regime will need to be underpinned by an appropriate institutional and enforcement framework.
Market mechanisms	• Electricity • Water	Markets can flexibly and dynamically account for climate change risks in determining the allocation of resources, with limited government intervention	The introduction of market mechanisms would be best suited to sectors where climate change is likely to restrict availability and/or access to resources.
Incentives	• Electricity	May be used to drive changes in practices and behaviour to better account for climate change risks	Incentives can most easily be accommodated within existing economic regulatory frameworks.
Disclosure	• Planning • Buildings • Water	Motivates entities to assess risks and provides mechanism to ensure users/ consumers are informed about risks	Mandatory disclosure could be used where information about climate change risks is available and the cost to disclose that information is not overly burdensome. Disclosure regimes can be used to put users/consumers on notice about climate change risks and, potentially, transfer responsibility for those risks.

3.82 The tools identified in Table 10 are not mutually exclusive. A mix of these tools can be used to respond to the spectrum of climate change risks that may arise in relation to a particular type of infrastructure or associated service. Subsequent chapters of this Report will provide insights into how an ideal regulatory framework can be developed to respond to climate change, drawing on the lessons learned and regulatory tools available in the context of existing regulatory frameworks that have been considered in this chapter.

CHAPTER 4: APPROPRIATE LEVEL OF GOVERNMENT TO ADDRESS ADAPTATION TO CLIMATE CHANGE

4.1 Ensuring that new and existing infrastructure are resilient to current and future climate change impacts will require a concerted and co-ordinated effort by all levels of government. There will be a role to play in developing new policy to ensure that climate change is properly accounted for in the siting, design, construction and operation of such infrastructure. Laws affecting infrastructure may require amendment to ensure that they facilitate rather than hinder adaptation to climate change. Tailored mechanisms to implement policy and apply laws aimed at addressing climate change for infrastructure will be needed to ensure that adaptation is effective.

4.2 Designing regulatory responses to climate change, including laws, policies and implementation mechanisms, poses unique challenges for government. Uncertainties associated with the location, nature, timing and scale of climate change impacts make it particularly difficult for government to know whether, when and how to respond. The level of government that is ultimately charged with responsibility for addressing the impact of climate change should be best placed to respond to this uncertainty.

4.3 There are a number of criteria that are relevant in determining which level of government is ideally suited to performing the various roles involved in facilitating adaptation of infrastructure to the effects of climate change. This chapter identifies these criteria and sets out a framework that can be used to identify the most appropriate level of government to drive climate change adaptation, whether through the development of policy, the amendment of laws and/or the implementation of adaptation responses. The chapter also applies the framework in relation to the various types of infrastructure and associated services under consideration in this Report and identifies an indicative list of actions that might be needed by each level of government in these areas.

A. Framework for identifying appropriate level of government to address climate change

4.4 In assessing the appropriate level of government to undertake adaptation to climate change, two main questions need to be addressed. First, it is necessary to identify the action that is required to ensure effective adaptation. Second, it is necessary to determine which level of government would be best placed to undertake that action.

4.5 As indicated in the previous chapter of this Report, there are a variety of actions that could be taken to help facilitate adaptation to climate change in relation to infrastructure and associated services through existing regulatory frameworks. The level of government that would be best suited to undertaking each of these actions will differ depending upon a range of criteria, which are discussed below.

(i) Types of adaptation response

4.6 There is a broad range of actions that are needed to ensure effective adaptation to climate change, including actions undertaken by government in the form of a regulatory response to adaptation. The regulatory responses can be broken down into three main categories, namely:

- Law-making
- Policy development to provide the framework for law-making
- Implementation of adaptation regulation

4.7 Notably, even though one level of government might be best placed to devise a policy framework for a particular sector, it may be more appropriate for another level of government to make or amend laws and yet another to implement the framework.

(ii) Criteria for assessing appropriate level of government

4.8 There are a variety of criteria that are relevant in assessing the appropriate level of government to design, develop and implement regulatory responses to climate change. These are discussed below.

(a) Effectiveness, efficiency and equity

4.8.1 In deciding which level of government should drive adaptation, it is essential to consider the relative capacity of the various levels of government to address climate change in the most effective, efficient and equitable way possible.[164] These principles encompass the notion that the body that is, from a legal and practical perspective, in the best position to understand and respond to climate change should assume responsibility to do so.

4.8.2 In assessing the ability of a particular level of government to respond 'effectively' to climate change, it will be necessary to consider the government body's powers, tools, resources, skills and know-how. It will also be necessary to consider the type of organisations or people to be regulated and their institutional relationships with government. So, for example, the federal government may be more effective in regulating organisations that operate nationally and regularly deal with the federal government, whereas the state/territory and local governments may more effectively regulate local communities.

4.8.3 Assessment of 'efficiency' will require consideration of the relative benefits and costs associated with measures the government body is able to take. Finally, an assessment of 'equity' will be needed to ensure that action taken by the body does not lead to differential and, potentially, inequitable impacts.

(b) Co-operative federalism

4.8.4 Co-operative federalism is a useful paradigm for consideration of the level of government that is most appropriate to address adaptation to climate change. This notion implies that federal, state/territory and local governments interact co-operatively and collectively to solve shared problems. It also implies that competence and power to address climate change may be concurrently spread across a number of different levels of government, although the specific roles performed by each level of government may differ.

164 F. Cimato, M. Mullan, *Adapting to Climate Change*: *Analysing the Role of Government*, Department of Environment, Food and Rural Affairs (DEFRA) Evidence and Analysis Series, Paper 1, 2010, p. 19. In this paper, the principles of effectiveness, efficiency and equity are described as principles for the design of a good adaptation framework. These principles are equally relevant when assessing which level of government should be responsible for driving adaptation.

4.8.5 It cannot be doubted that climate change is a common problem faced by all levels of government in Australia. However, the nature of the problem faced by each level and their respective ability to respond to the problem differs. As will be explained later in this chapter, despite these differences, there is scope for a collective response to climate change by all levels of government. Systems of co-ordination between the levels of government will be needed to maximise the overall effectiveness of adaptation measures taken by each level of government.

(c) Subsidiarity

4.8.6 The subsidiarity principle is a common principle used to delineate responsibility among various levels of government. In practical terms, it means that responsibility for a particular function should be assigned to the level of government that is best placed to undertake the function.[165] It also requires that decisions should be taken by an entity as close as practicable to the people affected by those decisions.[166] The assumption underlying this principle is that the proximity of decision-makers to affected persons enables the former to more easily understand and respond to issues affecting the latter.

4.8.7 Relegating responsibility for decision-making in relation to climate change to the entity that is as close as possible to affected persons means that adaptation responses can be tailored to respond to local conditions. However, the subsidiarity principle should not be used to support localised responses to climate change that undermine efficiency, effectiveness and equity and lead to fragmentation, inconsistency and differential treatment.

(d) Democratic engagement

4.8.8 Democratic engagement relates to the degree of participation of citizens in public life and in governance. The democratic process is highly valued in Australia and participation in the development of policy and laws, whether directly or otherwise, is a fundamental expectation in our society.

4.8.9 The benefits that democratic engagement may yield could be particularly important in the context of climate change adaptation. Such engagement could help to engender support for climate change action. Moreover, stakeholders may be more inclined to actively participate in or contribute to such action.

4.8.10 There is some variation in the degree to which the various levels of government are able to provide the extent of democratic engagement that may be necessary for effective adaptation. In determining the most appropriate level of government to address climate change, it is necessary to consider the level of government that is most able to engage with society and, thereby, drive implementation of actions needed to adapt to climate change.

(e) Pre-existing regulatory framework

4.8.11 The pre-existing regulatory framework and institutional arrangements for a particular sector may affect the capacity of a particular level of government to effectively and efficiently address climate change. For example, if a particular role or function has historically been performed at a local government level, it may be difficult for the state, territory or federal governments to assume responsibility for this role or function – at least in the short term – especially if the state, territory or federal governments lack the requisite tools and skills under the current legislative framework.

165 See definition of 'subsidiarity' in Victorian Competition and Efficiency Commission, *A Sustainable Future for Victoria*: *Getting Environmental Regulation Right*, Final Report, July 2009, p. xxvi.
166 Ibid.

4.8.12 Over time, regulatory frameworks and institutional arrangements can be changed to vest responsibility in a different level government, if that is considered necessary in the interests of effectiveness, efficiency and equity. However, in the meantime, it will be necessary to ensure that proper account has been taken of existing arrangements and that proposals for adaptive action, including the body that is charged with delivering that action, are compatible with those arrangements.

B. The role of the federal government

4.9 The federal government could play a role in adapting to the effects of climate change in relation to each of the three categories of regulatory responses that might be adopted – namely, law-making, policy development and implementation.

(i) Law-making

4.10 The federal government has a role in making laws that fall within the heads of power contained in section 51 of the Commonwealth Constitution. There are a limited number of areas in respect of which the federal government has explicit power to legislate in relation to infrastructure and associated services. These include telecommunications, defence, lighthouses and beacons, and railway construction with the consent of any State.[167]

4.11 The Commonwealth Constitution provides additional heads of power that may authorise the federal government to legislate for matters relating to infrastructure and climate change adaptation. These include the interstate trade and commerce power, which enables the federal government to regulate air navigation;[168] the external affairs power, which enables the federal government to implement legislation to comply with international treaties;[169] and the corporations power, which has been interpreted to give the federal government wide powers over the activities of corporations.[170]

4.12 Pursuant to these powers, the federal government has enacted sectoral regulation for telecommunications and for airport transport. It used the external affairs power to enact the *Environment Protection and Biodiversity Conservation Act 1999*, which applies to a range of proposed new developments that may have negative impacts on the environment and biodiversity. The federal government has power to amend these laws to ensure that climate change is properly accounted for.

4.13 Under 51(xxxvii) of the Commonwealth Constitution, the States may refer their law-making power to the Commonwealth in respect of a particular matter. Such a reference of power by the States was used by the federal government to introduce the *Water Act 2007* (Cth).

(ii) Policy development

4.14 In addition to its law-making powers, the federal government also has a role in making policy in a range of areas, including for those areas not covered by section 51 of the Constitution. The federal government can help to set national policy through COAG, Australia's peak intergovernmental forum, comprising representatives of the federal, state and territory governments. The main role performed by COAG is to initiate, develop and monitor the implementation of policy reforms that are of national significance and require co-operative action by all Australian governments.

167 Section 51(v), (vi), (vii) and (xxxiv) of the Commonwealth Constitution respectively.
168 Section 51(i) of the Commonwealth Constitution. See *Airlines of NSW Pty Ltd v NSW (No. 2)* (1965) 113 CLR 54.
169 Section 51(xxix) of the Commonwealth Constitution.
170 Section 51(xx) of the Commonwealth Constitution.

4.15 Apart from COAG, the federal government can use its involvement in national sectoral bodies to promote and/or co-ordinate policy and legislative change, including in the area of climate change. National bodies of this kind exist for a number of the sectors under consideration in this Report.

- In the building area, the Australian Building Codes Board (**ABCB**) is a joint initiative of all levels of government and includes representatives from the building industry. The ABCB is responsible for maintaining and updating the BCA. One of the body's stated missions is to 'support [COAG] in the pursuit of its National Reform Agenda that aims to address issues relating to climate change...'[171]
- In relation to the electricity sector, the Ministerial Council on Energy (**MCE**) is the national policy and governance body for the Australian energy market. The MCE was established by COAG and consists of Ministers with responsibility for energy from the federal, state and territory governments. The MCE's objectives include 'to provide national oversight and coordination of policy development to address the opportunities and challenges facing Australia's energy sector into the future and to provide national leadership so that consideration of broader convergence issues and environmental impacts are effectively integrated into energy sector decision-making'.[172]
- In respect of the water sector, the National Water Commission is another joint initiative by all levels of government. It was established under the *National Water Commission Act 2004* (Cth) with the primary purpose of advising COAG on national water issues and the progress of the National Water Initiative (**NWI**), which is Australia's blueprint for water reform. Under the NWI, Australian governments have agreed on actions to achieve a more cohesive national approach to the way Australia manages, measures, plans for, prices, and trades water. The objective underlying the NWI is to achieve a nationally compatible regulatory framework, which seeks to manage surface and groundwater resources for rural and urban use in a way that optimises economic, social and environmental outcomes.
- Infrastructure Australia is a statutory body established under the *Infrastructure Australia Act 2008* (Cth) to advise governments, investors and infrastructure owners on a range of issues affecting infrastructure, including current and future needs and priorities relating to nationally significant infrastructure. Infrastructure Australia reports to COAG through the Federal Minister for Infrastructure and Transport. Infrastructure Australia was responsible for the development of the National PPP Guidelines.

4.16 The federal government may also promote co-operation by the States and Territories in the context of the development of national policy through the use of its fiscal powers and economic resources. More specifically, the federal government may provide funding in exchange for the development of a consistent and cohesive national policy, which may be implemented by the state and territory governments. A good example of this approach in the past was the development and implementation of the National Competition Policy.

4.17 A recent development regarding the system of Ministerial Councils will also provide an avenue for the federal government to undertake policy development to address adaptation to climate change. The COAG Communiqué of 13 February 2011 indicates that Ministerial Councils will be reformed from 30 June 2011 to focus on strategic national priorities and new ways for COAG and its councils to identify and address issues of national significance. Select Councils will be established to achieve this objective. A Select Council will be established to specifically address climate change.

171 See 'About the ABCB' on the ABCB's website: www.abcb.gov.au.
172 See 'About MCE' on the website for the Department of Resources, Energy and Tourism: www.ret.gov.au.

(iii) Implementation

4.18 In some areas where the federal government has primary legislative power, it will also be largely responsible for implementation. Examples include airline and airport regulation and telecommunications.

4.19 The federal government may also have a role to play in the implementation of responses to climate change in areas for which the state and territory governments have primary responsibility. One mechanism that the federal government can use in this regard is to fund adaptation action and/or to provide financial rewards for compliance with adaptive regulation that is consistent with a national framework. The Building Better Cities (**BBC**) program, which was established in 1991, provides an example of the use of this mechanism by the federal government as a tool to achieve implementation.

4.20 The purpose of the BBC program was to fund urban development projects in each State and Territory that had the capacity to revitalise and remove barriers to change in run-down or under-utilised areas of major cities. Under the program, state and territory governments were required to identify proposals for funding that met selection criteria established by the federal government. The Program was implemented through a 'Better Cities Taskforce' comprising representatives of federal, state, territory and local governments.

4.21 Funding provided by the federal government under the BBC program removed barriers to investment in the target areas in a way that private investment could not. The program is generally regarded as a success largely because of the effective collaboration between all levels of government, which was an important element of the program.

4.22 The federal government's new national urban policy – 'Our Cities, Our Future' – adopts a similar approach for the future development of Australia's cities as the BBC program. The aim is to guide policy development and public and private investment in cities to ensure that certain key objectives are met, including productivity, sustainability and liveability. The policy document refers to establishment of the 'Liveable Cities' program, which will provide funding to facilitate tailored local solutions to urban design and infrastructure challenges in our major cities, including to address the challenges arising from climate change.[173]

4.23 In 2009, COAG agreed that national criteria for capital city planning systems should be developed. COAG further agreed that, by 1 January 2012, all States and Territories will have plans in place to meet these criteria. Importantly, COAG agreed that the Commonwealth would link future infrastructure funding decisions with compliance with these criteria. The criteria have now been developed and require that capital city strategic planning should address nationally significant policy issues including 'climate change mitigation and adaptation'.[174] These criteria provide a significant opportunity for the federal government to ensure that climate change adaptation is adequately addressed for new infrastructure. However, successful implementation will depend upon co-operation by the state and territory governments and the amount of federal funding available.

C. The role of state and territory governments

4.24 The state and territory governments will also play an important role in responding to the effects of climate change. Given the broad legislative powers held by these governments, it is likely that the most significant role to be played by them relates to making or amending laws affecting infrastructure and associated services.

173 Department of Infrastructure and Transport, *Our Cities, Our Future, A national urban policy for a productive, sustainable and liveable future*, 2011, p. 31.
174 COAG Reform Council Capital City Strategic Planning Systems. See http://www.coagreformcouncil.gov.au/agenda/cities.cfm.

(i) Law-making

4.25 The state and territory governments have power to make their own laws over matters that are not within the scope of section 51 of the Commonwealth Constitution. Historically, these governments have legislated in a wide range of areas, including those relating to infrastructure and associated services. In particular, state and territory legislation exists in relation to buildings, planning, electricity, water, waste, transport and the environment. As they have wide legislative powers in relevant areas, like transport, regional development and water, it may be most effective to embed adaptive principles and requirements in existing state legislation. The state and territory governments are best placed to amend these legislative regimes to ensure that they properly account for the impact of climate change. State and territory governments are also in a good position to ensure that adaptation laws are appropriately integrated with other state legislation and policies.

4.26 Regulatory regimes that have already been established at the state or territory levels cannot be easily replaced with federal regimes for a number of reasons. First, as mentioned above in paragraph 4.10, the legislative competence of the federal government is limited by the Commonwealth Constitution, although the state and territory governments may agree to authorise the federal government to legislate in areas in the national interest, as was the case for the *Water Act 2007* (Cth). Secondly, in most cases, the existing regulatory regimes are underpinned by complex institutional and government arrangements. It may be practically difficult and costly to remove these arrangements and replicate them at a federal level.

4.27 There is also an argument that law-making by state and territory governments provides an opportunity for competition and innovation on policy and regulation between them. Further, climate change impacts may vary significantly between the States and Territories so localised approaches may be necessary. However, this needs to be balanced against the additional costs incurred by having a plethora of different regulatory regimes throughout the country and the potential that individual States and Territories may not take sufficient action to protect action from climate change effects.

(ii) Policy development

4.28 The state and territory governments will be instrumental in ensuring consistency and coherence between, on the one hand, adaptation frameworks that may be adopted at the national level and, on the other hand, adaptation policy within their respective jurisdictions. This role will be facilitated through current federal programs to address deficiencies in state/territory planning regimes, such as the Liveable Cities program and Reform of the Capital City Strategic Planning Systems, where the federal government does not have legislative competence but can use its fiscal powers to demonstrate leadership in the area and to encourage policy convergence at the state and territory levels.

4.29 The state and territory governments will also have an important role to play in ensuring that adaptation policy within their respective jurisdictions is consistent and coherent. So, for example, policies on planning, coastal development and regional development may need to be reviewed and amended to ensure that the underlying objectives and outcomes of all relevant policies are compatible. A key task for state and territory governments is to ensure that adaptation is integrated with other state/territory policies, such as those relating to regional development.

(iii) Implementation

4.30 The state and territory governments will also play a role in implementing regulatory frameworks aimed at addressing climate change and/or specific adaptation action that has been agreed upon at an inter-governmental level. Existing regulatory regimes relating to buildings and electricity are examples of the implementation by state and territory governments of frameworks that have been established at a national level through the ABCB and the MCE respectively. In addition, state and territory government departments will continue to be instrumental in implementing climate change adaptation policy through, for example, the establishment of coastal protection works and the institution of bushfire management practices, such as fuel reduction burning.

4.31 State and territory government agencies generally have staff with experience and capacity in many activities relevant to climate change adaptation. These include emergency services, building, planning and transport. A key challenge for all governments will be to ensure that there is adequate training in place for staff to manage and implement climate change adaptation activities. This is a particular problem with an ageing workforce in relevant fields, like bushfire management. This challenge is likely to increase as climate change impacts become more severe.

D. The role of local government

4.32 Local governments are established by state and territory governments to provide community services at the local level. These services include town planning, waste collection, and the development and management of municipal roads and drainage.

(i) Law-making

4.33 The powers held by local government to perform these functions are defined by state or territory legislation. The exercise of local government powers are also governed by principles, policies, guidelines that may be adopted by the relevant state or territory government.

4.34 Local government has limited ability to make laws and policies compared to the federal, state and territory governments. Nevertheless, these is scope for localised responses to climate change by councils, particularly in the area of town planning. There are a number of examples where councils have tailored their planning schemes to address climate change issues.[175]

(ii) Policy development

4.35 Councils also develop and apply local plans, which may be known as council plans or municipal plans. These plans typically express a council's vision for its municipality and it may include policies about adapting to climate change.[176]

(iii) Implementation

4.36 Council officers are currently responsible for the application of building and planning regimes and, therefore, will be involved with the implementation of responses to adaptation that may be adopted through those regimes.

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175 See, for example, the *Byron Shire Development Control*, which includes specific provisions to ensure that development is carried out in a manner which does not adversely affect coastal processes and which will not be adversely affected by coastal processes. Similarly, the *Blue Mountains Local Environment Plan* provides that development consent must be refused for bushfire prone land unless it complies with bushfire protection objectives. In Victoria, the *Mornington Peninsula Planning Scheme* provides that new development proposals should include an assessment of climate change effects.

176 See, for example, the *Darebin Climate Change Action Plan 2009 2015*, which provides a framework for Darebin Council in Victoria to support the Darebin community in significantly reducing their greenhouse gas emissions by 2020. It has also been prepared in response to the recognised threat and severity of climate change and its effects on the Darebin community.

4.37 In physical and practical terms, local government is closer to citizens than the other levels of government. Therefore, local government is also ideally suited to being involved in the implementation of adaptation action, especially through stakeholder engagement in the councils' respective municipalities.

E. Co-operation between governments

4.38 The universality and widespread impact of the climate change problem lends itself to a co-operative response between the various levels of government in Australia. Conflicting objectives, priorities and actions among these levels of government can inhibit effective adaptation and may, in some cases, lead to maladaptation.

4.39 The National Climate Change Adaptation Framework (**NCCAF**) is an existing framework that provides for such a co-operative response. The NCCAF outlines an agenda of collaboration between governments with an emphasis on two priority areas.

4.40 The first priority area referred to in the NCCAF is building understanding and adaptive capacity. In relation to building understanding, NCCAF notes the ad hoc, fragmented and limited nature of the information that is currently available regarding climate change impacts. With respect to adaptive capacity, the NCCAF refers to the need to have skills, resources, governance systems and political will in order to effectively respond to the impact of climate change.

4.41 The NCCAF recommends the establishment of an 'Australian Centre for Climate Change Adaptation' (**ACCCA**) in order to address these issues. Among other things, the ACCCA would deliver information to support climate change adaptation decision-making at the national, regional and local levels and would co-ordinate and ensure practical relevance of adaptation research. Clearly, obtaining the best available information on climate change impacts is an essential input to sound policy and law-making and implementation of climate change action. Notably, the ACCCA has not been established as a separate entity but its functions are performed through the Climate Change Adaptation Program, within the Department of Climate Change and Energy Efficiency.

4.42 The second priority area referred to in the NCCAF is reducing sectoral and regional vulnerability. The NCCAF focuses on sectors and regions that are nationally significant, where short-term decisions could be affected in the longer term by climate change impacts and where early adaptation planning could yield significant benefits. The NCCAF emphasises the need to identify and assess the impact of climate change, including in relation to water resources, coastal regions, human settlements and major infrastructure. It also refers to the need to review existing rules, codes and standards, particularly in relation to building and planning, to increase resilience to climate change.

4.43 The National Climate Change Adaptation Research Facility (**NCCARF**) was established pursuant to the NCCAF. It focuses on interdisciplinary research in relation to climate change impacts and adaptation. Its key roles include:

- developing National Adaptation Research Plans to identify critical gaps in the information available to decision-makers;
- synthesising existing and emerging national and international research on climate change impacts and adaptation and developing targeted communication products;
- undertaking a program of integrative research to address national priorities; and
- establishing and maintaining adaptation research networks to link together key researchers and assist them in focusing on national research priorities.[177]

177 See 'About NCCARF' on NCCARF's website: www.nccarf.edu.au.

4.44 The NCCAF and NCCARF provide a solid foundation for future co-operative action to address adaptation to climate change by Australian governments. In order to ensure that such co-operative action is successful in achieving effective adaptation to climate change, it will be necessary to have strong leadership and a clear demarcation of roles and responsibilities of the various levels of government.

4.45 NCCARF appropriately has a focus on research. However, a key challenge is in translating this research into action by policy makers and regulators at all levels of government. It is arguable that there is a need for a body that would assist the federal, state and territory governments with practical and effective implementation of climate change adaptation policies and regulation. Such a body could have members appointed by state, territory and local governments as well as the federal government. Its key roles could include:

- Assessing the preparedness of state, territory and local governments in responding to climate change impacts and adaptation;
- Assisting these governments in the implementation of national and state/territory adaptation plans;
- Disseminating best practice guidelines;
- Assessing performance and benchmarking against agreed climate change adaptation plans; and
- Making recommendations to government regarding necessary reform.

4.46 The structure and role of the National Water Commission may provide a possible model for such an organisation.

F. The role of other parties

4.47 In determining the appropriate role of the various levels of government in fostering adaptation to climate change through regulatory responses, the contribution that may be made by other parties in this process – including business enterprises and non-governmental organisations – should also be considered.

4.48 Co-regulation and/or the use of industry-led bodies to establish standards can be an effective way of minimising regulatory burden while at the same time enhancing stakeholder engagement. Examples include the development of building standards by Standards Australia, whose membership includes industry representatives, and the establishment of industry codes in the telecommunications sector by the Communications Alliance, which is the peak industry body for the sector. The effectiveness of these forms of stakeholder engagement in facilitating adaptation to climate change depends upon the existence of an appropriate legal framework, which includes monitoring and compliance mechanisms.

G. Application of the criteria for assessing appropriate level of government

4.49 In this section, the criteria for assessing the appropriate level of government set out in section A above are applied to the various levels of governments to determine which level would be best placed to pursue a particular regulatory response to climate change.

(i) Federal government

4.50 The review and amendment of regulatory frameworks to ensure that infrastructure and associated services are capable of responding to the impact of climate change entails a significant reform agenda, which will require leadership at a national level to provide much-needed guidance and up-to-date information, promote best practice and ensure consistency and equity across the country.

4.51 Application of a number of the criteria indicate that the federal government would be best placed to provide this leadership and, more specifically, assume responsibility for the following types of regulatory responses to climate change:

- Designing policy frameworks for the development of legislative responses to climate change by the States and Territories
- Gathering and disseminating national information on climate change risks
- Establishing and/or driving the development of benchmarks or standards
- Providing funding to support climate change initiatives

4.52 The principle of co-operative federalism supports the view that the federal government could provide a co-ordinating role in the area of climate change adaptation. This view is supported by the principles of effectiveness, efficiency and equity based on the federal government's tools, resources, skills and know-how. More specifically, the federal government has a unique ability to co-ordinate action between the various jurisdictions and, therefore, is well placed to effectively develop national frameworks and collect information from each of the jurisdictions.

4.53 From an efficiency perspective, the federal government could capitalise on economies of scale to co-ordinate policy and standard development and collect and disseminate climate change information. Equity also supports the view that the federal government should co-ordinate the development of policy and applicable standards to minimise the incidence of differential, discriminatory treatment between jurisdictions. Finally, the federal government could utilise its financial resources to provide funding for necessary climate change measures.

(ii) State and territory governments

4.54 Based on the fact that most of the pre-existing regulatory frameworks affecting infrastructure and associated services have already been developed by the state and territory governments, this level of government would be best placed to modify existing regimes.

4.55 Given the shared nature of the climate change problem, co-operative federalism suggests that state and territory governments could benefit from acting collaboratively with the federal government to implement national policy frameworks to address climate change at the state/territory level. The principle of subsidiarity further suggests that the States and Territories might also play an important role in tailoring state/territory policy frameworks that might be used to facilitate adaptation to climate change to ensure that they are consistent with any national framework that might be adopted.

(iii) Local government

4.56 Local governments are closer to citizens than the other levels of government. Therefore, on the basis of the subsidiarity principle, councils are, in many instances, best placed to implement national and state/territory policies aimed at addressing the impact of climate change at a local level. This particularly applies to the application of planning laws to buildings and communities.

4.57 Local government may be able to achieve a greater level of democratic engagement with its citizens in the drawing up of local plans and policies. In some instances, this could result in regulation, particularly local planning rules. Democratic engagement will be an important factor in gaining support for action, particularly for difficult issues, such as retreat from sea level rise and bushfire prone areas.

4.58 Some councils may also argue that local policies and regulations allow for innovation and choice between councils. On the other hand, different rules applying in different municipalities could lead to fragmentation of effort, extra costs and differential (and potentially, inequitable) treatment of individuals.

H. The role of government in adaptation for infrastructure and associated services

4.59 This section of the chapter uses the framework set out above to consider some key roles for the different levels of government to address adaptation to climate change in relation to the infrastructure and associated services under consideration in the Report. In particular, it focuses on new or additional roles that might be of assistance.

4.60 Table 11 on the next page identifies new regulatory responses – including laws, policies and implementation mechanisms – that may be needed to facilitate adaptation to climate change and the level of government that would be best placed to pursue these responses. The regulatory responses have been identified based on the analysis undertaken in chapter 3 where aspects of existing regulatory frameworks for infrastructure and associated services that might facilitate or hinder adaptation to climate change were considered. The regulatory responses identified in Table 11 would help to maximise the effectiveness of adaptation in respect of each category of infrastructure and associated service.

Table 11. Additional roles for levels of government to consider for adaptation

Sector/Area	Federal Government	State/Territory Government	Local Government
Building	*Buildings are subject to an existing national regulatory framework, which helps to ensure uniformity and consistency across all jurisdictions. The federal and state/territory governments are jointly involved in the development of building rules and standards, whereas the state/territory governments and local governments are involved in the implementation of framework. While changes will be needed to ensure that the framework adequately responds to the impact of climate change, the basic elements to facilitate adaptation to climate change are already contained within the framework. Changes will also need to be made to the way in which building legislation is applied in practice in each of the state/territory jurisdictions to ensure that a rigorous assessment of climate change risks is undertaken. Accurate, comprehensive information about climate change risks will be an important input for this process. Finally, particular action will be needed to ensure the resilience of existing buildings. The administrators of state/territory regimes will play an important role in this regard.*		
	Ensure that the BCA reflects current and future impacts of climate change	Modify state/territory legislation to require compliance of entire building with the BCA when alterations/additions are made to buildings in areas vulnerable to climate change effects	
	Drive review and updating of Australian Standards to ensure that they properly account for the impact of climate change	Train industry participants, including building surveyors and certifiers, to ensure that they are better able to account for the effects of climate change	
	Ensure that State/Territory deviation from the BCA is minimised		
	Provide funding for training of industry participants, including building surveyors and certifiers, to ensure that they are better able to account for the effects of climate change		
	Provide funding/incentives (e.g. tax breaks) for the retrofitting of existing buildings to make them more resilient to the effects of climate change		

Table 11 continued

Sector/Area	Federal Government	State/Territory Government	Local Government
Planning	*At present, state/territory governments are responsible for the design of planning frameworks within their respective jurisdictions, whereas local governments implement these frameworks in the municipalities that they govern. This has led to a fragmented approach, which could undermine efforts to achieve a concerted, effective response to the impact of climate change. National consistency is important in the context of planning in order to provide relative certainty and clarity about the way in which climate change effects should be addressed. Such consistency could be fostered through the implementation of the federal government's urban policy 'Our Cities, Out Future', which requires the States and Territories to have in place plans for each city to deliver 'an urban Australia that is more productive, sustainable and liveable'.*[178] *In addition, accurate, comprehensive information about climate change risks will be an important input for decision-making in the planning area. Despite the need for a national planning framework, state/territory and local governments will still play a critical role in implementation. In particular, state/territory governments will need to ensure that their strategic plans are responsive to climate change and local government will be instrumental in implementing these plans as well as facilitating stakeholder engagement.*		
	Design national framework to ensure that climate change is taken into account in relation to strategic and statutory planning	Modify state/territory legislation to implement national framework	Implement state/territory legislation and adaptation strategy
	Consider making Commonwealth payments to the States and Territories for infrastructure, conditional on satisfactory adaptation plans and implementation	Implement national framework	
	Provide consistent, national information on the range of climate change risks that could be relevant for strategic or statutory planning	Identify areas within state/territory that are likely to be particularly vulnerable to the impacts of climate change (including sea level rise, bushfires and floods)	Stakeholder engagement to facilitate implementation of national framework and state/territory adaptation strategy

178 Department of Infrastructure and Transport, above fn 173.

Table 11 continued

Sector/Area	Federal Government	State/Territory Government	Local Government
	Establish benchmarks and thresholds for planning decisions (e.g. sea level rise projections, number of extreme bushfire days, probability of major flood events)	Prepare and implement strategy for the state/territory based on national framework and vulnerability mapping. These strategies should respond to COAG's findings in relation to its review of capital cities' strategic planning systems.[179]	
	Provide funding for training of strategic and statutory planners to ensure that they are better able to account for the effects of climate change in decision-making processes	Train strategic and statutory planners to ensure that they are better able to account for the effects of climate change in decision-making processes	
	Develop model to enable consideration of compensation arrangements for back zoning		

179 In 2009, the COAG Reform Council was asked to: review capital city strategic planning systems against agreed national criteria; support continuous national improvement in capital city strategic planning; and build and share knowledge of best practice planning approaches. Among other things, the review will consider the extent to which strategic plans will effectively address climate change. The review will be submitted to COAG in December 2011 and be released to the public in February 2012.

Table 11 continued

Sector/Area	Federal Government	State/Territory Government	Local Government
Environmental Impact Assessment	*Environmental impact assessment regimes exist at the federal and state/territory levels. The objectives and basic approach underlying each of these regimes are largely consistent. However, scope does exist for the development of a national framework to harmonise the way in which climate change is addressed in the context of environmental impact assessment regimes. In addition, accurate, comprehensive information about climate change risks will be an important input for decision-making in relation to proposed projects that have been subjected to an EIA process. Furthermore, training will be needed to ensure that those entities undertaking the assessments are able to rigorously assess the impact of climate change on the proposed development.*		
	Design national framework that can be applied at federal and state/territory levels, to ensure that climate change is taken into account in relation to EIA processes	Modify state/territory legislation to implement national framework	
	Provide consistent, national information on the range of climate change risks that might be relevant for EIAs	Review triggers and projects covered by EIA regimes to ensure that projects that are likely to be vulnerable to the impact of climate change are subjected to a special assessment process that accounts for climate change risks	
	Provide funding for training of developers/ consultants to ensure that the assessment of the impact of climate change in the context of EIAs are undertaken correctly and adequately account for current and future climate change risks	Train developers/consultants to ensure that the assessment of the impact of climate change in the context of EIAs are undertaken correctly and adequately account for current and future climate change risks	
		Identify areas within state/territory that are likely to be particularly vulnerable to the impacts of climate change (including sea level rise, bushfires and floods) and for which a special EIA might be necessary	

Table 11 continued

Sector/Area	Federal Government	State/Territory Government	Local Government
Electricity	*A national regulatory framework exists for the supply of electricity in most parts of Australia. Central bodies are responsible for law and policy-making (AEMC), implementation (AEMO) and enforcement (AER) of the regime. These bodies will need to be engaged in order to implement changes to ensure that the regulatory framework adequately responds to the impact of climate change. These changes could be complemented by efforts by the federal and state/territory governments to foster alternative energy supply options, particularly through distributed generation. In addition, accurate, comprehensive information about climate change risks will be an important input for decision-making by AEMO and infrastructure owners and operators in the sector.*		
	Foster dialogue to expand the scope of the National Electricity Objective to provide for explicit recognition of and response to environmental issues, including climate change	Modify state/territory legislation to facilitate uptake of co-generation	
	Engage the AEMC and AER to modify incentives underlying economic regulatory frameworks to ensure that climate change is properly accounted for	Identify areas within state/territory that are likely to be particularly vulnerable to the impacts of climate change (including sea level rise, bushfires and floods) and for which a special measures might need to be taken by generators and network service providers to protect infrastructure	
	Identify and facilitate dialogue between the AEMC and industry participants to increase up-take of co-generation and other forms of distributed generation		
	Provide consistent, national information on the range of climate change risks that could input into operating decisions taken by AEMO, generators and network service providers		

Table 11 continued

Sector/Area	Federal Government	State/Territory Government	Local Government
Telecommunications	*A federal regime exists for the regulation of the telecommunications sector. The regulatory framework will need to be reviewed and changed to ensure that it adequately responds to the impact of climate change. Complementary tools, including codes of practice and technical standards, may need to be developed with input from industry participants to ensure that telecommunications infrastructure is resilient to the impact of climate change. Accurate, comprehensive information about climate change risks will provide important context for this process.*		
	Review existing regulatory framework to ensure that climate change is taken into account (e.g. through carrier licences and ongoing maintenance obligations)	Identify areas within state/territory that are likely to be particularly vulnerable to the impacts of climate change (including sea level rise, bushfires and floods) and for which a special measures might need to be taken by carriers to protect infrastructure	
	Review immunity from compliance with planning and environmental impact assessment laws in relation to the establishment of low impact facilities infrastructure		
	Drive development of new codes of practice and technical standards to ensure that new and existing infrastructure is resilient to climate change impacts		
	Provide consistent, national information on the range of climate change risks that could be relevant to the type, location and design of new infrastructure		
	Establish national framework for co-ordination of the development of new telecommunications infrastructure (including the NBN) to maximise diversity and, therefore, resilience to climate change impacts		

Table 11 continued

Sector/Area	Federal Government	State/Territory Government	Local Government
Water	*Even though an overarching national policy framework exists for certain aspects of water planning and management under the NWI, the institutional structure, governance arrangements and regulation of the sector by the various state and territory governments is still characterised by fragmentation, duplication and, in some cases, inconsistency. A more robust and comprehensive national framework, which addresses the spectrum of climate change issues affecting water resources and infrastructure, would be beneficial to guide changes to state/territory regulatory frameworks. State/territory regulators will need to be engaged to ensure that the administration of certain aspects of the regulatory regime (particularly, licensing and economic regulation) effectively account for the impact of climate change. Accurate, comprehensive information about climate change risks to water resources and infrastructure for these regulators would be helpful.*		
	Design national framework for: • Assessment and response to climate change risks in the context of national and state/territory water planning and management policies • Access to water infrastructure to increase alternative water supply options • Expansion of existing rural water markets to urban areas • Roll-out of distributed water and wastewater facilities • Co-ordinated and simplified economic, health and environmental regulation to support diversity of water supply options, including stormwater harvesting and recycling	Amend state/territory licensing regimes to ensure that climate change risks are identified and assessed by licensees in relation to water infrastructure on an ongoing basis	
	Engaging state regulators to modify incentives underlying economic regulatory frameworks to ensure that climate change is properly accounted for	Modify economic regulatory frameworks to ensure that climate change is properly accounted for	
	Provide consistent, national information on the range of climate change risks that could input into the type, location and design of new infrastructure and also on the future availability of water resources	Identify areas within state/territory where water resources and infrastructure are likely to be particularly vulnerable to the impacts of climate change (including sea level rise, bushfires and floods)	

Table 11 continued

Sector/Area	Federal Government	State/Territory Government	Local Government
Waste	*Environmental protection regimes, which regulate waste facilities, exist in each of the state/territory jurisdictions. These regimes are supplemented by best practice guidelines for the siting, design, operation and management of waste facilities, which are prepared by state/territory regulators. The basic architecture of the regimes in each of the jurisdictions are largely consistent and do not require major changes to ensure a harmonised approach to climate change. Nevertheless, ideally, the guidelines would be developed centrally to ensure a consistent response to climate change risks for existing and future waste facilities. Accurate, comprehensive information about climate change risks would be an important complement to these guidelines. The guidelines would be enforced at a local level by the state/territory regulators.*		
	Develop best practice performance standards and guidelines for the siting, design, operation and management (including post-closure) of waste facilities to ensure that climate change is taken into account	Identify areas within state/territory that are likely to be particularly vulnerable to the impacts of climate change (including sea level rise, bushfires and floods) which may affect the design, location and operation of waste infrastructure	
	Provide consistent, national information on the range of climate change risks that could input into the location, design and operation of new infrastructure	Review landfill levy structure to determine whether additional funding may be needed to fund upgrades/re-design to make waste facilities more resilient to the impact of climate change	

Table 11 continued

Sector/Area	Federal Government	State/Territory Government	Local Government
Transport	*The regulatory framework for transport in Australia is very fragmented and is an ideal candidate for a more harmonised, co-operative approach. At present, there are differences regarding the way in which different transport modes are regulated within each state/ territory jurisdiction. There are also differences in the way in which a particular transport mode is regulated between jurisdictions. Moreover, the tools that might be used to facilitate adaptation to climate change vary greatly between the various regimes. An efficient and effective way to address climate change would be to establish a national framework to guide the identification and assessment of climate change risks for each of the transport modes in the various states and territories. State and territory governments would play an important role in modifying jurisdictional legislation to implement this framework. Furthermore, owners and operators of transport infrastructure would ideally be provided with accurate, comprehensive information about climate change risks so that they account for such risks in the strategic planning process.*		
	Design national framework to ensure that climate change impacts are identified and assessed for all main transport modes through infrastructure management plans/ master plans/ environmental management plans	Modify state/territory legislation to implement national framework	
	Develop codes of practice or relevant technical standards for the design and operation of the main types of transport infrastructure	Review lease arrangements with private infrastructure operators to ensure obligation imposed on them to account for climate change in the management and operation of the infrastructure	
	Provide consistent, national information on the range of climate change risks that could input into the location, design of new infrastructure and strategic plans for the operation and management of existing infrastructure	Identify areas within state/territory that are likely to be particularly vulnerable to the impacts of climate change (including sea level rise, bushfires and floods) which may affect the design, location and operation of infrastructure	
	Provide funding for training of owners and operators of infrastructure to ensure that they are better able to account for the effects of climate change in strategic planning processes	Train owners and operators of infrastructure to ensure that they are better able to account for the effects of climate change in strategic planning processes	

Table 11 continued

Sector/Area	Federal Government	State/Territory Government	Local Government
Major Infrastructure Procurement	*The regulatory regime for the procurement of major infrastructure consists of a national framework, which provides guidance to state/territory governments who implement the regime within each of the jurisdictions. While the national guidelines are an effective way to ensure that the impact of climate change is accounted for in the context of procurement decisions about major infrastructure, specific provisions may be needed to ensure that an adequate assessment is undertaken in every case of major infrastructure procurement. In addition, it will be necessary to ensure that implementation of the guidelines at the jurisdictional level is consistent and that the relevant state/territory decision-makers are fully equipped to make assessments about the impact of climate change on proposed major infrastructure. Ideally, these decision-makers would be provided with accurate, comprehensive information about climate change risks that could affect major infrastructure.*		
	Design national framework for the identification and assessment of climate change risks in relation to all methods of procurement of public infrastructure	Modify state/territory legislation and policies to implement national framework	
	Review National PPP Guidelines and other guidelines applicable to other procurement methods to ensure that climate change accounted for	Identify areas within state/territory that are likely to be particularly vulnerable to the impacts of climate change (including sea level rise, bushfires and floods) which may affect the design, location and operation of major public infrastructure	
	Provide consistent, national information on the range of climate change risks that could input into risk assessment for infrastructure procurement		
	Establish technical benchmarks and standards to ensure the resilience of major public infrastructure		
	Provide funding for training of state/territory government bodies using National PPP Guidelines to ensure that they are able to effectively account for the effects of climate change in decision-making processes	Train state/territory government bodies using National PPP Guidelines to ensure that they are able to effectively account for the effects of climate change in decision-making processes	

4.61 It is evident from Table 11 on the previous page that the same type of regulatory response might be necessary in relation to several categories of infrastructure or associated service. For example, there is a need for consistent, national information on climate change risks for each of the infrastructure and associated areas under consideration in this Report. Similarly, there is a need for training of various administrators and decision-makers in the context of a variety of different regulatory regimes. In these cases, in the interests of efficiency and to avoid unnecessary duplication, it may be advisable to set up a single body at the relevant jurisdictional level to provide the same service or perform the same function for all relevant sectors or areas. This national body would assist the federal, state, territory and local governments with the practical and effective implementation of climate adaptation polices and regulation. Such a body could have members appointed by state, territory and local governments as well as the federal government.

CHAPTER 5: PRINCIPLES TO UNDERPIN ADAPTIVE REGULATION TO ADDRESS CLIMATE CHANGE

5.1 Designing a regulatory framework that facilitates adaptation to climate change is a complex and challenging exercise, particularly in relation to Australia's infrastructure and associated services. Such a framework will need to address the risks that climate change poses for such infrastructure, not just in the short to medium term, but also for the duration of the life of the infrastructure. Additionally, the framework will need to address the considerable uncertainties associated with climate change, including the location, nature, timing and severity of climate change impacts or events that may occur. Finally, the framework will need to be compatible with regimes that are currently in place for the regulation of infrastructure and associated services.

5.2 In order to account for the diversity of infrastructure and associated regulatory frameworks as well the spectrum of climate change impacts that might materialise, any framework for adaptation to climate change must necessarily centre around core principles. These core principles will help to guide the way in which regulatory frameworks are designed, implemented and applied in practice. This chapter identifies the core principles that will need to underpin regulatory responses to climate change in order to ensure effective adaptation. The chapter also sets out the broader framework within which these principles can be applied.

A. COAG's principles of best practice regulation

5.3 In 2007, COAG released a guide entitled 'Best Practice Regulation', which sets out a range of principles for best practice regulation. These principles apply to the spectrum of regulation that may be developed by government. They provide a good foundation for the development of a regulatory framework to ensure effective adaptation to climate change.

(i) Establishing a case for action before addressing a problem

5.4 The design, implementation and application of regulation can be costly from the perspective of the government, the entities being regulated and society as a whole. Therefore, the use of regulation to respond to climate change should only be pursued if the risks justify such intervention. More specifically, if the likelihood that a particular type of infrastructure will be vulnerable to climate change effects is high and the impact of climate change will be significant, then the case for regulatory action to respond to climate change in such circumstances is relatively strong.

5.5 Implicitly, establishing a case for a regulatory response to climate change will necessarily require an identification and assessment of climate change risks. The risks will not be uniform for all types of infrastructure and associated services. On the contrary, the risks will depend upon a variety of factors including the type, location, design, age and relative usage of the infrastructure and the particularities of the climate change impacts to which the infrastructure may be subject.

(ii) A range of feasible policy options must be considered including self-regulatory, co-regulatory and non-regulatory approaches and their benefits and costs considered

5.6 There are a broad range of regulatory and non-regulatory responses that can be used to facilitate adaptation to climate change. An assessment will be needed to determine the ideal mix of such responses to ensure the most effective adaptation to climate change. This mix may vary from sector to sector and, potentially, between various locations.

5.7 While non-regulatory responses may be useful in achieving adaptation in some cases, regulation will be particularly important where the risks posed by climate change are potentially irreversible or catastrophic or where the costs of prevention now through proactive measures are lower than the costs of remediation or reactive adaptation, which will become necessary in the future.

5.8 If the conclusion is reached that a regulatory response is necessary to achieve effective adaptation in a given case, co-regulation options should be considered as a way of sharing the regulatory burden between government and industry. There are existing examples within the infrastructure sector where co-regulation may be effectively used to facilitate adaptation to climate change. For example, the telecommunications regime specifically provides for the development of codes by industry, which could be used to ensure that climate change risks are assessed for existing and proposed new telecommunications infrastructure. Under normal circumstances, compliance with such codes is voluntary pursuant to the existing telecommunications regime. However, the regulator does have enforcement powers that can be used to ensure compliance with certain codes.

(iii) Adopting the option that generates the greatest net benefit for the community

5.9 In assessing the 'net benefit' of a possible regulatory response to climate change, it is important that consideration is focused on ensuring efficiency (that is, effective adaptation at the lowest cost) but is not confined to pure economic costs and benefits. Instead, it will be necessary to include consideration of the broader benefits that might be associated with adaptive regulation but could be difficult to quantify, such as building resilience to climate change impacts and promoting permanent behaviour change. Moreover, the time-frame for the assessment of net benefit may need to be extended to include consideration of short, medium and long-term implications of climate change. This can be done through the use of a discount rate which accounts for costs and benefits associated with adaptive regulation that materialise well into the future.

5.10 The principle of inter-generational equity, which is already applied in the context of planning and environmental impact assessment regimes, is a useful way to conceptualise and account for current and future climate change impacts. The principle encompasses the notion that development today should meet the needs of the present without compromising the ability of future generations to meet their own needs. In a similar way, assessment of possible regulatory responses to climate change should account not just for the short-term benefits of taking action to respond to climate change but should also consider the implications of taking such action for future generations.

(iv) Legislation should not restrict competition unless justified

5.11 Regulation to require identification, assessment and response to the impact of climate change may have a significant financial impact on the owners and operators of infrastructure. In turn, the additional costs that infrastructure owners and operators might have to bear to address the effects of climate change may restrict consumer choice, raise prices and reduce overall economic efficiency and productivity, at least in the short term.

5.12 However, the possible negative implications of climate change regulation for competition – particularly, the impact on the consumer – need to be weighed against the longer term benefits for the infrastructure owner and operator and users of the infrastructure. In particular, short-term rises in user prices to allay the costs of adapting to climate change may be justified if, in the longer term, the infrastructure is more likely to be resilient to climate change. These factors will need to be considered in determining whether or not a particular regulatory response is justified.

(v) Providing effective guidance to relevant regulators and regulated parties in order to ensure that the policy intent and expected compliance requirements of the regulation are clear

5.13 The identification and assessment of climate change risks is complex, but will be an essential component of any regulatory response to climate change. The ability to simplify this process in the regulatory response and effectively communicate it to parties who may be involved in the process will be critical to the success of the response. Regulators and regulated parties who may be called upon to undertake these assessments will require as much guidance as possible to assist them in this task and they should be equipped with all the tools necessary to ensure that the assessment and response is adequate.

5.14 In this regard, policy documents and guidelines will be an essential complement to any regulatory response requiring account to be taken of climate change. The waste sector provides a good example of how best practice performance standards and guidelines can be used to provide clear direction to owners and operators of waste facilities without being unduly prescriptive. In addition to guidance documents, access to training and accurate, comprehensive information about climate change risks will also be critical.

(vi) Ensuring that regulation remains relevant and effective over time

5.15 Climate change is not a static phenomenon. On the contrary, the effects of climate change are likely to change over time. More specifically, the impacts are likely to increase in intensity and frequency and the geographical location of the impacts may change. Accordingly, it is important that regulatory responses to climate change are flexible so that they can respond to the current factual situation as well as accounting for the possible future impacts as they evolve. This will help to ensure that these regulatory responses remain relevant and effective over time.

5.16 Regulation can be designed so that it is responsive to climate change effects over time in a number of ways. One example is the performance-based BCA, which offers an opportunity to deal with the uncertainty surrounding the specific impacts of climate change on buildings as they evolve over time by prescribing performance requirements that accommodate future changes in the physical environment. Another example is the legislative requirement in Victorian and Queensland regulatory frameworks to periodically prepare port management plans. The frequent updating of these types of plans coupled with an effective monitoring and auditing regime will help to ensure that the impact of climate change on infrastructure is regularly considered and factored into decisions regarding infrastructure design, operation and management.

(vii) Consulting effectively with affected key stakeholders at all stages of the regulatory cycle

5.17 Effective stakeholder engagement will be critical to the success of efforts to facilitate adaptation to climate change. Such engagement will help to engender support for climate change action. Moreover, stakeholders are likely to be more inclined to constructively participate in such action if they have been engaged through the development of the regulatory response and in the context of the implementation of the response.

5.18 The planning system provides a good example of how stakeholder engagement may enhance the effectiveness of regulatory responses to address climate change. In particular, the planning system provides for community engagement in relation to strategic and statutory planning decisions. The nature and degree of stakeholder engagement provided for under the planning system can help secure community support for planning decisions that are aimed at addressing the effects of climate change.

(viii) Government action should be effective and proportional to the issue being addressed

5.19 Effectiveness will be an important objective underlying any regulatory response to climate change. In practical terms, effectiveness relates to the extent to which the response facilitates adaptation to climate change through the way that it is designed, applied and implemented. Notably, the relative effectiveness of a particular regulatory response may be greater in one sector compared to another. For example, voluntary codes of practice such as those that currently exist in the context of the telecommunications sector could work well in a sector that is already characterised by a significant degree of co-regulation and voluntary compliance by the industry. However, such codes may not work as well in sectors that are the subject of heavy regulation. Therefore, it is essential that the effectiveness of a particular regulatory response is considered in relation to the broader regulatory and practical context in which it will be applied.

5.20 The issue of proportionality is also particularly important in the context of regulatory responses to climate change because the risks are so variable. Ideally, a regulatory response will be commensurate with the relevant climate change risks. In this regard, it is critical that risks are neither over-estimated nor under-estimated to ensure that the regulatory response matches the true level of risk, rather than being excessive or inadequate. More intrusive regulatory intervention is justified when the overall risk is greatest whereas less interventionist tools are preferable where the overall risk is relatively low.

5.21 Environmental impact assessment regimes, which are process-oriented in nature, provide an example of how the regulatory response can be tailored to respond to the specific environmental risks arising in relation to a proposed project. In particular, under EIA regimes, project proponents are required to identify the environmental risks that may arise in relation to the specific project in question and demonstrate how the project responds to those risks. Furthermore, conditions can be attached to the approval of developments to ensure effective management of the particular environmental risks posed by the project. In a similar way, regulatory responses to climate change can be developed, which allow for an accurate assessment of risks in a particular case before adaptive action is taken.

B. Other general principles of best practice regulation

5.22 COAG's principles for best practice regulation establish a good starting point for the design of regulatory responses to climate change. However, there are additional principles that have been developed by other bodies that could also be helpful in developing a comprehensive framework for adaptation to climate change. These principles, which are drawn from the Victorian Guide to Regulation,[180] are discussed below.

(i) Flexibility

5.23 The uncertainty associated with climate change means that a flexible regulatory response is essential. A flexible framework will help to ensure that the regime is responsive to the spectrum of climate change impacts that might materialise.

5.24 A flexible regulatory framework could take the form of broad objectives, as in the case of planning regimes. Another approach could be to adopt a reflexive, iterative decision-making model, which allows for incremental change to be made to the regulatory response based on information about climate change effects as it becomes available. Environmental management plans in the transport sector, which need to be reviewed regularly, provide an example of this approach.

5.25 However, flexibility should not be used as a mechanism to avoid taking action where action is necessary.[181] Accordingly, discretion will need to be limited to prevent avoidance of adaptive action.[182] Furthermore, flexible mechanisms should be underpinned by binding rules, which require that climate change effects are adequately addressed.

(ii) Consistency and predictability

5.26 Consistency and predictability associated with regulatory responses to climate change need to be assessed in a number of different contexts.

5.27 First, it will be essential to ensure that a regulatory response to climate change is inherently consistent and predictable in order to create a stable regulatory environment and foster business confidence. This is likely to be challenging given the uncertainty associated with climate change and its impacts but could be achieved by prescribing a clear, defined process according to which climate change impacts will be assessed, even if the outcome of the process is not known in advance. The regulatory response should also be applied consistently to all regulated parties that are in similar circumstances. Failure to do so will undermine the integrity of and, consequently, confidence in the regime.

5.28 Second, consistency and predictability needs to be assessed between the regulatory response and the pre-existing regulatory framework within which it will be applied. Regulatory responses to climate change may take the form of new laws. However, at least in the short term, it is more likely that existing regulatory frameworks will be used to facilitate adaptation to climate change. In either case, it will be important to ensure that the regulatory responses to climate change for a particular type of infrastructure or sector are compatible with the existing regulatory framework.

180 Second edition, May 2011.
181 J McDonald, *The Role of Law in Adapting to Climate Change*, WIRES Climate Change, Volume 2, March/April 2011, 283–295, p. 289.
182 R Kundis Craig, '"Stationarity is Dead" – Long live Transformation: Five Principles for Climate Change Adaptation Law', 34 *Harvard Environmental Law Review*, 9, p. 17.

5.29 Third, consistency and predictability will need to be ensured between the regulatory response and other inter-connected sectors or regulatory frameworks. This will be particularly important in cases where different types of infrastructure are physically linked and/or inter-dependent in some way (e.g. railway lines and ports). It will also be important in cases where there are overlaps and/or synergies between regulatory frameworks (e.g. planning and building). In designing regulatory responses to climate change in these cases, it will also be important to take stock of the possible upstream or downstream implications of those responses for other sectors and/or services. To the extent possible, regulatory responses across inter-connected sectors and regulatory frameworks should be streamlined. This will help to provide clarity and avoid confusion for regulated parties.

(iii) Transparency

5.30 Another fundamental design principle for adaptive regulation is transparency. It is essential that entities affected by the regulatory response understand the purpose underlying the regulatory response, the way in which it will be applied and enforced, and all underlying documents and information that are relevant to the regulatory response. Transparency of this kind can help to engender support for the regulatory response and foster a willingness to co-operate and participate constructively in adaptation.

5.31 The building regime is an example of a regulatory framework that could benefit from increased transparency to help facilitate adaptation to climate change. Although both the BCA and Australian Standards, to which the BCA refers, are essential to understand the requirements for construction of new buildings, these documents are not available free of charge. Accessibility to these documents may need to be reviewed if they are to play a significant role in the transformation of Australia's building stock to respond to climate change.

5.32 Lack of information and awareness about climate change impacts could lead to market failures and maladaptive behaviour. Therefore, transparency about climate change risks will also be critical to the effectiveness of regulatory responses to climate change. Ongoing access to accurate, up-to-date information about climate change risks can provide important context for these regulatory responses. A model that could be used in this regard is the requirement in the context of the Victorian planning system to undertake a coastal hazard vulnerability assessment, which accounts for current and future climate change risks, in relation to proposed re-zoning of low-lying land for residential purposes.

(iv) Accountability and appeal rights

5.33 It is important that the government is held accountable for the design of regulatory responses to climate change and for the way in which those responses are applied and enforced in practice. Accountability will impose a strong incentive on the government to ensure that the climate change risk analysis upon which any regulatory response is based has been undertaken with sufficient care and rigour.

5.34 A key mechanism to ensure accountability is the Regulatory Impact Statement (**RIS**) process. This process ensures that government consults on proposed regulation, gives affected parties an opportunity to make submissions, and transparently demonstrates the costs and benefits of the proposed regulation.

5.35 Another effective way of ensuring accountability is through the establishment of mechanisms to appeal against decisions that may have significant impacts on individuals and/or businesses. Appeal mechanisms will create a system of oversight in relation to regulatory decisions that seek to facilitate adaptation to climate change to ensure that regulatory responses are justified and commensurate with the relevant risks.

C. Adaptive regulation principles that are specific to climate change

5.36 In addition to the general principles for best practice regulation, which have been discussed above, there are a number of additional principles that will be particularly important in the design of regulatory responses to facilitate adaptation to climate change. These principles are discussed below.

(i) Focus on risk

5.37 In order to effectively facilitate adaptation, any regulatory response to climate change must necessarily focus on risk. The primary objective underlying such responses is to ensure that the risks to infrastructure and associated services posed by climate change are avoided or, at least, mitigated.

5.38 Regulatory responses need to ensure that the various climate change risks that could affect infrastructure and associated services in the short, medium and longer terms have been identified, assessed and that measures are in place to respond to those risks. As previously mentioned, the regulatory response should be commensurate with current and future risks. Furthermore, the regulatory response should be flexible and dynamic enough to respond to climate change risks as they evolve over time.

5.39 Existing regulation of major hazard facilities in the States and Territories could provide a model of how regulation to address climate change risks could be designed. Regulatory regimes for major hazard facilities oblige operators of such facilities to demonstrate that measures have been taken to identify all foreseeable major incidents, including their likelihood and consequences, and the adequacy of the measures used to minimise on and off-site risks.

(ii) Take account of and manage uncertainty

5.40 Climate change is characterised by uncertainty. Among other things, there is uncertainty regarding the location, nature, intensity and frequency of climate change impacts. This uncertainty means that the design of regulatory responses to address the effects of climate change will be particularly complex. Regulatory frameworks will need to be designed to address a spectrum of scenarios that may arise, including cases where:

- Risks are relatively certain and concrete
- Risks are uncertain but could be potentially catastrophic if they materialise
- The impacts of climate change are diffuse and spread over a number of different entities and/or materialise progressively over time
- The likelihood of particular climate change impacts is relatively low but the consequences could be catastrophic and irreversible if they materialise

5.41 Clearly, a one-size-fits-all solution is not possible to accommodate each of these scenarios. The question then arises as to whether the regulatory response should focus predominantly on the relatively certain, contained climate change risks or, rather, whether the response should be tailored to address the worst case scenario involving widespread, catastrophic, irreversible effects.

5.42 At a minimum, the risk of irreversible, catastrophic consequences for a particular type of infrastructure or associated service obliges consideration of a precautionary approach. In practical terms, the application of the precautionary principle means that the absence of full scientific consensus regarding projected climate change impacts cannot be used as an excuse for not taking measures to prevent serious or irreversible harm. Rather, the precautionary principle supports decisions taken now to respond to risks that might materialise in the future.[183]

5.43 Application of the precautionary approach is all the more compelling in the context of long-lived infrastructure. Decisions taken today about siting, design, operation and management of such infrastructure will need to account for climate change impacts that could materialise well into the future, when the infrastructure is still standing and operational. Responses might include increasing the robustness of design or to increase the rate of depreciation to allow for earlier replacement.[184]

5.44 However, a precautionary approach is likely to be costly and it is unclear whether it will be politically palatable and practically feasible to take a regulatory response today to respond to climate change risks that are likely to materialise some time after the government proposing the response has left office. Nevertheless, the high costs associated with a precautionary approach must be weighed against the risk of premature scrapping of damaged infrastructure or expensive retrofitting once climate change risks become clearer.[185]

5.45 A variety of approaches have been proposed to support decision-making in the presence of uncertainty associated with climate change. One such approach is to implement 'no-regret' measures, which would be justified under all possible future climate scenarios, and 'win-win' measures, which reduce the vulnerability to climate change while meeting other policy objectives, including climate change mitigation. However, the exclusive use of 'no regrets' and 'win-win' policies could lead to inadequate adaptation action being taken.[186] Another approach would be to design regulatory responses for new long-lived infrastructure based on current best estimates of climate change risks. Any residual risks that become clearer with time could be addressed through obligations regarding operation, maintenance and insurance of such infrastructure.[187] More cautious approaches may be justified, especially where there are risks of very serious or catastrophic harm. 'Safety margins' or uncertainty parameters could be included in risk assessments. A range of tools can be used to assist decision-making in these circumstances, including scenario analysis, real options analysis, probability-weighted cost-benefit analysis and tolerable windows approaches.[188]

183 Victorian Competition and Efficiency Commission, *A Sustainable Future for Victoria*: *Getting Environmental Regulation Right, Final Report*, July 2009, p. 349.
184 S Fankhauser, J B Smith, R Tol, 'Weathering Climate Change: Some Simple Rules to Guide Adaptation Decisions', 30 *Ecological Economics* (1999), 67, p. 68.
185 S Fankhauser, J B Smith, R Tol, above fn 184, p. 73.
186 F. Cimato, M. Mullan, *Adapting to Climate Change*: *Analysing the Role of Government*, Department of Environment, Food and Rural Affairs (DEFRA) Evidence and Analysis Series, Paper 1, 2010, pp. 19–20.
187 J McDonald, above fn 181, p. 289.
188 Victorian Competition and Efficiency Commission, above fn 183, pp. 360–361.

5.46 Whichever approach is adopted, good regulatory practice demands that a regulatory response to climate change is underpinned by:

- A comprehensive risk and uncertainty assessment;
- A consideration of the range of precautionary measures that are available;
- Identification of knowledge gaps and provision of support for research and ongoing monitoring;
- Periodic review to enable re-assessment as new information becomes available; and
- Each of the measures should be subject to a cost-benefit analysis, which accounts for the range of future costs and benefits (or their best estimates).[189]

(iii) Consider equity and discount rates

5.47 Climate change will have different physical impacts across sectors, regions and social groups. For example, coastal communities are likely to be most vulnerable to climate change through a combination of sea level rise and increased incidence of coastal inundation and extreme storm surges whereas inland, rural areas may be at greatest risk from extreme temperatures, bushfires and erosion. Differences in the physical impact of climate change may be compounded by variations in the ability to adapt. Low income households are likely to be most vulnerable to climate change effects, particularly heat waves, floods and higher electricity costs.[190] Climate change can, therefore, exacerbate existing inequalities.

5.48 Accordingly, in designing regulatory responses to climate change, it will be important to ensure that the direct and indirect impact of such responses is equitable and that one sector, region or social group is not unduly burdened. An assessment will be needed of who will ultimately pay for the implementation of the regulatory response. If the burden will fall disproportionately on those least able to pay, incentives and compensation mechanisms may be needed to change this outcome.

5.49 A key equity consideration is inter-generational equity. The costs of regulation to improve the ability to adapt to climate change are typically borne much earlier than when the benefits accrue. By the same token, future generations suffer disproportionately if the current generation fails to take action. The choice of discount rate in determining the net present value (NPV) of a regulation has an enormous impact on whether a cost benefit analysis favours the regulation. The Australian Government Office of Best Practice Regulation recommends that the discount rate for regulatory interventions is 7%. This percentage values a benefit 50 years in the future at about 3.4% as much as the benefit today. Given the long life of infrastructure and the potential impact of climate change on future generations, a significantly lower discount rate may be appropriate.

189 Victorian Competition and Efficiency Commission, above fn 183, pp. 358–361.
190 F. Cimato, M. Mullan, above fn 186, p. 17.

D. Framework for the application of adaptive regulation principles

5.50 The broader framework within which the principles for adaptive regulation are applied will also be critical to the effectiveness of regulatory responses to climate change. Elements of this framework are discussed below.

(i) Regulatory approach

5.51 There are a variety of regulatory approaches that could be used to facilitate adaptation to climate change. These have been outlined in Chapter 2. Each approach has its advantages and disadvantages with respect to adaptation to climate change.

5.52 Prescriptive regulation provides regulators and the entities being regulated with certainty regarding the requirements with which compliance is expected. This approach may be particularly useful where climate change risks are relatively clear and defined. However, the main disadvantage associated with this approach is that it is relatively inflexible and denies the entities being regulated from exercising any degree of discretion in achieving compliance with the regulatory objectives.

5.53 A performance-based approach provides more flexibility. It could be used where the outcomes or objectives are clear and the manner in which they are achieved will not undermine the attainment of these objectives. However, defining performance standards so that they guarantee that current as well as future climate change risks will be effectively addressed is likely to be a challenging exercise. Furthermore, it may not always be clear how performance standards can be met, both from the perspective of regulators and regulated entities. This lack of certainty may pose particular problems for smaller entities that lack experience and/or resources.

5.54 Principle-based regulation, which draws on core principles to underpin adaptation action, could be used to form the basis of overarching requirements regarding adaptation to climate change that apply in a broad range of sectors and circumstances. Such an approach is relatively flexible and may allow the regulatory framework to respond to changes in the broader practical context in which it is applied. However, ambiguity regarding the interpretation and application of principles in the array of circumstances to which the regulatory framework applies may pose particular problems for compliance and enforcement.

5.55 Process-based regulation can be used where diverse risks need to be managed simultaneously. Process-based regulation can be used as a mechanism to ensure that climate change risks are identified and adequately assessed and that measures are taken to respond to these risks. This approach allows for risks to be addressed as they evolve over time. However, it may undermine the need for certainty and predictability by sectoral participants because the outcome of the risk assessment process may vary from case to case.

5.56 Market-based or economic regulation could be used to manage choices and decisions that sectoral participants make regarding a range of issues, including investment in new infrastructure and the way in which existing infrastructure and associated resources are managed. Market-based regulation will be particularly useful in improving the efficiency of the supply and allocation of resources affected by climate change – including water and electricity. However, it will be important to ensure that the objectives underlying such regulation account for the impact of climate change and are responsive to climate change effects as they evolve over time.

5.57 Co-regulation allows industry to participate directly in the development and evolution of the regulatory framework, which enables the burden of regulatory development to be shared between industry and the government. However, the success of such an approach will depend upon the extent to which industry is willing to co-operate with government and how susceptible the development of the regulatory framework is to industry capture.

5.58 In deciding which approach would be most effective in responding to the effects of climate change, the criteria set out in Table 12 overleaf should be applied. In addition, it should be noted that the attractiveness and effectiveness of each approach as a means to addressing climate change may ultimately depend upon whether the approach is compatible with the pre-existing regulatory framework.

Table 12. Criteria to determine appropriate regulatory approach

Criteria	Prescriptive	Performance	Principle	Process	Market	Co-Regulation
The regulator can specify, measure and monitor performance and compliance		✓				
It is difficult to set performance benchmarks	✓				✓	
There is a single, commonly agreed means of controlling risk	✓					
The transaction and compliance costs associated with demonstrating performance are reasonable		✓				
The target is in a better position than the regulator to determine appropriate action to avoid risk		✓		✓		
There are a large number of risks that need to be managed simultaneously and targets have the capacity to assess risks and develop tailored solutions				✓		
The risks are diffuse and targets are not well equipped to assess and respond to risks	✓					
There are strong incentives for the target to perform		✓	✓	✓		✓

(ii) Regulatory tools

5.59 There are a range of existing regulatory tools that could be used to facilitate adaptation to climate change. These tools are set out in Table 10. Summary of useful regulatory tools in Chapter 3. The table of tools also identifies the ideal circumstances in which these tools could be applied to maximise effectiveness of adaptation to climate change.

5.60 The availability of funding for the introduction, application and enforcement of these tools may affect their relative attractiveness in a particular sector. In addition, the success of these tools in achieving adaptation to climate change may depend upon the existence of effective compliance and enforcement mechanisms.

(iii) Regulatory focus

5.61 In broad terms, regulation may focus on the structure of a sector (e.g. structural regulation for the electricity and water sectors), the operations within the particular sector (e.g. building regulation for proposed new buildings) and/or the processes that may underlie decision-making within the sector (e.g. environmental impact assessment regimes). It will be necessary to consider which regulatory focus will be most effective in ensuring adaptation to climate change. The outcome of this assessment may well vary depending upon the type of infrastructure under consideration. The various options for regulatory focus are summarised in Table 13 below.

Table 13. Options for regulatory focus

Stage of Infrastructure	Type of Regulation	Objective of Regulation
Market entry	Structural regulation	Restructure sector Enhance competition Increase efficiency
Strategy	Strategic planning	Framework for control and regulation of land use and development
Design	Technical standards Performance standards	Standards defined to protect against risks
Assessment	Statutory planning Environmental impact assessment Economic regulation	Approval only granted once the various risks and interests have been identified, considered and addressed
Procurement	Procurement guidelines	Assessment of various criteria required as a pre-condition to procurement of infrastructure
Operation	Statutory planning Works approval Economic regulation	Requirements imposed to ensure that operation of infrastructure meets certain minimum standards
Decommissioning and post-closure	Environmental regulation Health and safety regulation	Requirements imposed to ensure that infrastructure post-closure meets certain minimum standards during decommissioning and post-closure

5.62 It is unlikely that structural regulation will be a particularly useful mechanism to address climate change because the focus of such regulation is typically on enhancing competition and efficiency within a sector. However, process-oriented regulation, which could be used to determine whether infrastructure projects should be approved, would be a useful way to address climate change risks before infrastructure is developed. Operational regulation may also be used to ensure that climate change risks are addressed on an ongoing basis throughout the life of infrastructure. It may be necessary to adopt regulation with multiple foci – e.g. at the pre-approval and operational stages – to ensure that climate change is constantly and consistently considered through the life of infrastructure, from design and construction through to operation and decommissioning.

(iv) Dealing with existing infrastructure

5.63 Perhaps the most significant challenge in designing regulatory responses to climate change is dealing with existing infrastructure. Existing infrastructure is likely to be significantly more vulnerable to the impact of climate change than new infrastructure. Yet, most existing regulatory regimes apply to new infrastructure. There is no easy regulatory solution to this problem. Government funding and/or financial incentives may be needed to encourage retrofitting of existing infrastructure.

(v) Timing

5.64 The timing of adoption of regulatory responses to climate change will be critical. Hasty responses that are based on ill-considered speculation about future climate change impacts may prove costly. However, delay in taking action may also be costly if irreversible damage eventuates. Early responses will be most appropriate when the regulatory response relates to long-lived infrastructure and the chance of irreversible impacts is relatively high.[191]

(vi) Decision-making framework

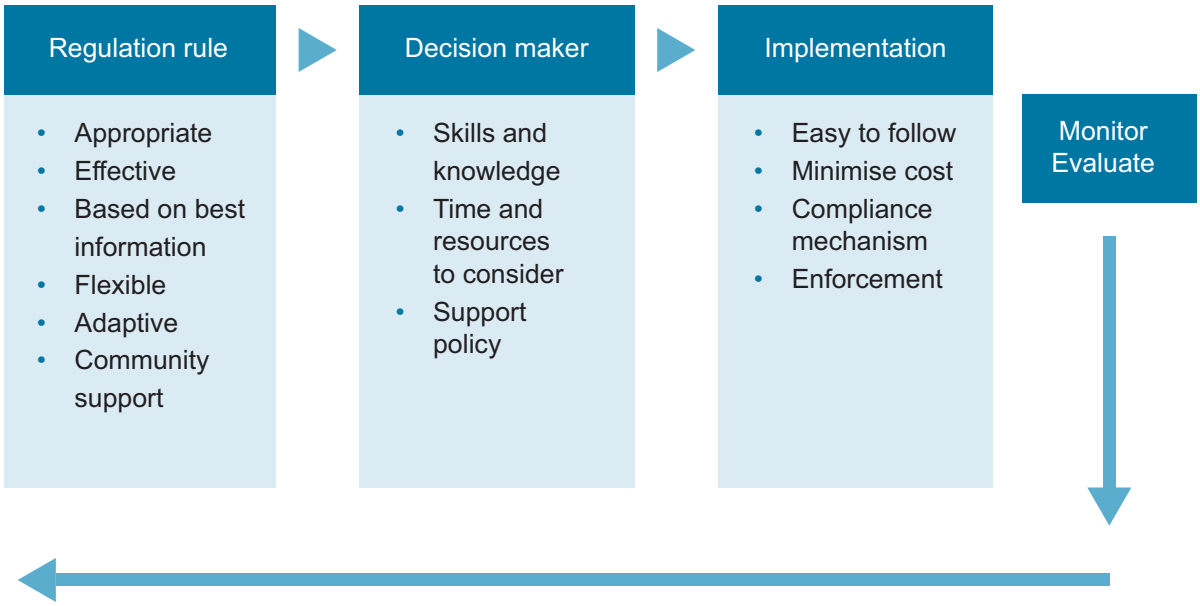
5.65 The process of making decisions regarding how the impact of climate change should be addressed for particular types of infrastructure is likely to be challenging. Decision-makers will be called upon to make predictions about the short, medium and long-term impact of climate change, despite the scientific uncertainty surrounding these impacts. To overcome the complexity that such uncertainty necessarily entails, it will be important to employ clear and effective decision-making processes that will help decision-makers confront the uncertainty and make decisions in the face of such uncertainty.[192]

5.66 An adaptive management model is set out in Figure 3 on the next page. It will be necessary to ensure that the entity with access to the best information, skills and resources undertakes the climate change assessment. It will be equally important to ensure that the consideration of climate change is integrated into all relevant decision-making processes. Finally, it will be essential to regularly monitor and evaluate the implementation of the regulation and to adapt the regulation and decision-making process based on this evaluation.

191 Andrew Macintosh, 'A Theoretical Framework for Adaptation Policy' in *Adaptation to climate change : law and policy*, Editors, Tim Bonyhady, Andrew Macintosh, Jan McDonald, The Federation Press, 2010, p. 61.

192 J Smith, J Vogel, J Cromwell III, 'An Architecture for Government Action on Adaptation to Climate Change. An Editorial Comment', *Climate Change* (2009) 95:53–61, p. 57.

Figure 3. Model for adaptive management



(vii) Process of law-making

5.67 The regulation-making process is typically conditional on the preparation of a RIS. The purpose of a RIS is to ensure that the proposed regulation represents the most efficient solution to an identified problem. Regulation is justified by demonstrating that it is likely to yield benefits that are greater than the costs it imposes and it generates greater net benefits (that is, total benefits less total costs) than any of the other viable options.[193]

5.68 In the case of regulatory responses to climate change, the nature and magnitude of benefits and costs may be difficult to quantify given the uncertainty associated with climate change impacts. It will be necessary to ensure that flexibility exists within the context of the RIS process to account for this uncertainty. Standard cost-benefit analysis and discount rates may not be appropriate for uncertain but potentially catastrophic climate change risks.

5.69 There are a number of techniques that are available to ensure the RIS process takes account of this uncertainty. These include choice modelling, probability-weighted costs and multi-criteria analysis.[194] In some cases, it would be appropriate to consider the worst case scenario and whether it is so serious that a conservative, precautionary approach should be taken. In these cases, a Robust Decision Making Framework that 'works reasonably well no matter what the future holds' may be appropriate.[195]

193 Victorian Guide to Regulation, Second Edition, May 2011.
194 Victorian Competition and Efficiency Commission, above fn 183, pp. 360–361.
195 Lempert R.J., M.E. Schlesinger, *Robust Strategies for Abating Climate Change*, (2000) Climatic Change 45 (3/4): 387–401.

(viii) Liability and compensation

5.70 As the risks associated with climate change become clearer, the pressure to take adaptive action will mount. Failure to do so in relation to policy development, law-making and decision-making for particular cases may attract liability. Accordingly, regulatory regimes may need to be re-visited to determine the extent to which liability might attach to inadequate (or excessive) responses to climate change. Insurance may need to be sought in order to protect against the risk of liability and/or regulatory changes may be needed to limit these risks.

(ix) Link with carbon mitigation and ESD

5.71 Regulatory responses to facilitate adaptation to climate change may be linked to efforts to mitigate carbon emissions that cause climate change. In particular, measures taken to adapt to climate change may also help to mitigate carbon emissions. For example, demand management mechanisms to reduce consumption of electricity in response to tightening supply caused by climate change may also reduce emissions from electricity generation.

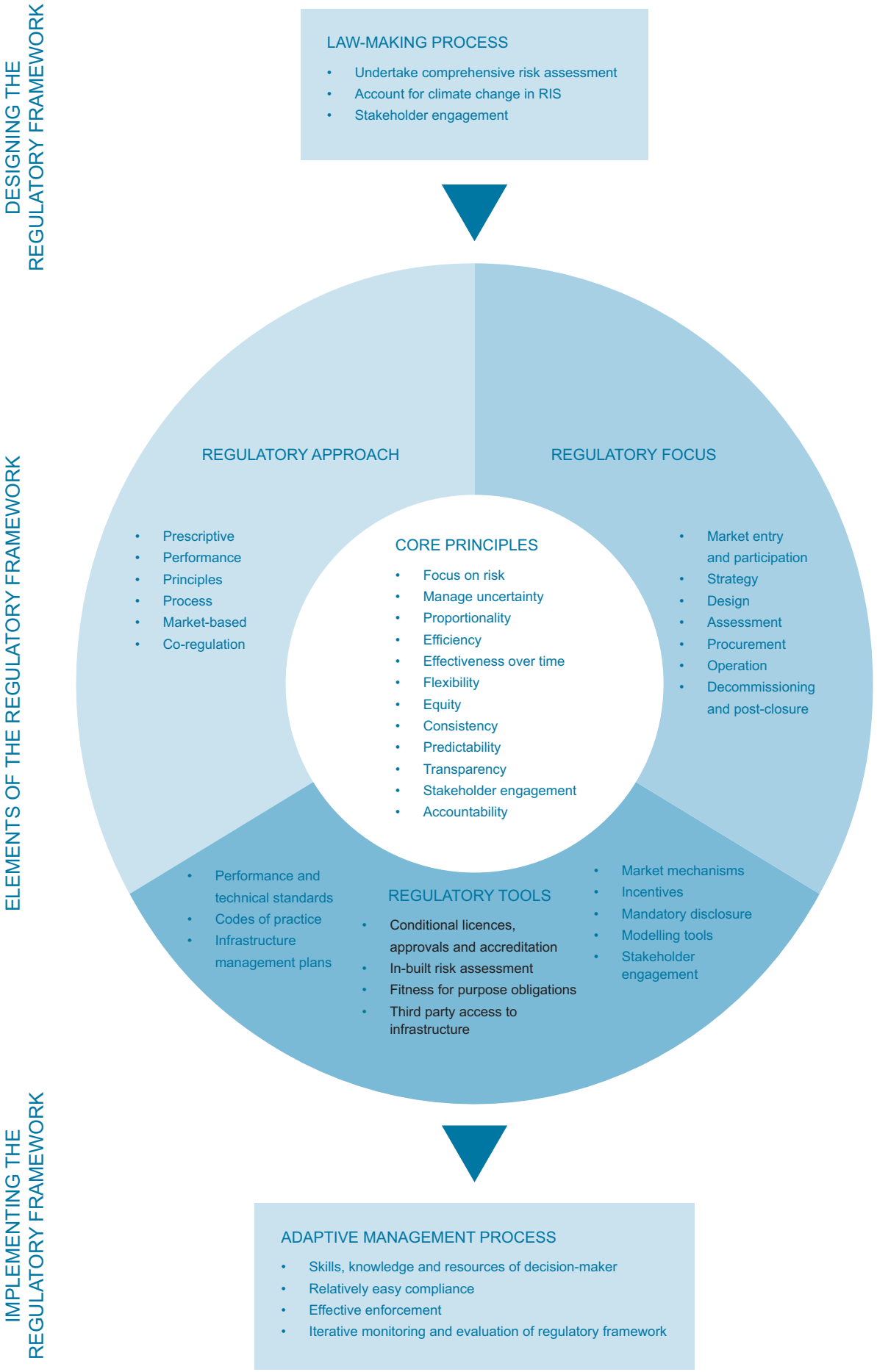
5.72 In a similar way, adaptation measures may promote ecologically sustainable development (**ESD**), which is a fundamental principle underlying planning regimes. Planning can be used to reduce the urban heat island effect by, for example, encouraging the planting of vegetation, which assists with adaptation. Such measures also help to create a healthier living environment, which promotes ESD.

5.73 Ideally, governments should pursue regulatory responses that concurrently address adaptation, mitigation and ESD. This will expand the benefits associated with a particular regulatory response and is likely to facilitate its implementation.

E. Summary

In summary, a framework for adaptation will be focused around certain core principles, which are aimed at addressing the complex challenges presented by climate change. These core principles must be complemented by a careful consideration of elements of the broader framework within which the principles for adaptive regulation are applied to maximise the effectiveness of regulatory responses to climate change. They must also be combined with a law-making process and implementation mechanisms that effectively account for the impact of climate change. This framework is summarised in Figure 4 on the next page.

Figure 4. Summary of adaptive management framework



CHAPTER 6: MAIN FINDINGS AND AREAS FOR FURTHER WORK

6.1 Climate change exposes our infrastructure and associated services to significant risks. Resilience to the effects of climate change will depend, at least in part, upon the applicable regulatory framework and the extent to which that framework facilitates adaptation to climate change by reducing or eliminating the risk of harm or damage or hinders adaptation to climate change by ignoring the impact of climate change or failing to adequately accommodate its effects.

6.2 There are a broad variety of regulatory frameworks affecting infrastructure and associated services. The objectives underlying these frameworks, the regulatory approaches, focus and available tools are, for the most part, distinct. Consequently, there is also some variation in the extent to which these frameworks are capable of facilitating or hindering adaptation to climate change.

6.3 All regulatory frameworks considered in this Report include elements that could facilitate adaptation to climate change, although all regulatory frameworks considered also include elements that may hinder adaptation to climate change.

A. Elements of regulatory frameworks that could hinder adaption to climate change

6.4 In summary, elements of the regulatory frameworks that could hinder adaptation to climate change include:

- Lack of explicit or implicit recognition of the need to adapt to climate change
- Regulatory framework only applies to new infrastructure and does not apply to existing infrastructure
- Lack of harmonisation and fragmentation of approach within jurisdictions and between jurisdictions
- Inadequate, inconsistent or outdated information regarding climate change risks
- Inability to review regulations or standards with sufficient frequency
- Implementation is ineffective
- Compliance is too difficult or too costly
- Enforcement mechanisms are weak or too costly to pursue

6.5 In relation to elements of particular sectoral regulatory frameworks that could hinder adaptation, these include:

- *Building*: For the most part, building standards do not account for risks posed by climate change, particularly future risks.
- *Planning*: Existing use rights prevent regulation to protect against climate change impacts where existing uses can be established. In some jurisdictions, compensation may be payable for back zoning if this has an impact on existing use rights.
- *Environmental impact assessment*: Regimes focus predominantly on the impact of a project or activities on the environment rather than the impact of the environment on the project. These regimes also assume that the environmental context is static and that human impacts are reversible.
- *Economic regulation of utilities (electricity and water)*: Insufficient account is taken of climate change in regulatory frameworks and may provide a maladaptive incentive for large, additional capital expenditure where operational expenditure and demand management may be more efficient and adaptive.
- *Telecommunications*: Telecommunications infrastructure may avoid adaptation measures as a result of exemption from state/territory planning and environmental assessment laws.
- *Major infrastructure procurement*: The Public Sector Comparator and discount rates under the National PPP Guidelines are not sufficiently focused on the full life of the infrastructure asset.

B. Elements of regulatory frameworks that could facilitate adaptation to climate change

6.6 The regulatory frameworks also contained a range of tools that could be particularly useful in facilitating adaptation to climate change, including:

- Performance-based standards, which provide flexibility to respond to the uncertain effects of climate change.
- Technical standards or guidelines for new and existing infrastructure to ensure that such infrastructure is designed, constructed and operated in a way that is resilient to climate change risks.
- Codes of practice, which could be used to ensure that climate change risks are accounted for as part of ongoing management and operation of existing infrastructure.
- Infrastructure management plans and associated service delivery plans that are periodically reviewed to ensure that climate change effects are addressed as they evolve over time.
- Licences, approvals and accreditation, which can be made conditional on adequate assessment and management of climate change risks.
- In-built risk assessment processes, which provide an opportunity for climate change risks to be included in existing regimes for risk assessment.
- Computer-based modelling tools to assist targets of regulation with assessment of climate change risks and, therefore, compliance with adaptive management regulation.
- Fitness for purpose obligations that could be used to ensure that infrastructure has been designed to cope with current and future climate change risks.
- Third party access to infrastructure, which provides an opportunity to diversify infrastructure that may, in turn, increase resilience.

- Market mechanisms, which can flexibly and dynamically account for climate change risks in determining the most efficient allocation of resources affected by climate change with limited government intervention.
- Incentives to drive changes in practices to better account for climate change risks.
- Mandatory disclosure about infrastructure performance and climate change risks to motivate entities to assess risks and provide information to consumers/users about those risks.
- Stakeholder engagement in the design and implementation of regulation to foster support for climate change action.

6.7 Some tools may be more suited to particular sectors and regulatory frameworks than others. Furthermore, in some cases, a mix of tools may be necessary to respond to the spectrum of climate change risks that may arise in relation to a particular type of infrastructure or associated service.

6.8 The availability of funding for the introduction, application and enforcement of these tools may affect their relative attractiveness in a particular sector. In addition, the success of these tools in achieving adaptation to climate change may ultimately depend upon the existence of effective compliance and enforcement mechanisms.

C. The appropriate level of government

6.9 The various levels of government have a role to play in facilitating adaptation to climate change through law-making, policy development and implementation of adaptation regulation in relation to infrastructure and associated services.

6.10 The review and amendment of regulatory frameworks to ensure that infrastructure and associated services are capable of responding to the impact of climate change entails a significant reform agenda, which will require leadership at a national level. The federal government would be best placed to provide this leadership and, more specifically, assume responsibility for the following types of regulatory responses to climate change:

- Designing policy frameworks for the development of legislative responses to climate change by the states and territories
- Gathering and disseminating national information on climate change risks
- Establishing and/or driving the development of benchmarks or standards
- Providing funding to support climate change initiatives
- Regulating sectors over which it has primary legislative competence

6.11 Based on the fact that most of the pre-existing regulatory frameworks affecting infrastructure and associated services have already been developed by the state and territory governments, this level of government would be best placed to modify existing regimes. States and Territories might also play an important role in tailoring state/territory policy frameworks that could be used to facilitate adaptation to climate change to ensure that they are consistent with any national framework that might be adopted.

6.12 Local governments are closer to citizens than the other levels of government. Therefore, councils would be best placed to implement national and state/territory policies aimed at addressing the impact of climate change at a local level.

6.13 Consideration could be given to establishing a national body to assist the federal, state, territory and local governments with the practical and effective implementation of climate adaptation polices and regulation. Such a body could have members appointed by state, territory and local governments as well as the federal government.

D. Principles for adaptive regulation

6.14 Government guidelines, in particular the COAG Principles of Best Practice Regulation, should be applied to regulatory responses to address the impact of climate change.

6.15 In addition, certain specific, core principles are needed to underpin the regulatory responses to climate change. These principles need to account for the diversity of infrastructure and associated regulatory frameworks, the spectrum of climate change impacts that might materialise now and in the future, and the uncertainty surrounding the nature, location, timing and scale of climate change impacts. These principles include:

- *Risk*: Regulatory responses to climate change need to ensure that current and possible future climate change risks have been identified and assessed and that measures are in place to respond to those risks.
- *Proportionality*: A regulatory response should be commensurate with the relevant climate change risks.
- *Effectiveness*: A regulatory response must be effective in facilitating adaptation to climate change through the way it is designed, applied and implemented.
- *Efficiency*: A regulatory response should represent the most effective response at the lowest overall cost.
- *Equity*: The direct and indirect impact of regulatory responses should be equitable; no one sector, region or social group should be unduly burdened.
- *Flexibility*: A flexible regulatory framework is needed to ensure that the regime is responsive to the spectrum of climate change impacts that might materialise.
- *Consistency and predictability*: Regulatory responses to climate change should be inherently consistent and predictable to provide a stable regulatory environment and foster business confidence. Consistency is also needed between such regulatory responses and the pre-existing regulatory framework and other inter-related regulatory frameworks.
- *Transparency*: Transparency about the underlying purpose of a regulatory response to climate change, the way in which it will be applied and enforced and all underlying documents and information are critical to engender support for the regulatory response and to foster a willingness to co-operate and participate constructively in adaptation.

6.16 In designing any regulatory response to the impact of climate change, particular attention needs to be given to potentially catastrophic or irreversible risks and critical tipping points. At a minimum, standard cost-benefit analysis and discount rates, which may not appropriately account for future impacts, will need to be revised. In addition, an adaptive regulatory approach should be adopted, which ensures that regulation and its implementation are regularly monitored and evaluated and adjustments are made to respond to climate change impacts as they evolve.

E. Regulatory reform, further work and national leadership

6.17 The challenge that climate change presents for Australia's infrastructure and associated services cannot be overstated. While current regulatory frameworks have aspects that may facilitate adaptation to climate change, as previously noted, there are also aspects that may hinder adaptation. Indeed, there is a risk that existing regulatory frameworks might 'lock in' maladaptive action, which could compromise the short, medium and long-term resilience of our infrastructure. A new approach is needed to ensure that effective responses to climate change are embedded in relevant regulatory frameworks to ensure that our infrastructure and associated services are resilient to climate change as we move into the future.

6.18 Regulatory responses to climate change will need to address the particular risks that arise in relation to the various types of infrastructure and associated services. In this regard, it is critical that risks are neither over-estimated nor under-estimated to ensure that the regulatory response matches the true level of risk, rather than being excessive or inadequate. More intrusive regulatory intervention is justified when the overall risk is greatest whereas less interventionist tools are preferable where the overall risk is relatively low.

6.19 As yet, a comprehensive identification and assessment of climate change risks has not been undertaken for the spectrum of Australia's infrastructure. This is understandable given the significant costs and resources required to undertake a comprehensive and useful assessment of the risks. Nevertheless, this assessment is an essential and indispensable precursor to the design of regulatory responses. Ideally, the assessment would be undertaken with the involvement of regulators so that the particularities associated with specific regulatory frameworks can be addressed during the risk assessment phase. Furthermore, the body that is best placed and resourced to undertake the risk assessment should be made responsible to do so, which, in some cases, will be private businesses operating in a particular sector.

6.20 Another area of further work relates to addressing the risks posed by climate change to existing infrastructure. Existing infrastructure is likely to be significantly more vulnerable to the impact of climate change than new infrastructure. Yet, most existing regulatory regimes apply to new infrastructure. In the future, serious consideration will need to be given to ways in which existing infrastructure can be made more resilient to climate change and how 'retreat' strategies may be supported by regulation. This will require consideration of property rights, constitutional provisions, insurance, risk sharing, government funding and new regulatory instruments.

6.21 Dealing with the uncertainty regarding climate change effects – particularly, the relatively unlikely yet catastrophic climate change events – through regulation is another area for further work. Consideration will need to be given to whether regulatory frameworks can be amended to mandate identification and assessment of these events (as well as the more certain and less catastrophic events) in relation to the design, construction, management, operation and use of infrastructure. It will also be necessary to determine whether, from a legal and practical perspective, regulation can be used to require infrastructure to be capable of responding to these events, even though the likelihood of occurrence is relatively low.

6.22 Notably, the review and amendments of regulatory frameworks to ensure that infrastructure and associated services are capable of responding to the impact of climate change entails a significant reform agenda, which will require leadership at a national level to provide much-needed guidance and up-to-date information, promote best practice and ensure consistency and equity across the country. The federal government is ideally positioned to provide such leadership given its ability to capitalise on economies of scale and its considerable fiscal powers.

APPENDIX A

A.1 This Appendix details the key climate change risks and projections for climate variables that are likely to have an impact upon infrastructure and associated services in Australia.

A.2 The IPCC projected a range of temperature increases based on six 'SRES scenarios'[196] of greenhouse gas emission trajectories until 2100, each reflecting a different level of emissions. The IPCC gave a best estimate and a 'likely range' of temperature change for each of the scenarios as set out in the Table 14 below.[197] These range from a minimum of 1.1°C for the B1 scenario (the lowest emission scenario) to a maximum of 6.4°C for the A1F1 scenario (the highest emission scenario). The IPCC identified the likelihood of the true value of the temperature change falling within these ranges as between 66% and 90%.

A.3 Table 14 lists model-based sea-level rises (without ice-flow impacts) for the different emissions scenarios, but without assigning the relative likelihood because of the uncertainty regarding feedback effects and the upper bound of sea level rise.

Table 14. Projected global average surface warming and sea level rise at the end of the 21st century[198]

Case	Temperature Change (°C at 2090–2099 relative to 1980–1999)[a]		Sea Level Rise (m at 2090–2099 relative to 1980–1999)
	Best estimate	*Likely* range	Model-based range excluding future rapid dynamical changes in ice flow
Constant Year 2000 concentrations	0.6	0.3–0.9	NA
B1 scenario	1.8	1.1–2.9	0.18–0.38
A1T scenario	2.4	1.4–3.8	0.20–0.45
B2 scenario	2.4	1.4–3.8	0.20–0.43
A1B scenario	2.8	1.7–4.4	0.21–0.48
A2 scenario	3.4	2.0–5.4	0.23–0.51
A1FI scenario	4.0	2.4–6.4	0.26–0.59

196 SRES relates to scenarios identified in the IPCC Special Report on Emission Scenarios (2000). They are B1, A1T, B2, A1B, A2 and A1FI and represent scenarios resulting in around 600, 700, 800, 850, 1250 and 1,550 ppm CO2 –e respectively.
197 IPCC Working Group I, above fn 1 Table SPM.3, p 13.
198 Ibid.

A.4 A technical report prepared by the CSIRO and the Bureau of Meteorology in 2007 provides additional insights into likely future climate change effects in Australia.[199] The Technical Report is partly based on the IPCC 4th Assessment conclusions and partly on climate modelling that simulates the Australian climate. The Technical Report contains projections for 23 climate variables (including temperature, precipitation, sea level rise, extreme wind events) and 6 ocean variables (such as sea surface temperature). This Report contains CSIRO's projections for 2030, 2050 and 2070. For some climate change variables, probability distributions have been assigned by the CSIRO, while others are more uncertain.

Average temperature

A.4.1 Australian average temperatures have risen by 0.9°C since 1950, with significant regional variations. By 2030, temperature is projected to rise by 1.0°C relative to 1990, with warming of between 0.7°C and 0.9°C in coastal areas and 1.0°C to 1.2°C inland. By 2050, warming is more dependent on emission trajectories. In a low emissions scenario, temperatures will rise by between 0.8 and 1.8°C and by between 1.5 and 2.8°C in a high emissions scenario. By 2070, the warming ranges from 2.2 to 5.0 °C for the high emissions scenario. There is a significant regional variation with less warming in the south and north-east and more inland.[200]

Extreme daily temperatures

A.4.2 Small changes in average temperatures can be associated with large increases in the frequency of extreme heat events. This is important because heatwaves can have a significant impact on infrastructure and biodiversity, as well as human health. Substantial increases in the frequency of very hot days over 35°C are projected for most parts of the country. For example, in Melbourne, the CSIRO projects a 20–40% increase in very hot days for 2030. Under a high emissions scenario, an increase of 70–190% is projected for 2070.[201] The CSIRO has also projected a significant increase in hot spells (three consecutive days over 35°C) in Victoria.[202]

Precipitation

A.4.3 Global warming is leading to an increasing amount of water in the troposphere and more evaporation. However, there are large regional variations with more rainfall in northern Europe, north and central Asia and less in the Mediterranean, southern Africa and parts of Southern Asia.[203] In Australia, there have been increases in rainfall since 1950 in north-western and central Australia, but decreases in the south-east and south-west.[204] Rainfall has decreased by around 15% in the south-west and by around 11% in the Murray Darling Basin since 1950.[205]

A.4.4 There is significant uncertainty regarding precipitation projections based on climate modelling. The average of models for 2030 is for 10% less to 5% more rain for northern areas and 10% less rain to little change in southern areas. By 2050, under a low emission scenario, the best estimate is for a 5% decrease in rainfall in the south and little change in the north. Under a high emissions scenario, the best estimate is for a rainfall decrease in the south of 7.5%. For the Murray-Darling Basin, model projections show a 5% to 15% reduction in rainfall (mostly in winter and spring) by 2060.[206]

199 CSIRO and the Bureau of Meteorology, *Climate Change in Australia Technical Report*, CSIRO, Canberra, 2007.
200 CSIRO and the Bureau of Meteorology, above fn 9, pp. 53–58.
201 CSIRO and the Bureau of Meteorology, above fn 9, p. 61.
202 CSIRO, Maunsell Australia Pty Ltd, Phillips Fox, Infrastructure and Climate Change Risk Assessment for Victoria, Report prepared for the Victorian Government (CSIRO, 2006) p. 9.
203 W. Steffen, above fn 4, p. 14.
204 CSIRO and the Bureau of Meteorology, above fn 9, p. 6.
205 W. Steffen, above fn 4, p 15, 16
206 W. Steffen, above fn 4, p. 14. Christensen et al, "Regional Climate Projections" in Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (2007) p. 20.

A.4.5 Considerable research is being undertaken regarding the potential links between climate change and the decline in rainfall in southern Australia. The evidence is now strong for a climate change link to the drying in south-west Australia and there is some evidence for a climate change influence on the decline of rainfall in south-east Australia. The South East Australia Climate Initiative led by the CSIRO has concluded that the current rainfall decline in south-east Australia is, at least in part, attributed to climate change and it is likely that the trend towards drier conditions will continue.[207]

Rainfall intensity and extreme precipitation

A.4.6 As well as changes in average precipitation, its frequency and intensity may change. CSIRO modelling projects strong increases in precipitation intensity this century with longer dry spells and more intense rainfall events.[208] These events will occur throughout the year in the north, and in the summer and autumn in the south.

Solar radiation, humidity and potential evaporation

A.4.7 The CSIRO projects increases in solar radiation in Victoria of 1 – 2% in 2050 and over Victoria and south-west Australia in 2070. These changes are caused by changes in cloud cover. Little change is projected for northern Australia.[209]

A.4.8 Small decreases are projected in relative humidity for most of Australia. The projected changes are around -2% to +0.5% for 2030 and higher in 2050 and 2070.[210]

A.4.9 Annual evapotranspiration from soil, vegetation and water surfaces is projected to increase by 2% by 2030. By 2070, high emission scenarios project increased evapotranspiration of around 6 % in the south and west and 10% in the north and east.[211]

Drought

A.4.10 Drought is projected to increase over most of Australia, but particularly over south-west Australia. Agricultural drought that constrains agricultural production and reduces inflow to dams has particularly significant economic and social effects. The frequency and intensity of agricultural drought is influenced not only by decreasing rainfall, but also by increasing temperatures and evaporation. Climate simulations show up to 20% more drought months over most of Australia by 2030, with up to 40% more droughts by 2070 in eastern Australia and up to 80% more in south-west Australia.[212]

Wind

A.4.11 There is variation between different climate models regarding the impact of climate change on wind speed. However, there is a tendency for increased average wind speed in most coastal areas in 2030 of 2% – 5% except around latitude 30° S in winter and 40° S in summer.[213] Depending upon the level of emissions, higher wind speeds are projected for 2070 of up to 15% in some regions. Changes to extreme wind speeds are likely to be similar to changes in average speed in winter, but not in summer.[214]

207 CSIRO, *Climate variability and change in south-eastern Australia*: *A synthesis of findings from Phase 1 of the South Eastern Australian Climate Initiative* (SEACI, 2010), p. 1–2.
208 CSIRO and the Bureau of Meteorology, above fn 9, p. 73.
209 CSIRO and the Bureau of Meteorology, above fn 9, p. 76
210 CSIRO and the Bureau of Meteorology, above fn 9, p. 78.
211 CSIRO and the Bureau of Meteorology, above fn 9, p. 80.
212 CSIRO and the Bureau of Meteorology, above fn 9, p. 83 citing F. Mpelasoka, K. Hennessy, R. Jones, B. Bates, Comparison of suitable drought indices for climate change impacts assessment over Australia towards resource management (Royal Meteorological Society, 2007).
213 CSIRO and the Bureau of Meteorology, above fn 9, pp. 84–89.
214 CSIRO and the Bureau of Meteorology, above fn 9, p. 88.

Fire weather

A.4.12 The number of days when the Forest Fire Danger Index is very high or extreme is likely to rise substantially.[215] The combined frequencies of these days is likely to increase 4 – 25% by 2020 and 15 – 70 % by 2050. For example, Canberra is likely to have an annual average of 26 to 28.6 very high or extreme fire danger days by 2020 and 27.9 to 38.3 such days by 2050, compared to the current average of 23.1 days.[216]

Tropical cyclones

A.4.13 Studies indicate a likely increase in intensity of tropical cyclones, but a possible decrease in their total number.[217] There is still considerable uncertainty about the impact of global warming on tropical cyclones. However, some modelling regarding Queensland tropical cyclones indicates a marked increase of 15% in the number of the most severe cyclones and the extension of cyclone tracks further south.[218]

Sea level rise

A.4.14 Global warming causes sea level rise because of the thermal expansion of the oceans, melting of glaciers and ice caps and losses from the ice-sheets of Greenland and Antarctica.[219] The IPCC 2007 Report provided model-based projections for sea level rise of 0.18m to 0.59m by 2100 with possible additional contribution from ice-sheets of 0.1m to 0.2m. However, the IPCC stated that, because of uncertainties in feedbacks and ice-sheet flow, the upper bounds may be exceeded.[220]

A.4.15 Actual sea level rise is currently tracking at or near the upper limit of IPCC projections.[221] Further, ice-sheet contributions from Greenland and Antarctica may substantially increase the upper limit of sea level rise. Arctic glaciers, ice caps and the Greenland ice-sheet have all been declining faster since 2000 than they did in the previous decade.[222] Projections presented to the Climate Change Science Congress in Copenhagen in 2009 indicated that sea level rise may well exceed 1 meter by 2100 with an upper limit of 2 metres.[223] A recent report projects global sea-level rise of 0.9 – 1.6 metres by 2100 with Arctic glaciers, ice caps and the Greenland Ice Sheet making a significant contribution.[224]

A.4.16 There is regional variability in sea level rise. Global climate models indicate that sea level rise on the east coast of Australia may be greater than the global mean sea-level rise.[225] Sea level rise will be exacerbated by storm surges that will enable inundation to penetrate further inland.[226] A modest increase in sea level rise is likely to cause a large increase in the frequency of extreme sea level events associated with high tides and storm surges.[227]

Marine changes

A.4.17 By 2030, the CSIRO projects that sea surface temperatures will rise between 0.6 – 0.9°C in the southern Tasman Sea and north-west shelf of Western Australia and 0.3 – 0.6°C elsewhere. Temperatures will continue to rise beyond these levels depending on the emissions scenario. Increases in ocean acidity are also expected with the largest increases in the high to mid-latitudes.[228]

215 CSIRO and the Bureau of Meteorology, above fn 9, pp. 90–91.
216 CSIRO and the Bureau of Meteorology, above fn 9, p. 91.
217 CSIRO and the Bureau of Meteorology, above fn 9, p 102.
218 L. Leslie et al, "Variability of tropical cyclones over the southwest Pacific Ocean using a high resolution climate model", Journal of Meteorology and Atmospheric Physics, Vol. 97(1–4), 2007, pp 171–180.
219 IPCC Working Group 1, above fn 1, p. 5.
220 IPCC, above fn 2, p. 45.
221 W. Steffen, above fn 4, p. 8.
222 Arctic Monitoring and Assessment Program, Snow, Water, Ice, Permafrost in the Arctic (2011), Executive Summary, p. 6.
223 I. Alison et al, The Copenhagen Diagnosis, Updating the World on the Latest Climate Science (University of New South Wales, 2009) p. 7.
224 Arctic Monitoring and Assessment Program, Snow, Water, Ice, Permafrost in the Arctic (2011), Executive Summary, p. 11.
225 CSIRO and the Bureau of Meteorology, above fn 9, p. 92.
226 CSIRO and the Bureau of Meteorology, above fn 9, p. 94.
227 W. Steffen, above fn 4, p. 12.
228 CSIRO and the Bureau of Meteorology, above fn 9, pp. 98 and 100.

TABLE OF REGULATION

This Table sets out the main regulatory instruments considered for this Report.

Sector	Regulatory Instrument
BUILDING	**CTH:** *Building Code of Australia*
	SA: *Development Act 1993*
	VIC: *Building Act 1993*
	WA: *Building Act 2011* (begins Oct 2011 replaces *Local Government (Miscellaneous Provisions) Act* 1960).
	NSW: *Environmental Planning and Assessment Act 1979*
	QLD: *Building Act 1975*
	TAS: *Building Act 2000*
	NT: *Building Act 1993*
	ACT: *Building Act 2004*
PLANNING	**SA:** *Development Act 1993*
	VIC: *Planning and Environment Act 1987*; *Coastal Management Act 1995*
	WA: *Planning and Development Act 2005*
	NSW: *Environmental Planning and Assessment Act 1979*
	QLD: *Sustainable Planning Act 2009*
	TAS: *Land Use Planning and Approvals Act 1993*
	NT: *Planning Act 1999*
	ACT: *Planning and Development Act 2007*
ENVIRONMENTAL IMPACT ASSESSMENT	**CTH:** *Environment Protection and Biodiversity Conservation Act 1999*
	SA: *Environment Protection Act 1993*
	VIC: *Environment Protection Act 1970; Environment Effects Act 1978*
	WA: *Environmental Protection Act 1986*
	NSW: *Environmental Planning and Assessment Act* 1979
	QLD: *Environmental Protection Act 1994*
	TAS: *Environmental Management and Pollution Control Act 1994*
	NT: *Environment Assessment Act 1994*
	ACT: *Environment Protection Act 1997*

Sector	Regulatory Instrument
ELECTRICITY	**CTH:** *National Electricity Rules*
	SA: *National Electricity (South Australia) Act 1996*
TELECOMMUNICATIONS	**CTH:** *Telecommunications Act* 1997, *Competition and Consumer Act 2010*
WATER	**CTH:** *Water Act 2007*
	SA: *Water Conservation Act 1936; Water Resources Act 1997*
	VIC: *Water Efficiency Labelling and Standards Act 2005; Water Industry Act 1994; Water Act 1989*
	WA: *Water Resources Legislation Amendment Act 2007*
	NSW: *Water Industry Competition Act 2006; Water Management Act 2000*
	QLD: *Water Act 2000; Water Supply (Safety and Reliability) Act 2008*
	TAS: *Water Management Act 1999*
	NT: *Water Act 1992*
	ACT: *Water Resources Act 2007*
WASTE	**SA:** *Environment Protection Act 1993; Zero Waste SA Act 2004*
	VIC: *Environment Protection Act 1970*
	WA: *Environmental Protection Act 1986; Environmental Protection (Landfill Levy) Act 1998*
	NSW: *Protection of the Environment Operations Act 1997; Waste Avoidance and Resource Recovery Act 2001*
	QLD: *Environmental Protection Act 1994*
	TAS: *Environmental Management and Pollution Control Act 1994; Litter Act 1973*
	NT: *Waste Management and Pollution Control Act 1998*
	ACT: *Environment Protection Act 1997; Waste Minimisation Act 2001*

Sector	Regulatory Instrument
TRANSPORT	Road
	VIC: *Road Management Act 2004; Road Safety Act 1986*
	WA: *Main Roads Act 1930*
	NSW: *Transport Administration Act 1988*
	QLD: *Transport Planning and Coordination Act 1994*
	TAS: *Transport Act 1981*
	ACT: *Road Transport (Safety and Traffic Management) Act* 1999
	Rail
	SA: *Rail Safety Act 2007*; *Railways (Operations and Access) Act 1997*
	VIC: *Rail Management Act 1996; Rail Safety Act 2006; Rail Corporations Act 1996*
	WA: *Rail Safety Act 2010*
	NSW: *Rail Safety Act 2008; Transport Administration Act 1988*
	QLD: *Transport (Rail Safety) Act 2010; Transport Infrastructure Act 1994*
	TAS: *Rail Infrastructure Act 2007; Rail Safety Act 2009*
	NT: *Rail Safety Act 2010*
	Ports
	VIC: *Port Management Act 1995*
	WA: *Port Authorities Act 1999*
	NSW: *Ports and Maritime Administration Act 1995*
	QLD: *Transport Infrastructure Act 1994*
	Air
	CTH: *Airports Act 1996*
MAJOR INFRASTRUCTURE PROCUREMENT	**Cth:** *Infrastructure Australia Act 2008*; *National Public Private Partnership Policy Framework* (Infrastructure Australia, 2008); *National Public Private Partnership Guidelines* (Infrastructure Australia, 2008); *Policy for Alliance Contracting*; *Commonwealth Procurement Guidelines*
	VIC: *Policy for Alliance Contracting* (July 2010); *The Practitioners' Guide for Alliance Contracting* (Department of Treasury and Finance, October 2010)

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