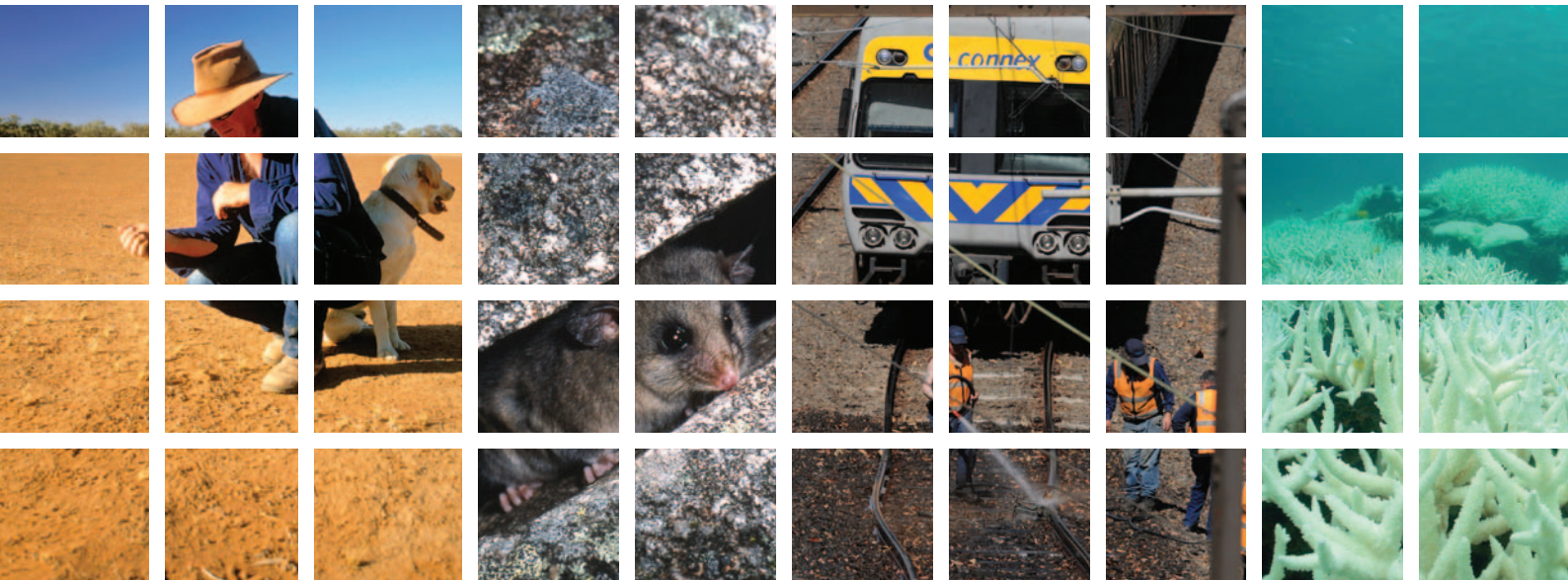


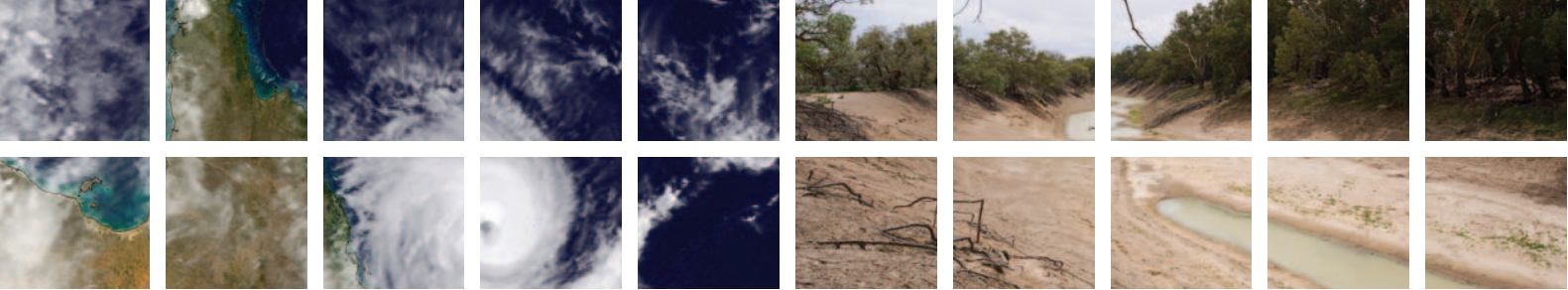


Australian Government

Adapting to Climate Change in Australia

An Australian Government Position Paper





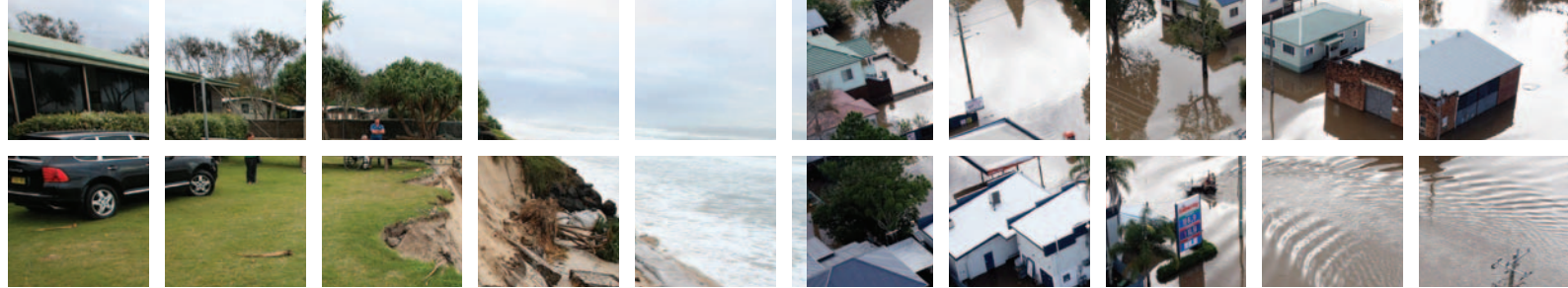
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Adapting to Climate Change in Australia – A Position Paper

ABOUT THIS PAPER

This paper sets out the Australian Government's vision for adapting to the impacts of climate change and proposes practical steps to realise this vision.

Adapting to the impacts of climate change will be a substantial ongoing challenge for all Australians well into the future. Meeting this challenge will require contributions from governments at all levels, businesses, communities and individuals. Individuals and businesses will adapt to developments as they unfold. However, governments have an important role to play in creating the right framework and in providing appropriate information to allow the private sector to make well-informed decisions. To this end, the Australian Government proposes to work through the Council of Australian Governments (COAG) to develop a national adaptation agenda. This agenda will clarify roles and responsibilities for adapting to the impacts of climate change and identify priorities for collaborative action between governments to position Australia to manage the unavoidable impacts of climate change.

Part One: Adapting to Climate Change Impacts – The Commonwealth's Vision

Key message: some climate change is unavoidable

Already Australia faces a stark fact – the opportunity to avoid climate change altogether has passed. Efforts to achieve significant reductions in global greenhouse gas emissions are aimed at minimising the extent of climate change and, in particular, trying to avoid the emergence of dangerous climate change. But this means that our climate will continue to change even if the world achieves a significant reduction in greenhouse gas emissions.

Adapting to the impacts of unavoidable climate change is critical to any effective climate change response. Along with efforts to reduce Australia's emissions and helping to shape a global solution, adaptation is one of the three pillars on which Australia's comprehensive climate change strategy is built.

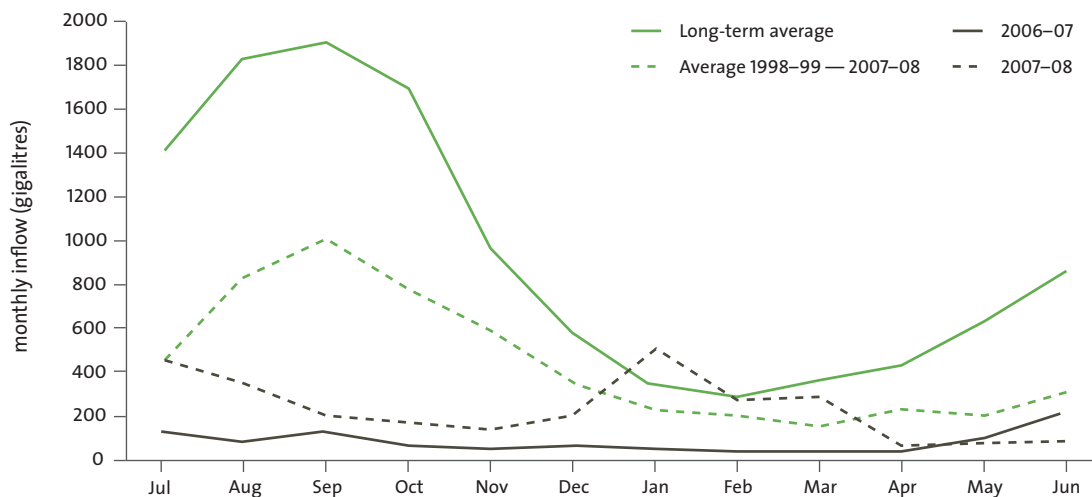


Human activities have already changed our climate

We are already experiencing the early effects of climate change.

Rainfall in south-west Western Australia has dropped by about 15 per cent.¹ Stream flow into Perth's dams between 1976 and 2000 almost halved as a result.² Research indicates that climate change has contributed to this.^{3,4,5} There is also evidence that reduced rainfall in south-eastern Australia – Victoria and the southern part of South Australia – cannot be explained by natural variations alone.^{6,7} Temperatures have risen across Australia and a number of consequences are already evident. We experience more hot days and fewer cold nights. Droughts are more severe because higher temperatures increase evaporation. The incidence of extreme fire weather in south-eastern Australia has increased.⁸ Warmer temperatures have led to a decline in spring snow cover in alpine regions of Australia,⁹ and there have been a number of serious bleaching events on the Great Barrier Reef over the last decade.¹⁰

Monthly inflows into the Murray-Darling system



Observations for most recent years and decade compared to the long term average. (Source: Murray-Darling Basin Authority, Annual Report 2007-08, www.mdbc.gov.au/subs/annual_reports/AR_2007-08/objective2_s2_1.htm)

- Bates et al (2008) cited in Steffen, W. (2009) *Climate change 2009: Faster change & more serious risks*. Department of Climate Change, Canberra, Australia.
- Water Corporation of Western Australia data supplied for Garnaut, R. (2008) *The Garnaut Climate Change Review*, Cambridge University Press.
- Cai, W. and Cowan, T. (2006) SAM and regional rainfall in IPCC AR4 models: Can anthropogenic forcing account for southwest Western Australian winter rainfall reduction? *Geophysical Research Letters* 33, L24708, doi:10.1029/2006GL028037
- Ryan, B. and Hope, P. (2006) *Indian Ocean Climate Initiative Stage 2: Report of Phase 2 Activity: January 2005-June 2006*. IOCI, Perth, Australia.
- Van Ommen, T. And Morgan, V. (2010) Snowfall increase in coastal East Antarctica linked with southwest Western Australian drought, *Nature Geoscience*, doi:10.1038/NGEO761
- Cai, W. and Cowan, T. (2008) Dynamics of late autumn rainfall reduction over south-eastern Australia. *Geophysical Research Letters* 35, L09708, doi:10.1029/2008GL033727.
- Cai, W. and Cowan, T. (2008) Evidence of impacts from rising temperature on inflows to the Murray-Darling Basin. *Geophysical Research Letters* 35, L07701, doi:10.1029/2008GL033390.
- Lucas, C., Hennessy, K., Mills, G. and Bathols, J. (2007) *Bushfire Weather in Southeast Australia: Recent Trends and Projected Climate Change Impacts*. Bushfire Cooperative Research Centre, Melbourne, Australia.
- Hennessy, K., Whetton, P., Smith, I., Bathols, J., Hutchinson, M. and Sharples, J. (2003) *The Impacts of Climate Change on Snow Conditions in Mainland Australia*. CSIRO Atmospheric Research, Aspendale, Australia.
- Hoegh-Guldberg, O. and Hoegh-Guldberg, H. (2008) *The Impact of Climate Change and Ocean Acidification on the Great Barrier Reef and Its Tourist Industry*. Report commissioned by the Garnaut Climate Change Review.



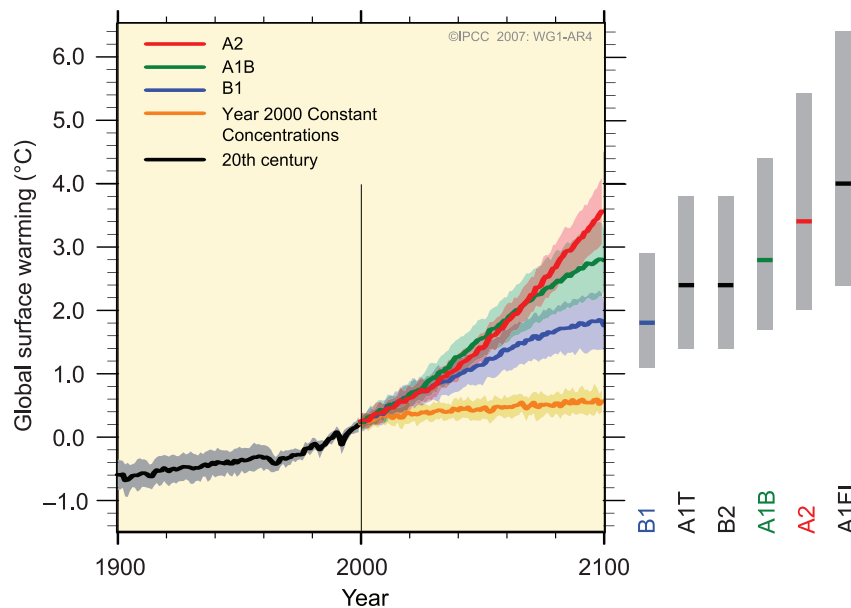
Further change is inevitable

Even when an ambitious international agreement is achieved to reduce dangerous greenhouse gases, some change is already 'locked-in'. This is because greenhouse gases stay in the atmosphere long after they are first emitted. What's more, the massive amount of heat being absorbed by the world's oceans as greenhouse gas concentrations rise means climate change cannot be reversed for many centuries.¹¹ The critical issue is to stop the situation getting worse and to begin to adapt to the changes that are already underway.

Because of this lag between the build up of greenhouse gas emissions and increases in global temperatures most of the change in climate over the next twenty to thirty years is already locked in. For example, the Intergovernmental Panel on Climate Change (IPCC) best estimates of how much global average temperatures will increase by 2030 vary by only 0.12°C for the lowest and highest modelled emissions scenarios.

Over a longer period reducing global greenhouse gas emissions will have a much larger effect on climate outcomes. By 2100 the IPCC best estimates of how much global average temperatures will increase vary by 2.2°C for the lowest and highest modelled emissions scenarios. CSIRO and Bureau of Meteorology projections of Australian temperatures in 2070 show a difference in best estimates of 1.6°C between highest and lowest modelled scenarios.¹²

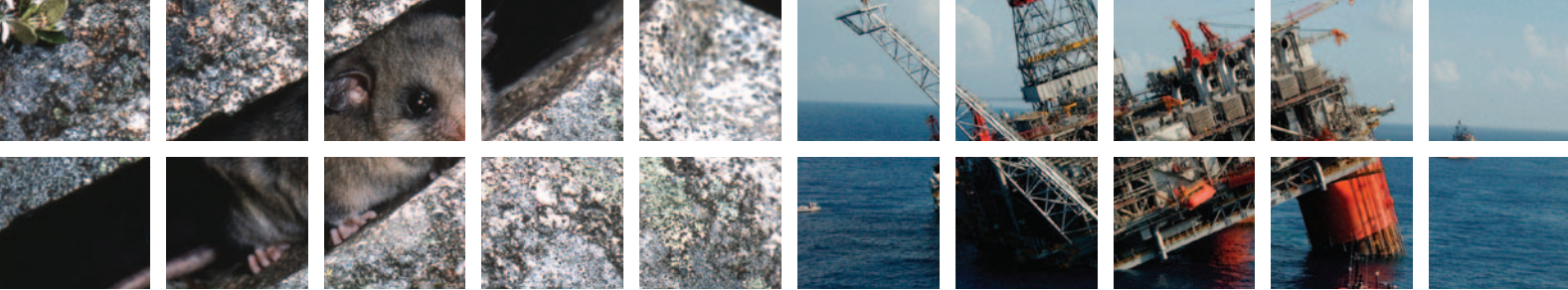
Multi-model averages and assessed ranges for surface warming



Solid lines are multi-model global averages of surface warming (relative to 1980-1999) for the scenarios A2, A1B and B1, shown as continuations of the 20th century simulations. Shading denotes the ± 1 standard deviation range of individual model annual averages. The orange line is for the experiment where concentrations were held constant at year 2000 values. The grey bars at right indicate the best estimate (solid line within each bar) and the likely range assessed for the six SRES marker scenarios. The assessment of the best estimate and likely ranges in the grey bars include the AOGCMs in the left part of the figure, as well as results from a hierarchy of independent models and observational constraints. (Source: Intergovernmental Panel on Climate Change (2007) *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M. and Miller, H.L. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.)

11 Solomon, S., Plattner, G.-K., Knutti, R. and Friedlingstein, P. (2009) Irreversible climate change due to carbon dioxide emissions. *Proceedings of the National Academy of Science* Vol 106, 6, doi:10.1073/pnas.0812721106

12 CSIRO and Bureau of Meteorology (2007) *Climate Change in Australia: Technical Report 2007*, CSIRO



Many scientists now believe that the climate system appears to be changing faster than earlier thought likely, and the risks associated with the upper range of the IPCC projections on climate change need to seriously be considered.¹³

The Australian Government recognises that a global deal on emissions reductions consistent with stabilising greenhouse gases at 450 ppm CO₂e or lower is in Australia's national interest. This would be consistent with limiting global warming to around 2°C.

However, Australia needs to consider what preparations it might be prudent to take against the possibility that global agreements are less effective. In the case of long-lived infrastructure, for example, it may be necessary to consider the possibility that temperatures may increase by 3-4°C as part of a comprehensive risk assessment.

Risks are serious and pervasive

Even if climate change can be contained to around 2°C of global warming, Australia will have to manage serious and pervasive risks from climate change impacts.

In 2007 the IPCC concluded that, for Australia, "Ecosystems, water security and coastal communities ... have a narrow coping range. Even if adaptive capacity¹⁴ is realised, vulnerability becomes significant for 1.5 to 2.0°C of global warming. Energy security, health (heat-related deaths), agriculture and tourism have larger coping ranges and adaptive capacity, but they may become vulnerable if global warming exceeds 3.0°C."

Information that has become available since 2007 suggests risks may be more significant than estimated by the IPCC.

While individual events cannot be directly attributed to climate change, extreme events experienced in 2009 that are consistent with projected changes demonstrate our vulnerability. The heatwave in south-eastern Australia in January and February 2009 illustrates our vulnerability to extreme heat events. This heatwave set new record temperatures and had impacts on human health, infrastructure and ecosystems. During this heatwave, the Basslink Interconnector (which transfers electricity between Victoria and Tasmania) experienced a shut down when temperatures exceeded its design limits, reducing power supplies to Melbourne. Rail lines buckled causing delays in transport. In Victoria there were 374 more deaths than would normally be expected.¹⁵ Climate change will result in more heatwaves.¹⁶ Hotter and drier conditions are also projected to result in more intense and more frequent bushfires.¹⁷ In the last decade, Australians have experienced fires that appear consistent with these predictions.

The National Biodiversity Vulnerability Assessment found that 'Australia's biodiversity has only so much capacity to adapt to climate change, and we are approaching that limit'.¹⁸ Climate change also exacerbates the effects of many existing stressors, which continue to be a significant threat to Australia's biodiversity.

13 Steffen, W. (2009) *Climate change 2009: Faster change & more serious risks*. Department of Climate Change, Canberra, Australia.

14 The IPCC defines adaptive capacity as "the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantages of opportunities, or to cope with the consequences.

15 *January 2009 Heatwave in Victoria: an Assessment of Health Impacts (2009)* Victorian Government Department of Human Services, Melbourne, Victoria, www.health.vic.gov.au

16 CSIRO and Bureau of Meteorology (2007) *Climate Change in Australia: Technical Report 2007*, CSIRO

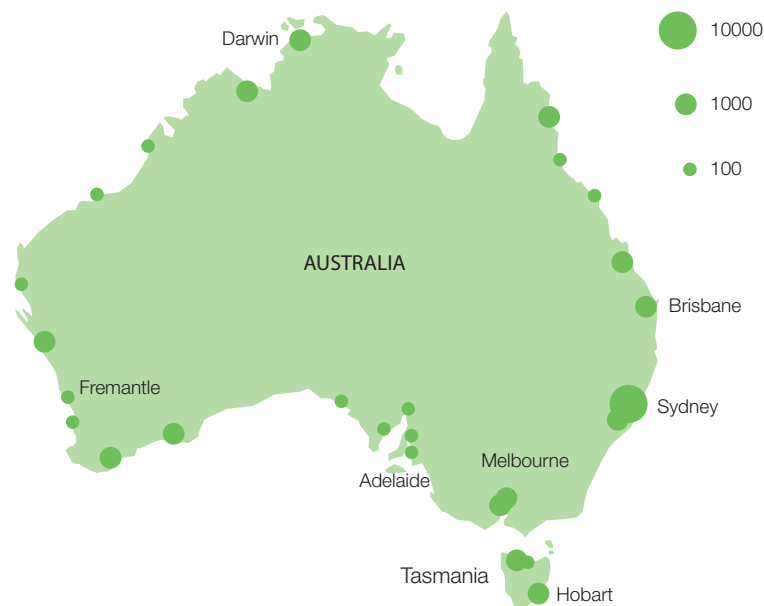
17 CSIRO and Bureau of Meteorology (2007) *Climate Change in Australia: Technical Report 2007*, CSIRO

18 Department of Climate Change (2009) *Australia's Biodiversity and Climate Change: Summary for policy makers 2009*, DCC, Canberra, page 2.



In 2007 the IPCC concluded that sea levels could rise between 18 and 79 cm by 2100, allowing for the break-up of land-based ice sheets. Further research over the last two or three years suggests this may be an underestimate.^{19 20 21} Sea level rise of up to one metre or more by 2100 cannot be ruled out. This would have more serious implications for coastal settlements and infrastructure.

The multiplying effect of sea level rise on high sea-level events



The green dots show how much more often high sea-level events are expected to occur at each location with a sea-level rise of 0.5 m. For example, the smallest dot shows that events will happen 100 times more often, so a storm tide that is expected once a century in the twentieth century climate would be expected to happen once a year on average with a sea level rise of 0.5 m. (Source: Antarctic Climate & Ecosystems Cooperative Research Centre, 2008, Position Analysis: Climate change, sea-level rise and extreme events: impacts and adaptation issues. ACE CRC, Hobart, Australia.)

Climate change risks will be pervasive. The impacts of climate change will affect almost every facet of Australia's economy, society and environment. Adapting to climate change will involve all levels of government, business and the community. Governments, councils, big business, small business owners, farmers, communities, families and individuals will all be affected by climate change in many, if not most, aspects of their lives. We will need to adapt our businesses and our lifestyles to less rainfall in many areas, more hot days and more extreme weather events.

19 Rahmstorf, S. 2007, 'A semi empirical approach to future sea-level rise,' *Science*, 315:368-370.
 20 Pfeffer, W.T., Harper, J.T. and O'Neel, S. (2008) Kinematic Constraints on Glacier Contribution to 21st-Century Sea-Level Rise. *Science* 321, 1340, doi: 10.1126/science.1159099.
 21 Church, J., White, N.J., Hunter, J.R. and Lambeck, K. (2008) *Briefing: A Post-IPCC Update on Sea Level Rise*. Antarctic Climate and Ecosystems Cooperative Research Centre, Hobart, Australia.



Key message: we need to pay attention now to our climate change adaptation needs

Decisions we make today will affect our future vulnerability

Many decisions we make today can increase or decrease our vulnerability to future climate change. Decisions about land use, infrastructure design, location and management of parks and reserves, investment in agricultural systems, and rules about water management all need to take future climate change into account.

Infrastructure we design today will need to be able to resist climatic pressures and extremes in fifty or one hundred years from now. Decisions about where we live – and in particular where we build new settlements – will need to take account of future climate risks, including floods, fires and coastal inundation. Decisions about investing in agriculture and rules about how we manage our water will also need to take account of future climate risks.

Uncertainty is a reason for flexibility and creativity, not for delay

Some things about Australia's future climate are fairly certain: it will be hotter, sea levels will rise, extremes such as heatwaves, droughts and storm surge will become more frequent and intense.

Other things are less certain: the rate and magnitude of change depends on how sensitive the climate system is to greenhouse gases. Beyond mid-century it also depends on future emissions, making it sensitive to our success in reducing greenhouse gas emissions now and into the future. Rainfall projections are less certain. While it seems likely that the southern part of Australia will become drier there is less confidence about northern Australia and parts of the eastern seaboard. We have limited information about how climate change will affect some extreme events such as cyclones and hail storms.

While some of this uncertainty can be reduced by better science, some residual uncertainty will always remain. Uncertainty about the future is not a reason to delay developing strategies for adapting to the impacts of climate change. Australians have considerable experience and success in dealing with other risks where there is uncertainty about what may happen in the future. Examples include commodity prices, currency exchange rates, and natural climate variability manifested in droughts and floods. The same flexible and creative approach is required to build resilience to climate change impacts.

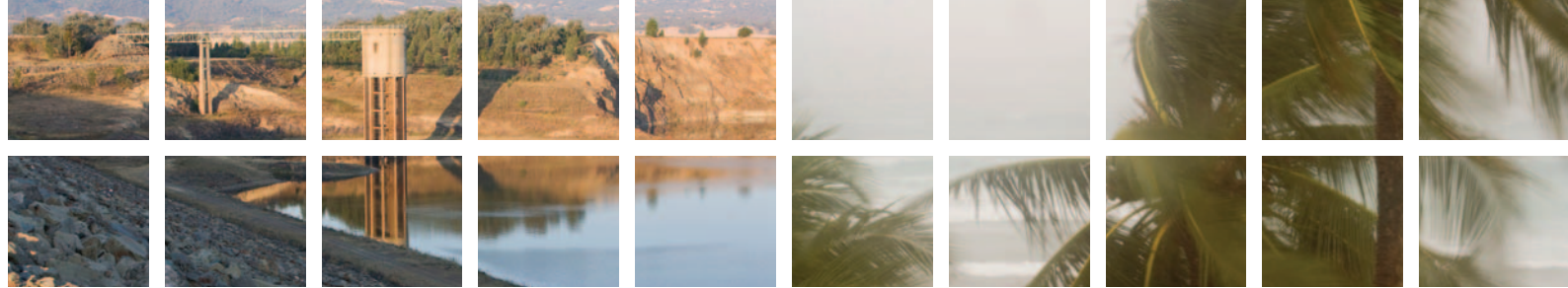
It will not be efficient or cost effective for adaptation responses to seek to prevent all adverse impacts of current and future climate change. Adaptation actions will need to achieve a suitable balance between the risks of acting too early or too late, and balance the potential benefits of actions with the likely magnitude of impacts.

It will take time to adapt

Adaptation to climate change is a new challenge. It will take time to build the skills and knowledge we need to manage climate change impacts. Our experience in dealing with natural climate variability will provide some insights into how to manage climate change impacts. Urban water supply managers, for example, have a long history in dealing with, and adapting to, high variability in rainfall across much of Australia. However, it will also be necessary to trial new approaches to emerging climate change risks and draw lessons from both successes and failures.

And once we have begun to adapt it will take time for some decisions to make a difference. For example, new building standards will be needed to enable buildings to withstand more severe weather events. But, once those new standards are agreed, it will take time to implement them both in existing buildings wherever possible and in new structures as our building stock is gradually replaced.

So the time to start acting is now.



Key message: adaptation is a shared responsibility – governments, business and the community all have a stake and a role in responding to climate change impacts

Just as adapting to the impacts of climate change is a new challenge, it is also a shared challenge, and a shared responsibility.

Governments at all levels, businesses, and the community have important, complementary and differentiated roles in adapting to the impacts of climate change. Defining these roles will allow all parties to begin planning for a changing climate and take whatever action is necessary to adapt to climate change impacts.

Adapting to the impacts of climate change is, in large measure, about managing risks. Risks will be dealt with most efficiently if they are well understood and allocated to those who are best placed to manage them.

Businesses and the community must play their part

Vulnerability to climate change is a critical new risk to the nation. Business and communities will need to assume responsibility as they do in managing other risks. For example, just as prudent businesses undertake due diligence processes prior to engaging in major new endeavours, so will businesses and communities need to start to factor climate change into their everyday decision making.

Individuals and businesses are often best placed to manage the risks associated with their assets. The private benefits individuals and households can gain from adapting to climate change provides an incentive for them to take reasonable steps to manage their exposure to those risks, and so reduce the potential costs to them of climate change.

Most of the assets and activities at risk from climate change are owned or managed by businesses and the community. It is therefore reasonable to expect that much of the national effort to adapt to the impacts of climate change will be actions taken by businesses and communities.

It is not feasible for governments to bear all of the costs of adapting to the impacts of climate change. It would also be inefficient for governments to make decisions about how to adapt to climate change impacts on behalf of individuals and businesses that are better placed to manage their own risks.

The Garnaut Review summarised the comparative advantage of business and communities in adapting to climate change in the following way:

‘Some may expect that government can, and should, protect the community from climate change by implementing the right strategy, program or initiative to allow Australians to maintain established lifestyles. This is not a realistic expectation for four reasons. First, climate change will require adjustment of innumerable, locally-specific customs and practices over time. Second, the range and scale of impacts that is likely across Australia is such that it is not feasible for governments to underwrite maintenance of established patterns of life for people in all places. Third, the uncertainty surrounding climate change impacts makes it impossible to predict their timing, magnitude or location with precision.

Finally, appropriate responses to climate change impacts will be specific to circumstances. In many instances, centralised government will lack the agility to orchestrate a differentiated response with the necessary precision to address local needs. The informational requirements of government would be extreme and costly. It is unlikely that an intrusive or directive approach to adaptation would be as effective as one motivated by local interests.’²²

22 Garnaut, R. (2008) *The Garnaut Climate Change Review*, Cambridge University Press, page 364.



Insurance markets are commonly used to spread risks – such as the risk of fire, theft or motor vehicle accidents – across the community. The price of insurance can be an incentive for people to adopt or avoid particular behaviours. Insurance markets could be valuable in managing risks from climate change, for example by providing incentives for people to take actions that reduce exposure to climate change impacts. Government policy settings to maintain a strong and flexible economy will, in general, help to ensure that price signals are able to drive efficient behavioural responses.

Governments have an important capacity building and reform role

Governments have an important role in creating the right conditions and incentives for businesses and the community to make efficient investment decisions and manage risks from climate change impacts.

Providing information for business and communities to adapt

Individuals and businesses can only take effective action to adapt to climate change if they are well informed about its potential impacts and risks. It is in the interests of businesses and individuals to invest in the specific information they need to assess and manage their risks from the impacts of climate change. However, there is little incentive for them to invest in basic knowledge that may be of limited benefit to them but of broader public benefit. Governments have a role to play in filling these information gaps, including by providing better public information (such as high quality climate projections) to build understanding and better inform decision making across both the public and private sectors.

Setting the right conditions for business and communities to adapt

An effective response to climate change will require contributions from and engagement by all levels of government as well as business and the community. Governments have an important role in establishing the right conditions for business and communities to make efficient investment decisions that are able to take appropriate account of climate change impacts. Governments must ensure that regulatory arrangements do not distort market signals and facilitate the ability of all to adapt to climate change. Governments also need to ensure that risk is appropriately recognised and apportioned. Policy instruments, such as land-use planning, codes and standards or environmental or public health legislation, can play an important role where market mechanisms are ineffective.

Government programs and assets

In many cases governments are responsible for providing goods and services that benefit the community. These include, for example, providing public goods such as flood and coastal protection, emergency management, public health and safety measures, and natural resources protection; and managing public assets, including public lands, national parks and reserve systems and government-owned infrastructure. Governments, like business and communities, should ensure that climate change considerations are appropriately factored into their management of public assets.

Governments also have a role in dealing with market failure where the private sector might decide not to deliver a particular public good service, but there is a strong case for governments to intervene.



The roles of Commonwealth, State, Territory and Local Governments are different

Different levels of government have different responsibilities and will therefore have different roles in helping Australia adapt to the impacts of climate change.

The Australian Government has stewardship of the national economy and is responsible for promoting Australia's national interests more broadly. As climate change will impact on virtually every sector of the economy and society, the Commonwealth will need to take a leadership role in positioning Australia to adapt to climate change impacts that may affect national prosperity or security. In some cases this will require direct action, for example the Australian Government manages some important assets – including natural assets such as Kakadu – that are vulnerable to the impacts of climate change. In other cases the Commonwealth will play a role in driving and coordinating national reform efforts.

State, Territory and Local Governments, by contrast, deliver more services and manage more assets than the Commonwealth Government. They will therefore have a bigger role in direct adaptation action, including decisions on urban land release. State and Territory Governments are also responsible for a good deal of regulation that bears on our ability to adapt to the impacts of climate change. Building codes and land use planning regulations are examples.

In many cases impacts of climate change are most effectively managed by a single State, Territory or Local Government. In other cases a combined response by several governments or tiers of governments will be required. In cases where a number of governments must act, or where national leadership by the Commonwealth is required, COAG may be the appropriate body through which to act. Local Governments will be key actors in adapting to the local impacts of climate change and the engagement of Local Government will be a critical part of any national reform agenda.

THE AUSTRALIAN GOVERNMENT'S ROLE

Maintaining a strong, flexible economy and a social safety net

A strong flexible economy will help Australia adapt to climate change impacts by ensuring resources are available to respond to climate change and can be deployed efficiently. A strong and flexible economy will also ensure price signals – such as through insurance markets – are able to drive efficient decision making. A strong social safety net is essential to assist those who may otherwise have difficulty in adapting, for example, vulnerable groups, such as the aged, the poor and Indigenous communities. It is envisaged that any support to these groups would be delivered through the existing social welfare system.

Leading national reform

Some climate change risks have the long-term potential to undermine the national economy or affect natural systems of national significance. The Australian Government has a responsibility to lead national reform to ensure Australia is well placed to deal with these risks. Similarly, while many adaptation decisions will be based on local conditions, it will be important where necessary to maintain national consistency in important areas of standards. Part Two of this paper identifies national priorities for adapting to the impacts of climate change.



Managing Commonwealth assets and programs

The Australian Government owns or manages a large portfolio of assets at risk from climate change impacts. These risks will require careful management. Commonwealth assets include defence facilities, and national parks and reserves, including Kakadu and Uluru Kata Tjuta.

Climate change impacts may also affect the delivery of a range of public good services for which the Commonwealth either has significant responsibility or provides substantial funding. These include environmental protection, community health, emergency management and national security.

The Government will therefore need to ensure it is factoring climate change considerations into its own operations, through embedding climate change in its policy making and asset management.

National science and information

Individuals and businesses can only take effective action to adapt to climate change if they are well informed about its potential impacts and risks.

The Australian Government is best placed to generate most of the important public good science and other information that will be needed for Australia to effectively adapt to the impacts of climate change. Much of this information is too costly for individual businesses to generate but can be used by many businesses, community organisations and State and Local Governments for adaptation planning.



Part Two: The Strategy for Implementing the Commonwealth's Vision

Delivering an effective national adaptation agenda will require action by businesses, communities and all levels of government.

Key message: sectors will be affected by climate change at different times and in different ways – so we need to identify some national adaptation priorities

The pressures of climate change will not be felt uniformly across Australia and will not be felt at the same time across all sectors and regions. Although we need to be prepared for adaptation, not all sectors and not all potential impacts need to be considered and planned for with the same urgency.

As part of developing an effective response to adaptation, it is important to identify priorities for attention over the next five to ten years. In considering what the Commonwealth's priorities should be, attention needs to be given to:

- the magnitude and timing of impacts on a particular area (informed by the IPCC and more recent analysis and assessments); ^{23 24 25}
- whether it is important to take early action to reduce or eliminate risks of locking in inefficient policies or investing in assets which have not factored in climate change risk; and
- whether the matter is a Commonwealth responsibility or requires Commonwealth leadership to deliver a nationally consistent and/or effective outcome.

Based on analysis of these considerations, the Government has identified the following as initial national priorities for adaptation action:

- coastal management;
- water;
- infrastructure;
- natural systems of national significance;
- prevention, preparedness, response and recovery with regard to natural disasters; and
- agriculture.

23 Steffen, W. (2009) *Climate change 2009: Faster change & more serious risks*. Department of Climate Change, Canberra, Australia.
24 Richardson, K., et al (2009) *Synthesis Report from Climate Change: Global Risks, Challenges and Decisions Conference (Copenhagen, 10-12 March 2009)*, University of Copenhagen, Denmark.
25 Karl, T.R., Melillo, J.M. and Peterson, T.C. (eds.) (2009) *Global Climate Change Impacts in the United States*. Cambridge University Press, New York.



Coastal management

While Local Governments and States and Territories have the leading role in managing the coastal zone, the magnitude of national wealth and critical infrastructure invested in the coastal zone warrants coastal management being given national priority status. Ports, airports, military facilities, as well as residential and other private infrastructure located in vulnerable coastal locations will require increased maintenance in the future. There will also be adverse impacts on coastal and estuarine ecosystems. The frequency of extreme sea level events (including storm surges) can increase with even modest sea level rise, making many existing coastal assets vulnerable.

Water

Climate change is already affecting water availability and security across Australia. Managing Australia's water resources will remain an important national priority into the future, and it will be important that water policies and programs continue to factor in changes in climate.

Infrastructure

Significant current investments in infrastructure and its long lifespan make it essential to consider the impacts of climate change now to avoid locking in ineffective and inappropriate infrastructure and policies. The Commonwealth has a key interest in ensuring the owners of nationally significant infrastructure (such as ports, roads, and infrastructure for water, electricity and telecommunication services) provide continued and uninterrupted functioning of these assets, which are critical to supporting our national economy.

Natural systems of national significance

Climate change is already affecting Australia's natural ecosystems, and given their high vulnerability to climate change, natural systems of national significance, such as the Great Barrier Reef and Kakadu, will require ongoing priority attention. In addition to these important places, the interconnectedness of natural systems points to the need for holistic landscape approaches that maintain ecosystem functions as ecosystems adapt.

Preparation for and management of natural disasters

There is some evidence climate change is already impacting on the frequency and intensity of extreme events.²⁶ Action is required to ensure we have the capacity to respond to a likely increase in natural disasters.

Agriculture

Given its national importance, and the close dependence of agricultural production on water availability, it will be important to include agriculture as a national adaptation priority.

EMBEDDING CLIMATE CHANGE IMPACTS IN POLICY DEVELOPMENT

As a fundamental guiding principle, adaptation considerations and responses will be embedded within existing policy and institutional frameworks. This is because, in most instances, climate change is likely to exacerbate existing risks and therefore can be dealt with most efficiently through existing institutions and frameworks. Reforms will be applied on a sectoral/portfolio basis to ensure future planning and policy development within the Commonwealth anticipates climate change impacts.

26 IPCC (2007) *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press. Table SPM.2



In many instances, adaptation reforms will also deliver co-benefits and reinforce existing policy objectives.

Given the nature of climate change risks, new institutional or policy structures will be considered only where a demonstrated case has been made and existing frameworks cannot manage those risks effectively.

Some priorities are already being pursued using the ‘embedding’ process

A number of reforms and initiatives already underway are factoring in climate change.

The Government is investing \$12.9 billion in the single largest investment in climate change adaptation – ‘Water for the Future’. The program focuses upon four national priorities: taking action on climate change, using water wisely, securing our water supplies, and supporting healthy rivers and wetlands.

The program delivers a number of major streams of work to help Australians adapt to a future with less water.

These include:

- development of new, science-based limits on water use for the Murray-Darling Basin;
- purchasing water to put back into the rivers of the Murray-Darling Basin;
- improving the efficiency of irrigation systems to minimise water loss;
- developing a robust water market, so that as water becomes more scarce there are incentives to deliver it to the areas of highest priority;
- improving water markets and trade so that water can move to where it is valued most;
- investing in alternative water supplies and water saving initiatives in our cities and towns; and
- improving the quality of our water information systems nationally through the Bureau of Meteorology.

Recognising that the rivers and water resources of the Murray-Darling Basin ignore state boundaries, collaboration between the Commonwealth and Basin State Governments resulted in an historic Intergovernmental Agreement (IGA) on Basin reform. The IGA acknowledges that truly national approaches can be necessary to ensure effective adaptation.

Factoring in climate change, and building and maintaining reef resilience is central to Commonwealth and Queensland efforts to protect the Great Barrier Reef, including through the June 2009 Great Barrier Reef Intergovernmental Agreement which recognises climate change pressures.

In the primary industries sector, the Government is funding adaptation projects that will:

- reduce cropping industries’ vulnerability to climate change by providing crops with genetic traits suited to hotter, drier, elevated carbon dioxide environments, and management strategies that minimise the risks to production;
- help growers manage grapes grown under more stressful dry and hot conditions while maintaining quality by developing, evaluating and disseminating new techniques;
- identify the most effective livestock management practices for adapting to climate change in northern and southern Australia by evaluating the effects on production and profitability of responses to predicted impacts under existing and new management strategies;
- facilitate the preparation and adaptation of Australia’s south eastern fisheries by examining the biophysical, social and economic implications of climate change; and
- build a framework for farmers considering relocating to other regions to adapt to climate change.

In November 2009 the Ministerial Council for Police and Emergency Management endorsed a Climate Change Adaptation Action Plan. The climate change adaptation strategies and projects outlined in the Plan will be a key part of ensuring that emergency management planning and processes in Australia will be prepared for the impacts of climate change.



Climate change will be embedded in new policy reforms

While particular attention will be needed on the national adaptation priorities identified above, all new policy development processes (be they health, tourism, transport, environment, national security or regional development) will need to consider whether changing climate is relevant to policy implementation, and, if so, how to take those risks into account.

The process of embedding climate change in new policy reform will involve explicitly identifying climate change risks and ensuring appropriate account of their implications is taken in policy development and program delivery. In doing this, it will also need to allocate climate change risks to those best placed to manage them and promote active management of risks by those parties.

PROVIDING PUBLIC GOOD INFORMATION

It is in the interests of businesses and individuals to invest in the specific information they need to assess and manage their risks from the impacts of climate change. However, they may have little incentive to invest in knowledge that may provide limited benefit to them, but have broader public benefits.

In such cases, governments may be best placed to provide the information businesses and communities need to adapt to the impacts of climate change. Within this context, the Commonwealth will continue to provide public good information on a national scale.

One important type of public good information to assist with adapting to the impacts of climate change is improved advice about how and when the climate is likely to change. This will include impacts and projections at national, regional and local scales.

In May 2009, the Australian Government adopted a National Climate Change Science Framework (www.climatechange.gov.au/en/publications/science/cc-science-framework.aspx) that will build on the past achievements of Australia's climate change science community and enhance future efforts by focusing Australia's climate science expertise on an agreed set of national priorities. The Framework also identifies the science capabilities, human capital and infrastructure investment needed to deliver on these priorities; and sets out ways to harness our full science capacity to address those priorities. A High Level Coordination Group chaired by the Chief Scientist for Australia has been established to develop and oversee an implementation plan for the Framework.

One capability identified in the Framework is predicting future climate. The Framework acknowledges the importance of improving our understanding of how climate change will affect the frequency and intensity of extreme climate events such as storms, heatwaves and cyclones. It also recognises that we must improve our capacity to project climate over the one to 30 year time scale that is of interest to many decision makers.

In addition to climate projections, businesses and communities will need information about the impacts these changes are likely to have and options for adapting to them. Some of this information is locally specific and could be generated by the private sector. However, there is still a very large public good component, both because of the high cost and diffuse benefits and because some information relates to publicly managed assets such as natural ecosystems.



The Government has established a National Climate Change Adaptation Research Facility and associated research networks to generate the information decision makers need to manage the risks of climate change impacts in critical areas.

The Facility, in consultation with policy makers, is leading the development of a number of National Adaptation Research Plans which will identify critical gaps in the information needed by decision makers, set research priorities based on these gaps, and identify the science capacity that could be harnessed to conduct this priority research.

Themes are:

- emergency management;
- human health;
- marine biodiversity & resources;
- primary industries;
- settlements and infrastructure;
- social, economic and institutional dimensions;
- terrestrial biodiversity; and
- water resources and freshwater biodiversity.

CSIRO's Climate Adaptation Flagship is developing information about adaptation responses to counter the impacts of climate change. It is analysing future climate change in Australia, delivering strategies to manage their impact, and developing new ways to combat and even benefit from these challenges.

The Australian Government commissioned the CSIRO to undertake assessments to provide robust estimates of current and future water yield in several regions of Australia in light of climate change and other risks. So far studies have been completed in the Murray-Darling Basin, Northern Australia and Tasmania with one covering south-west Western Australia approaching completion (<http://www.csiro.au/partnerships/SYP.html>). The assessments are helping to underpin the sustainable planning and management of water resources.

Key message: some key changes can only be delivered by Governments working together

Some of the priorities identified in this paper can only be pursued through Commonwealth and State and Territory cooperation, due to State and Territory roles in service delivery or in management of key sectors, such as emergency management, planning and land management, and the need for a national focus to drive change.

In some cases, the scope of the task demands a nationally coordinated approach, with each sphere of government having a distinctive but critical role. These roles will vary depending on the scale and nature of the risks being managed. A national partnership on government efforts to adapt to climate change will help exploit economies of scale, reduce structural inefficiencies, avoid duplication and promote information sharing, while recognising the benefits of services being delivered by the sphere of government closest to the issue. For example, COAG announced at its December 2009 meeting national criteria for capital city strategic planning systems that will provide the platform to re-shape our capital cities. The criteria will ensure our cities have strong, transparent and long-term plans that will, amongst other things, address climate change.



Tests for whether a national response is required will include:

- where a complete adaptation response can only be mounted through a collaborative effort (e.g. water, emergency management and some areas of standards);
- where there is current policy overlap and a collaborative effort is required, for example where there might be inconsistent approaches between jurisdictions that produce inefficiencies or higher costs for business; and
- if the magnitude of the risk to national wellbeing warrants all governments working together – where failure in one jurisdiction is a problem for the entire nation. Failure of critical infrastructure, such as electricity generation might be an example where such collaborative action is warranted.

Addressing the priorities for national action identified in this paper will provide a basis for a national approach to adaptation that will position Australia to effectively manage the impacts of climate change into the future.

In some cases, such as water reform, governments are already working together to deliver a national solution.

In other cases, such as coastal development, new processes of national co-operation will be needed. In each case, a robust information base will be needed to develop evidence based adaptation strategies.

The National Coastal Risk Assessment (www.climatechange.gov.au/en/publications/coastline/climate-change-risks-to-australias-coasts.aspx) released in November 2009 provides the evidence base around which to begin to develop national co-operation in the coastal zone. The Assessment:

- provides a preliminary analysis of the extent and magnitude of risk to Australia's coastline, coastal biodiversity, cities and towns, and infrastructure;
- provides decision makers with a better understanding of the potential risks; and
- identifies priority areas for research, data gaps and investment.

A National Coastal Forum on 18-19 February 2010 is an important next step in developing a national approach to coastal management.

Similarly, the strategic assessment of the vulnerability of Australia's biodiversity to climate change (www.climatechange.gov.au/publications/biodiversity/biodiversity-climatechange.aspx) provides a road map for reforming our management of biodiversity and strengthening national commitment to conserve Australia's biodiversity in the face of the climate change challenge.

In developing national arrangements the objective will be to generate strength of action through collaboration and elimination of duplication.

Key message: we need to measure how well we are adapting to climate change

To track our progress on positioning Australia to adapt to climate change the Government has decided to commission a regular Climate Futures Report. The Report will be produced every five years and will provide a mechanism to evaluate how effective our collective adaptation efforts are. It will tell us how well Australia is placed to deal with climate change risks and evaluate the effectiveness of policy measures taken by governments to improve resilience to climate change impacts. An initial Climate Futures Report will be produced before the end of 2010.



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