CLIMATE COMMISSION

THE CRITICAL DECADE

Victorian climate impacts and opportunities

Summary

Victoria's climate is already changing and is likely to change further in the future, posing significant risks to the state.

– Many types of climate-related extreme events are expected to increase in frequency and intensity in the future. The heatwaves, drought and bushfires of the past decade provide Victorians with a window into that future.

– The number of hot days has increased over the last few decades and is expected to continue increasing into the future. Critical infrastructure, such as roads, railways and power lines, is vulnerable to prolonged exposure to high temperatures.

– Conditions for large and intense bushfires are likely to become more common in the future. The number of 'very high' and 'extreme' fire danger days could increase significantly over the next few decades.

– Over the last 40 years much of eastern and southern Australia has become drier, with Victoria experiencing a 10-20% reduction in autumn and winter rain over the last 20 years.

– Global sea-level rise is tracking near the highest levels scientists expect. This means that a potential 1 m rise over this century is a serious risk threatening Victoria's iconic beaches, and thousands of residential and commercial buildings.

The next chapter of the climate story is about how Victoria, and Australia, can find solutions that minimise the risks of climate change while providing extra benefits for our health, community, economy and environment. Harnessing clean energy, taking advantage of new economic opportunities and building sustainable communities can all provide new opportunities for Victorians.

– Victoria has substantial renewable energy resources. Victoria receives enough energy from the sun to produce double the state's current energy needs, and parts of Victoria have some of the best conditions in the world to harness wind energy.

– Around the world, investment in renewable energy is growing strongly and costs are rapidly coming down. For instance, in some countries the cost of solar electricity is now competitive with retail electricity prices.

– Making our cities more sustainable can also make them healthier and more livable, while reducing energy costs and greenhouse gas emissions.

– Improving the environmental performance of buildings, for instance by using more energy efficient lighting, heating, cooling and refrigeration, offers opportunities to save energy costs and provide healthier conditions for workers. Melbourne has world class examples of green buildings.

With thanks to Climate Commission's Science Advisory Panel, Adjunct Professor Alan Pears and ClimateWorks Australia for their comments on the report.

This report draws from the Climate Commission's reports: *The Critical Decade and The Critical Decade: Climate Change and Health*, and is the Commission's 12th report.

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THE CRITICAL DECADE

Queensland climate impacts and opportunities

Summary

Queensland's climate is already changing and is likely to change further in the future, posing significant risks for the state. The next chapter of the climate story is about how Queenslanders, and Australians, can find solutions that minimise the risks of climate change while providing extra benefits for our health, community, economy and environment.

Queensland's agricultural industries are at risk from climate change.

– Agricultural productivity is affected by climate change through: higher temperatures; changes in the amount, intensity, seasonality and variability of rainfall; and changes in the frequency and/or intensity of extreme events such as droughts, bushfires and floods.

– As a result of climate change, beef, sugar and cereal production in Queensland is expected to decline.

– Queensland farmers are accustomed to dealing with a highly variable climate, but in the future, new risk management and adaptation strategies will be even more important as the climate changes.

Queensland's tourism industry is at risk from climate change.

– Tourism is a key industry for Queensland, employing 120,000 people and attracting tourists from around the world. Queensland's tourism industry relies on its unique local attractions including sandy beaches, the Great Barrier Reef, and World Heritage rainforests.

– In the last three months of 2011, visitors to tropical North Queensland spent $735 million. Higher temperatures and changing rainfall will place the rainforests in a highly stressed situation towards the end of the century.

– The Great Barrier Reef is threatened by higher sea surface temperatures and more acidic oceans.

– Queensland's natural environment supports 70% of Australia's native birds, 85% of its mammals and more than 50% of the nation's reptiles and native frogs. Many of Queensland's species and ecosystems are already threatened and climate change poses a serious additional threat to Queensland's unique biodiversity.

Sea-level rise threatens Queenslanders' property and lifestyle.

– Long stretches of sandy beaches in southeast Queensland – the Gold Coast, Moreton Bay, Brisbane and the Sunshine Coast – are threatened by the increased coastal erosion resulting from rising sea levels.

– The Gold Coast has more houses than any other region in Queensland within 110 m of erodible coastline, with more than 4,000 residential buildings at risk.

– Moreton Bay and the Sunshine Coast follow with around 2,000 residential buildings at risk in each region.

Using energy more efficiently can provide new opportunities for Queenslanders.

– Making our cities more sustainable can also make them healthier and more liveable, while reducing energy costs and greenhouse gas emissions.

– Improving the environmental performance of buildings – for instance, by using more energy-efficient lighting, heating, cooling and refrigeration – offers opportunities to save energy costs and provide healthier conditions for workers.

– Many businesses are already cutting energy costs and pursuing new business opportunities, such as using waste products to produce energy. This area will continue to grow with a changing climate.

Queensland is an ideal location for harnessing solar energy.

– Queensland is truly the Sunshine State with some of the world's highest levels of solar exposure.

– Queensland is leading Australia in solar photovoltaic system installation, and has doubled its use of solar energy in less than two years. By July 2012, more than 200,000 Queensland households and businesses had installed solar panels.

– While use of solar energy has grown rapidly, Queensland can take more advantage of its solar resources. Solar photovoltaic systems currently provide around 4% of the state's total electricity generation capacity.

– Around the world, investment in renewable energy is growing strongly and costs are rapidly coming down. In remote areas of Australia the cost of solar electricity is estimated to already be cheaper than retail electricity.

With thanks to the Science Advisory Panel, Dr Paul Marshall, Professor Ove Hoegh-Guldberg, Dr Mark Howden, Mr Alan Pears and Dr Steven Crimp for their comments on the report.

This report draws on the Climate Commission's reports *The Critical Decade: Climate science, risks and responses* and *The Critical Decade: Climate change and health*, and is the Climate Commission's 14th report.

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THE CRITICAL DECADE

New South Wales climate impacts and opportunities

Summary

New South Wales (NSW) is home to over a third of Australians and 31% of the national economy and is highly vulnerable to climate change. Climate change is increasing the risk of hot weather, heatwaves, and bushfires, and changing the patterns of drought and heavy rainfall. A changing climate is costly, putting pressure on human health, agriculture, infrastructure and the natural environment.

NSW is becoming hotter and drier. Record-breaking hot days have more than doubled across Australia since 1960 and heatwaves in the greater Sydney region, especially in the western suburbs, have increased in duration and intensity.

Over the last 40 years much of eastern and southern Australia has become drier. The continuing drying trend increases the risk of longer and harsher droughts. While there will continue to be wet years, the future trend of declining rainfall poses challenges for Sydney's long-term water security.

This long-term increase in hot and dry weather has made NSW more susceptible to bushfires. Very high fire danger days have already become more frequent, and will occur even more often in the coming decades.

Coastal infrastructure in NSW is vulnerable to flooding from sea-level rise. A 1.1m rise by the end of the century could put between 40,000–60,000 houses, 1200 commercial buildings and 250km of highway in NSW at risk of inundation.

This is the critical decade for action. To minimise climate change risks we must begin to decarbonise our economy and move to cleaner energy sources this decade. The longer we wait the more difficult and costly it will be.

NSW is well-placed to capitalise on the global trend towards clean energy. Globally the clean energy sector attracted $263 billion worth of investment in 2011 and is one of the fastest growing sectors in the world. In Australia $5.3 billion was invested in clean energy in 2011. NSW, with a legacy of innovation and achievement in renewable energy development, has significant opportunities.

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With thanks to the Science Advisory Panel.

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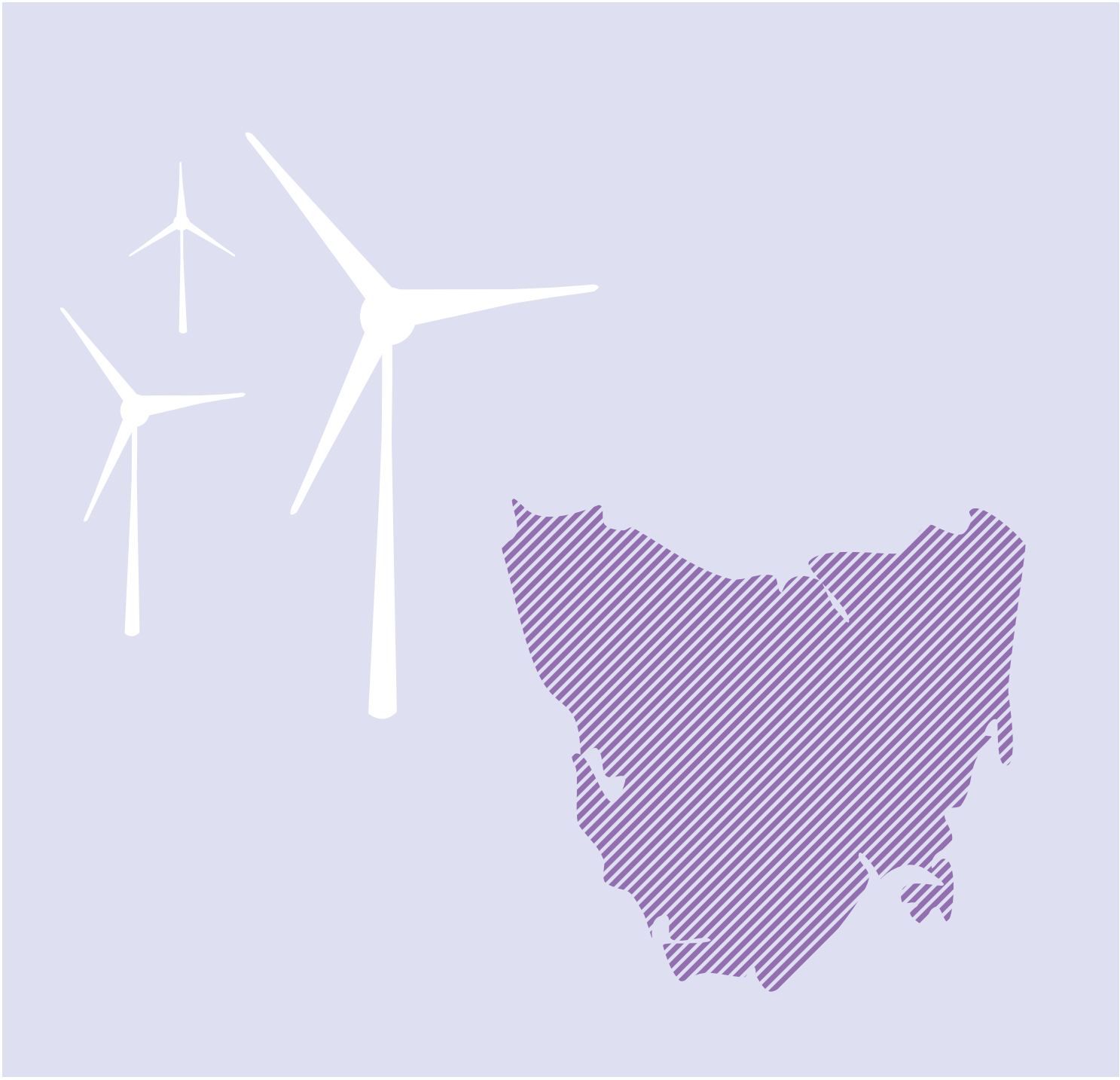
THE CRITICAL DECADE

Tasmanian impacts and opportunities



Over many decades thousands of scientists have painted an unambiguous picture: the global climate is changing and humanity is almost surely the primary cause. The risks have never been clearer and the case for action has never been more urgent.

Our Earth's surface is warming rapidly and we can already see social, economic and environmental impacts in Australia.

Failing to take sufficient action today poses substantial risks to our economy, society and way of life into the future. This is the critical decade for action.

This document highlights the key impacts and opportunities for Tasmania and accompanies *The Critical Decade* report and other work at www.climatecommission.gov.au. It draws on recent research into climate change impacts in Tasmania.

Key messages

- Tasmania has become drier, posing challenges for agriculture and Tasmania's hydro-electric power supply.
- Changes in Tasmania's climate will have far-reaching implications for agriculture, tourism, electricity generation, fisheries, biodiversity and human health.
- A hotter climate is a climate of more extremes. Tasmanians can expect to feel the impacts of more intense rain events and associated flooding, as well as increased fire danger days.
- Tasmania is particularly vulnerable to sea-level rise because most Tasmanians live close to the coast. For instance, in some places a 50 cm sea-level rise could result in a present 1-in-100 year event becoming an annual or more frequent event by the end of the century.
- Tasmania's internationally renowned biodiversity is at risk from a changing climate. For instance, it is likely that hotter temperatures will reduce available habitat for unique Tasmanian plants and animals. The Tasmanian fisheries industry, worth $522 million per year, will also be at risk from rapidly increasing water temperatures and new invasive species.
- This is the critical decade for action. The choices we make between now and 2020 will shape our future. To minimise climate change risks we must begin to decarbonise our economy and move to cleaner energy sources this decade. The longer we wait the more difficult and costly it will be. Tasmania is leading Australia in renewable energy generation and is well-placed to capitalise on the global trend towards clean energy.

1. Changes in rainfall patterns and rising temperatures pose challenges for agriculture and power supply.

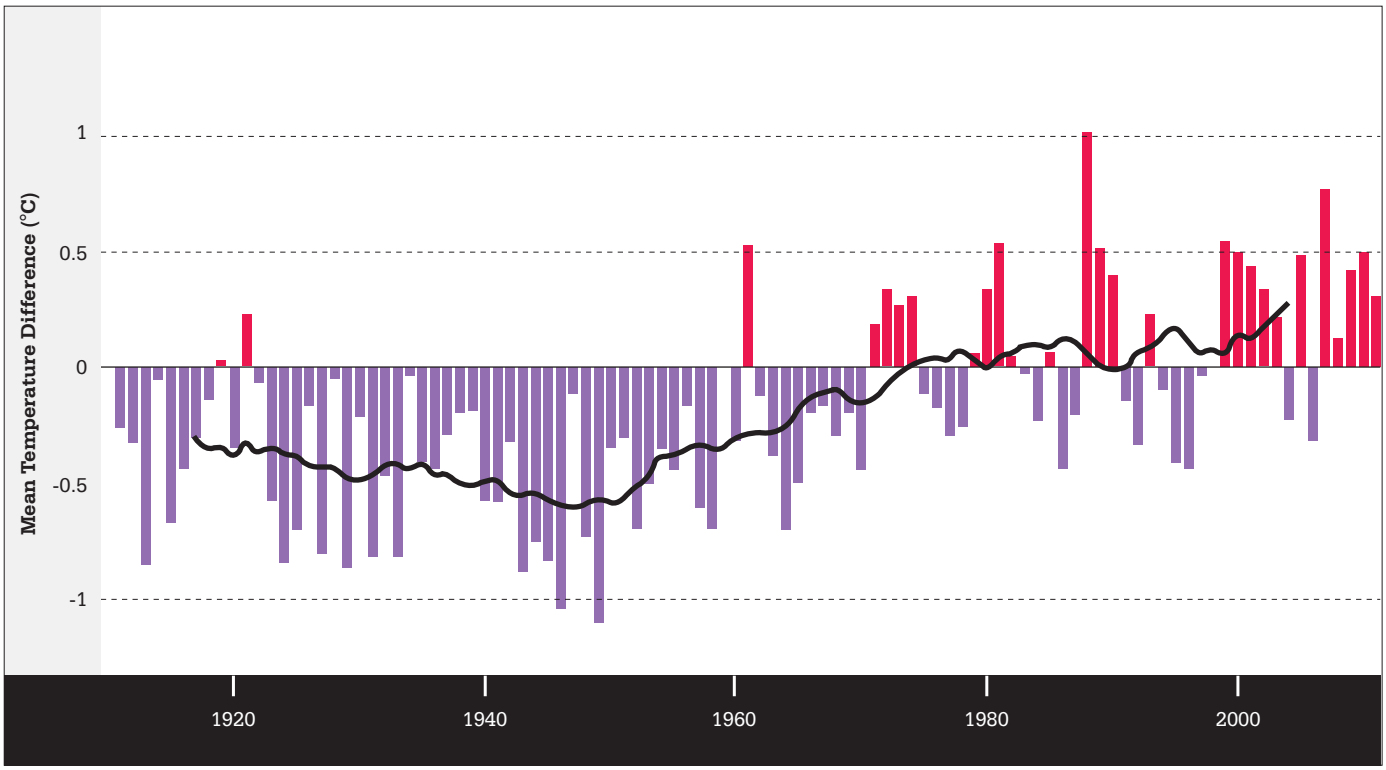
Average annual temperature in Tasmania has risen by 0.8°C over the past century **(Figure 1)**, slightly less than the increase for mainland Australia. Tasmania's total annual rainfall has reduced, most noticeably in autumn, and there has been greater variability in rainfall year-to-year since 1975 (Grose *et al.*, 2010; BOM/ACSC, 2011).

These changes – warmer temperatures and changing rainfall – are expected to continue. The number of days warmer than 25°C is projected to double or triple in most regions of Tasmania. Some areas – such as around Bridport and Launceston – could see 40 additional days above 25°C per year by the end of the century, a significant change to the climate (White *et al.*, 2010). Overall the amount of rain falling may not change significantly. However, the location and intensity is likely to change. It is likely there will be more extreme wet days, more intense rainfall and more dry days – that is, less 'average' conditions.

Intense rain events and associated flooding cause significant damage to homes, communities and infrastructure, and place stresses on emergency and medical services. These incidents are projected to increase over the next century. The largest increases in rainfall intensity will be in areas where the most variable and intense rain is already observed. The number of extreme wet days could increase by up to 25% per year in both the southwest and northeast of the state (White et al., 2010). For example, it is expected that by late this century what is now a 1-in-200 year rainfall event in St Helens could become a 1-in-20 year event (White *et al.*, 2010).

Climate affects almost every aspect of agricultural production, including the plants used, agricultural yield and quality, and which areas are farmed. Therefore projected changes in rainfall and temperature will have significant impacts on agriculture. Agriculture plays an important role in the Tasmanian economy, with a total value in 2009/10 of about $1.08 billion (ABS, 2011).

Figure 1. The long-term trend in Tasmania's average temperature. The purple bars show the yearly temperature difference from the 1961 to 1990 average and the red line shows the average long-term temperature. This graph shows that from around 1950 there has been a steady temperature rise – approximately 0.8°C – in Tasmania. Most human-caused carbon dioxide emissions have occurred since 1950.



Source: Modified from BOM, 2011

Some changes in climate will have a negative impact on agriculture. For example, the projected increases in rainfall during summer and autumn in the eastern regions of Tasmania could cause more fungal disease during the period when crops are developing and particularly vulnerable. As the temperature rises new weeds and pests, such as the Queensland fruit fly, may establish in Tasmania (Holz *et al.*, 2010).

As Tasmania's climate becomes more like that of mainland Australia, Tasmania may be able to sustain a broader range of crops. Warmer temperatures mean that in some regions the number of 'growing degree days' (days when plants grow) will increase, with potential benefits for crop yields. Wheat crops, for example, have potential to increase yield by 10–15% (Holz *et al.*, 2010) Increases in growing degree days also means more grape varieties can be grown in Tasmania and by 2070 conditions in northern Tasmania could be similar to the current conditions in the Coonawarra region of South Australia (Holz *et al.*, 2010). Mainland wineries are already seeing opportunities in Tasmania, with two major Australian wineries, Brown Brothers and Shaw and Smith, recently acquiring cool-climate vineyards in Tasmania.

Changes to rainfall patterns and evaporation rates will also affect runoff and water availability, posing significant challenges for farmers. There is a risk not only for water supplies and irrigation but also for Tasmania's large hydroelectric system. An ongoing decline has been observed in the inflows to hydroelectric system catchments over the past century and this decline is projected to continue. Decreased inflows could lead to an overall reduction in power generation capacity by 2100 and could have an impact on power generation if not addressed (Bennet *et al.*, 2010).

2. Rising sea levels will threaten coastal towns and homes.

Global average sea level has risen by about 20 cm since the late 1800s, and at an increasing rate since the early 1990s. Sea levels have also risen around Tasmania, although at a slightly slower rate than the global average. Over the next century, global sea levels are projected to increase by at least 0.5 m and perhaps by as much as 1.1 m.

Tasmanian communities are vulnerable to the impacts of sea-level rise because 75% of the population lives in coastal areas (DCC, 2009). An estimated 8,700–11,600 houses, with a value of up to $3.3 billion, may be at risk of flooding towards the end of this century **(Figure 2)**, assuming a sea level rise of 1.1 m which is at the higher end of projections (DCC, 2009).

The impacts of sea-level rise are felt most acutely during severe storm events. Even small rises in sea-level lead to very large increases in the frequency of coastal flooding when combined with a storm surge and high tide. In some locations in Tasmania, a half metre sea-level rise would result in a present 1-in-100 year event becoming an annual or more frequent event by the end of the century (Church, 2008; Hunter 2011).

Figure 3. Sea-level rise will contribute to sandy beach erosion, such as at Five Mile Beach in Pittwater near Hobart.

Photo: C. Sharples

6. There are low-carbon opportunities in Tasmania.

In the coming decades, Tasmania will progressively see many opportunities that a low-carbon future will provide.

Renewable energy

Renewable energy will play a vital role in decarbonising our economy through reducing reliance on fossil fuels. Tasmania already produces around 70% of its electricity from renewable sources, mainly hydro (water) and wind (DEDTA, 2011). A growing number of Tasmanians are using renewable energy, including energy generated from wind, solar photovoltaic cells and methane from waste. Research and development is under way on other commercial-scale electricity generation options such as wave, geothermal and bioenergy technologies.

Tasmanian businesses taking advantage of renewable energy opportunities include engineering and manufacturing firms who have, for example, constructed steel towers for wind farms in Tasmania and other states.

Tasmania has the capacity to produce around half of Australia's renewable electricity (DEDTA, 2011). The Basslink electricity transmission cable between Tasmania and the mainland has enough capacity to allow Tasmania to send electricity that is beyond its own needs to Victoria.

Figure 11. Woolnorth Bluff Point Wind Farm.

Photo: Hydro Tasmania

Box 2. Renewable Energy on King Island

King Island, which is in Bass Strait about half way between mainland Australia and the Tasmanian mainland, has historically used diesel generators to meet its electricity needs. In 1998 Hydro Tasmania established Australia's second commercial wind farm on King Island. Following installation of more wind turbines as well as solar photovoltaic systems, diesel fuel use has been reduced by 45% (Hydro Tasmania, 2011).

Hydro Tasmania is working on innovations to increase renewable energy generation on King Island to over 65% of the island's needs, with capability to produce 100% of electricity from renewable sources some of the time. New developments will include expanding the wind farm, improving batteries and other energy storage, installing new diesel engine technology and trialling use of biodiesel.

The new storage systems and diesel engine, combined with advanced control systems, will allow excess wind energy to be absorbed for later use, and rapid switching between diesel and wind generation. This integrated system is designed to allow for times when wind generation exceeds demand and when it falls short of demand. In addition to these new electricity generation systems, a smart grid is being installed to provide better matching of supply and demand.

Box 3. Nichols Poultry Farm Sustainability Program

Nichols Poultry Farm, a free range poultry farm in the north of Tasmania, has found a way to save money while helping to reduce the farm's carbon emissions.

Owner, Rob Nichols, installed a 225 kilowatt wind turbine in 2008 to produce renewable power on the farm **(Figure 12)**. The turbines produce about 300 megawatts of electricity per year, providing almost 50% of the needs of the poultry processing plant. When not needed on site, power is fed back into Tasmania's electricity grid. It is expected that the original investment will be paid back through reduced electricity costs within five years of installation.

Rob also started a separate business, *Blowing in the Wind*, to assist other small businesses to set up and maintain similar wind projects. The business is currently assisting with three other local wind turbine projects which are all expected to be operational by mid-2012.

Figure 12. Rob Nichols uses renewable energy on his poultry farm.

Photo: Nichols Poultry Farm

Wind

Tasmania has excellent access to reliable wind power because it lies within the path of the 'Roaring 40s' – a belt of strong westerly winds that circle the earth's mid-southern latitudes.

Some organisations are already utilising this potential. There are two operating wind farms in the state: Woolnorth Wind Farm in the northwest **(Figure 11)**, the largest wind farm in the southern hemisphere, and the Huxley Hill Wind Farm on King Island **(Box 2)**. There are also a number of privately owned wind turbines in the state, including a 225 kilowatt wind turbine located on the Nichols Poultry Farm **(Box 3)** and two wind turbines on Flinders Island with a combined generation capacity of 80 kilowatts. Additionally, new wind turbines are being installed on Flinders Island and expansion of the wind farm on King Island is planned.

Forests

Forests cover around half of Tasmania and about one fifth, or 150 million hectares, of Australia **(Figure 13)** (MIG, 2008). Australia has a much larger area of forest per person than many other countries (DAFF, 2011), and therefore the effect that carbon storage in forests has on our overall greenhouse gas emissions is more significant than in many other countries.

Figure 13. Forests are important stores of carbon.

Photo: Department of Agriculture, Fisheries and Forestry

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The Critical Decade: South Australian impacts

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Our Earth's surface is warming rapidly and we can already see social, economic and environmental impacts in Australia.

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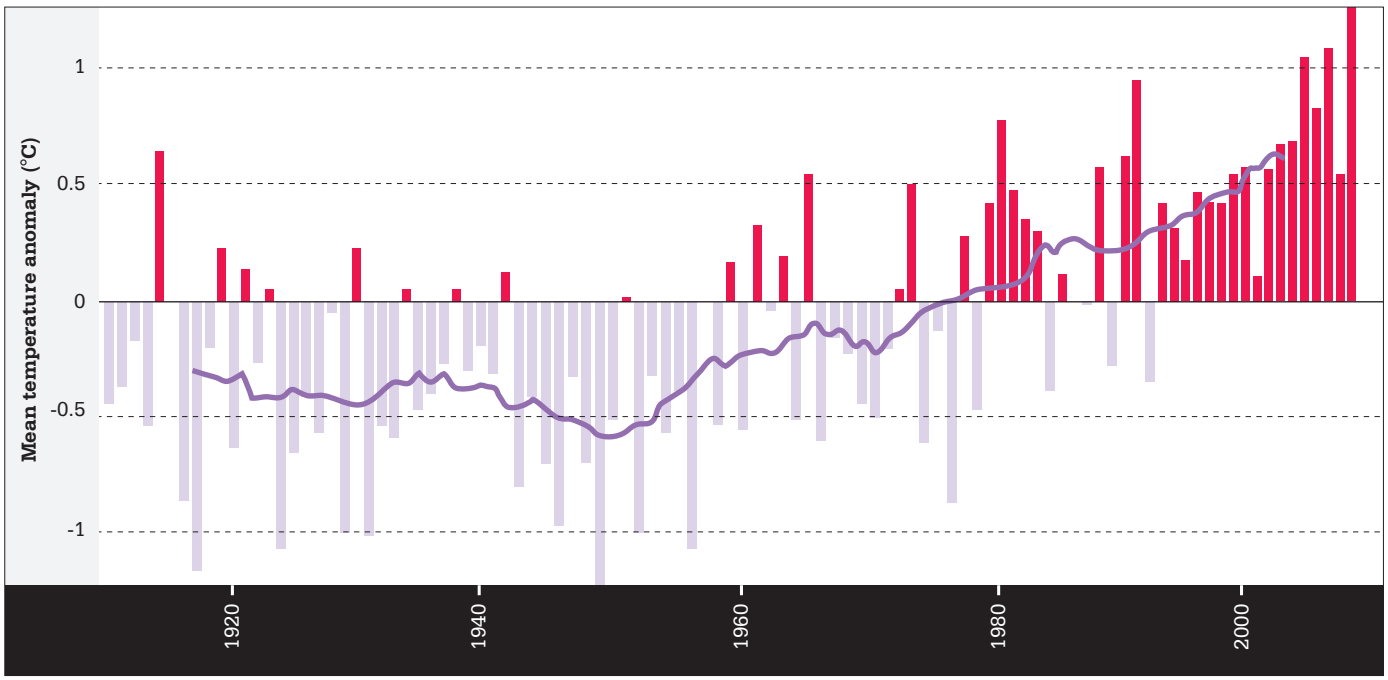
This document accompanies The Critical Decade report and highlights the key impacts for South Australia.

1. Rising temperatures will affect health.

- Average yearly temperature in South Australia has risen by almost 1°C over the past century **(Figure 1)** and the last decade was South Australia's warmest on record (BoM 2010).
- Temperatures will continue to rise. At present, Adelaide experiences, on average, 17 days out of the year with uncomfortably hot weather (above 35°C). By 2030 the number of extremely hot days could rise to about 23, and by 2070 further increase to as much as 36 in a year (CSIRO 2007).
- More record hot days and associated heatwaves increase the risk of heat-related illnesses and death, particularly in the elderly.

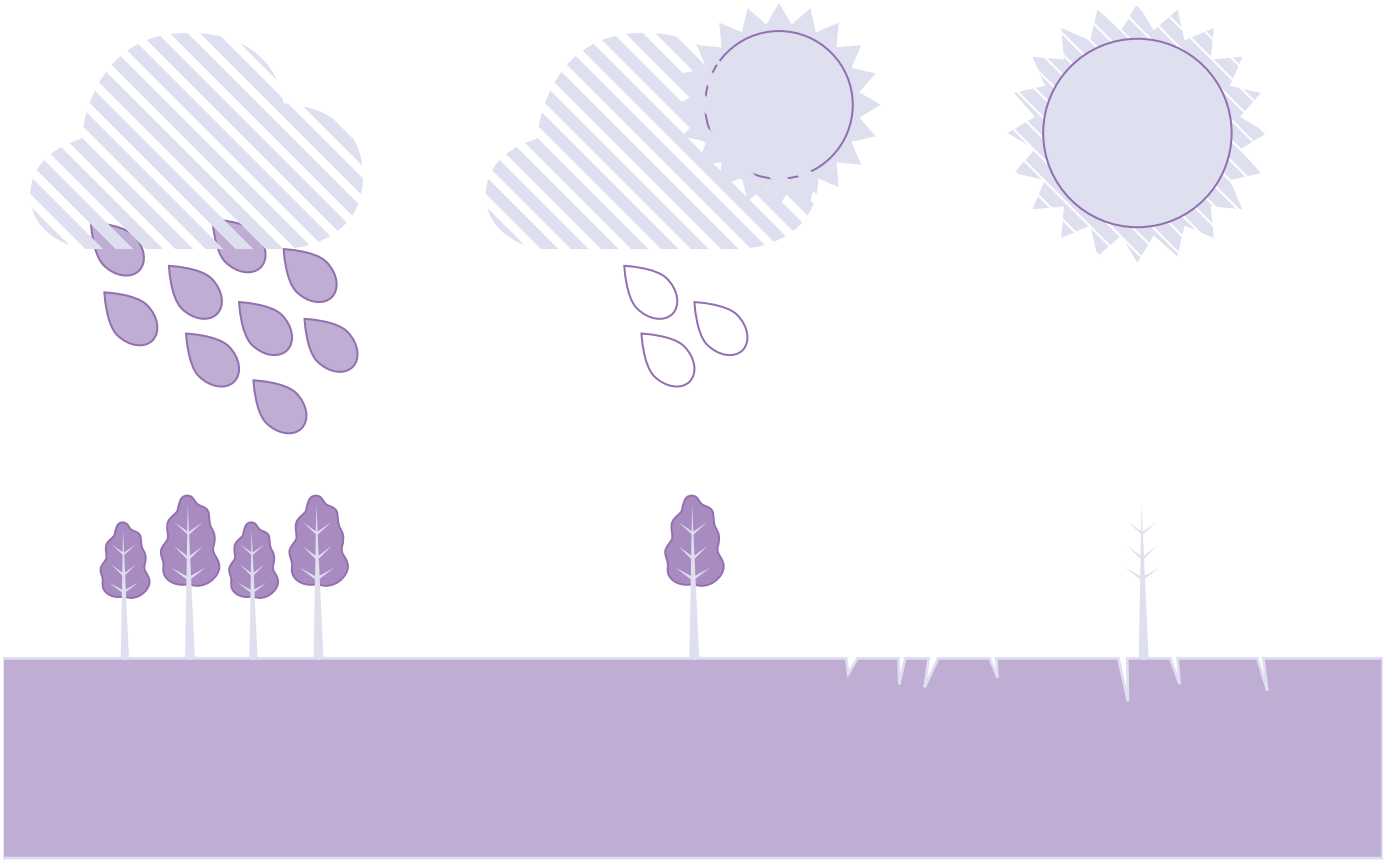
Figure 1. The long-term trend in South Australia's average temperature, measured as the difference from the 1961 to 1990 average. This graph shows that from around 1950 there has been a steady temperature rise – approximately 1°C – in South Australia. Most human-caused CO_2 emissions have occurred since 1950.



Source: Bureau of Meteorology

2. Changing rainfall patterns, combined with higher temperatures, pose significant risks to South Australia's agricultural areas and urban water supplies.

- There has been a clear decline in rainfall in southern South Australia since 1970. There is some evidence that this decline in rainfall is linked to climate change, and it is more likely than not that the drying trend will continue.
- Droughts will become more severe because of higher temperatures, and the drying soil will lead to further additional warming. This will have significant impacts on South Australia's agricultural belt.
- A continuation of the drying trend would also have large risks for drinking water availability. Research so far suggests the southern Murray-Darling Basin is drying – which has clear implications for water availability in Adelaide and other parts of South Australia. A prolonged drought in south-eastern Australia from 1997 to 2009 resulted in extremely low river flows in the Murray Darling basin, less than 50% of the long-term average (Chiew et al 2011, Potter et al 2010). The dry conditions have been attributed, at least in part, to climate change (CSIRO 2010, Murphy and Timball 2008).
- In summary, while much uncertainty remains about specific details of rainfall changes in future, we can say with considerable certainty that rainfall patterns will change as a result of climate change and often in unpredictable ways, creating large risks for water availability.



3. Rising sea levels will exacerbate existing vulnerability in South Australia's coastal towns and infrastructure.

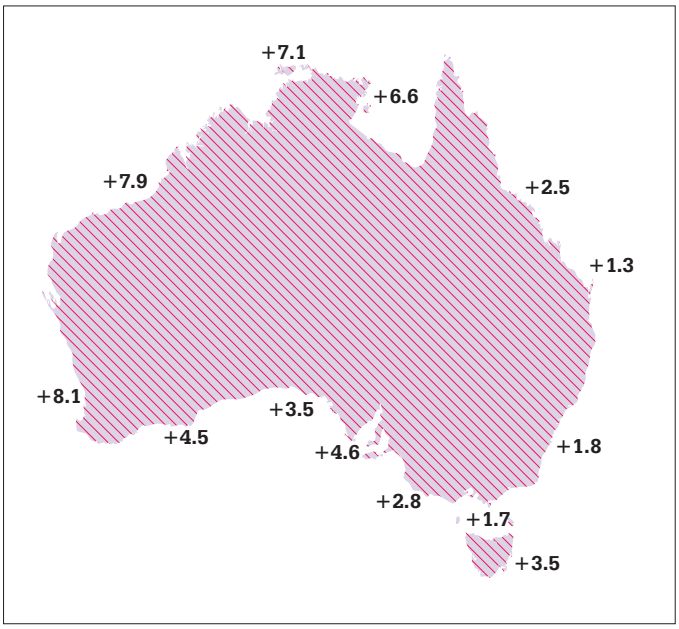
– On average sea level has risen globally by 3.2 mm a year since the early 1990s, affecting many coastal communities. Sea levels in South Australia have been rising at a rate higher than the global average – approximately 4.6 mm per year since the early 1990s, with much variability from year to year **(Figure 4)**.

– Globally, sea level has risen by about 20 cm since the late 1800s. Another 20 cm increase in sea level by 2050, which is feasible at current projections, would more than double the risk of coastal flooding in Adelaide. A rise of 50 cm, which is likely later this century, will lead to very large increases in the frequency of coastal flooding; flooding that is currently considered a 1-in-100 year event would occur every year **(Figure 5)**.

– Many of the risks due to sea level rise are associated with these flooding events, which damage cities, towns, and the supporting infrastructure in low-lying coastal areas. These flooding events can also lead to erosion of sandy beaches and soft coastlines.

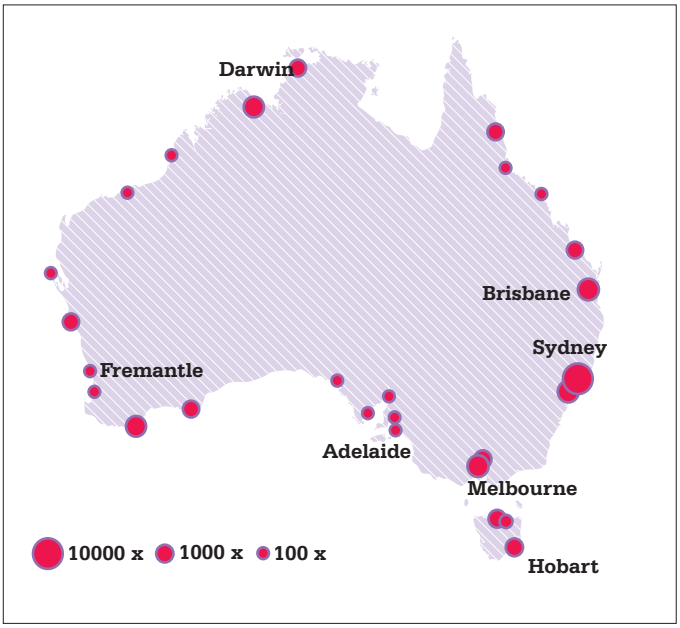
– Between 25,200 and 43,000 residential buildings in the state of South Australia may be at risk of flooding towards the end of this century – with a value of between $4.4 billion and $7.4 billion (DCC 2009) **(Figure 8)**. South Australia has the second highest value of total assets at risk – with over $45 billion dollars worth of houses, buildings and roads at risk of flooding (DCCEE 2011).

Figure 4. Local sea-level rise (mm/year) around Australia from the early 1990s to 2008.



Source: NTC 2008

Figure 5. Estimated multiplying factor for the increase in the frequency of occurrence of high sea-level events caused by a sea-level rise of 0.5 metres. High sea-level events are very sensitive to small increases in sea level.



Source: ACE CRC 2008.

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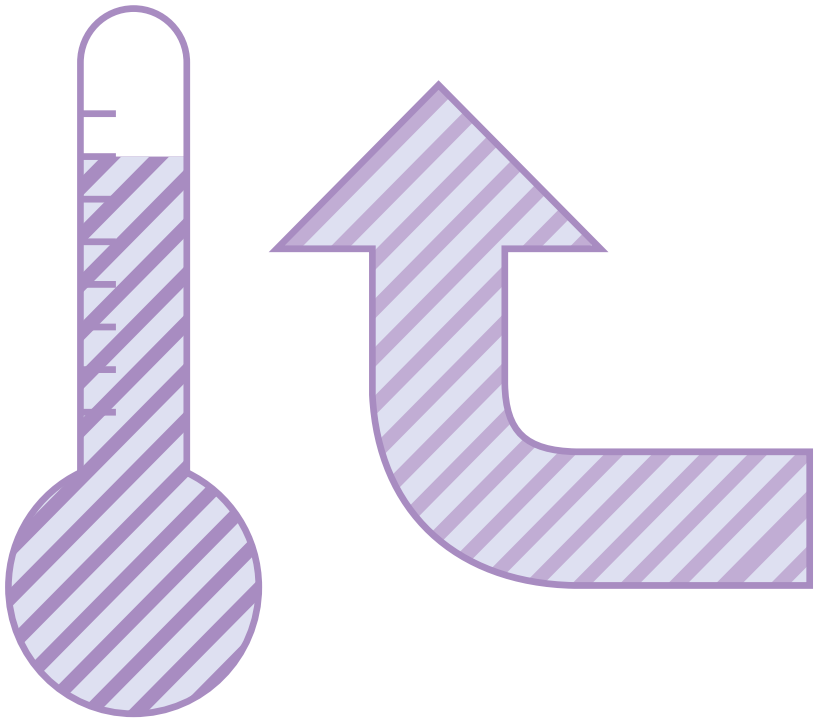
Western Australia climate change impacts



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This document accompanies *The Critical Decade* report and highlights the key impacts for Western Australia.

Key messages

- Western Australia, particularly the south-west, is vulnerable to climate change.
- Rainfall patterns in Western Australia have changed over the last 40 years. There is significant evidence that climate change has contributed to the marked drying trend in the southwest of the state. This has had serious implications for urban water supplies and agriculture.
- Sea levels along the west coast of Australia have been rising at more than double the global average. With significant part of the population living in coastal cities and towns, rising sea levels pose significant risks to Western Australia's coastal infrastructure and iconic sandy beaches.
- Western Australia is home to internationally recognised biodiversity, already stressed by habitat fragmentation and further threatened by a changing climate. Suitable habitat for a range of iconic species including the quokka, Carnaby's cockatoo and the tingle tree is likely to be substantially reduced as the climate changes. The world famous Ningaloo Reef, like other coral reefs, is highly sensitive to a changing climate. The reef, and the multi-million dollar tourism industry it supports, faces significant long-term risks from a changing climate.
- This is the critical decade for action. The choices we make between now and 2020 will shape our future. To minimise climate change risks we must begin to decarbonise our economy and move to cleaner energy sources this decade. The longer we wait the more difficult and costly it will be. Western Australia has abundant potential for expanding renewable energy generation, with some of the best wind and solar resources in Australia.

2. Declining rainfall and higher temperatures have serious implications for agriculture and urban water supplies in the southwest.

This drying tend is particularly important as most of the state's population and much of its agricultural activity occur in the southwest corner. The impact of the drying trend on the Perth water supply is now well known (Box 1).

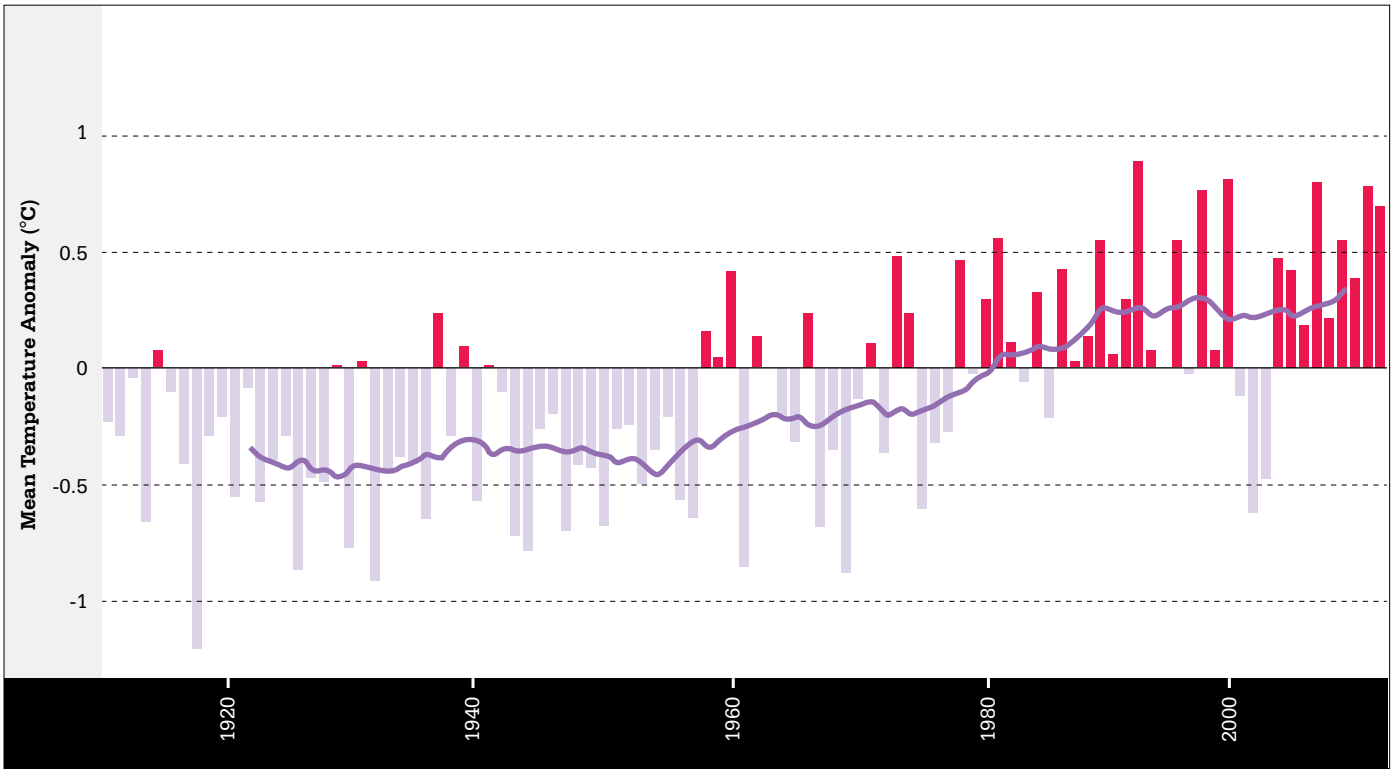
The drying trend has important consequences for the Western Australian wheatbelt. The growing season has become shorter and drier in the northeastern part of this area, and yields in this region have declined (Stephens et al. 2009). By 2050, changing rainfall and higher temperatures could result in yield losses of more than 30% (van Gool 2009).

Despite the significant drop in rainfall over the past three decades, many Western Australian farmers have adapted and have improved average wheat yields (Farre et al 2009). These gains have been achieved through improvements in technology and management practice, including the adoption of no-till cultivation, which conserves soil moisture (Agtrans Research 2009), as well as reductions in waterlogging and the spread of dryland salinity (Ludwig et al. 2009). This example demonstrates that the realised impacts of climate change do not only come from changes in the climate system, but are also dependent on management changes and adaptive measures that people may take directly in response to climate change.

However, recent experience shows how a drier climate could reduce crop yields, pointing towards limits to our adaptive capacity. Following the very dry conditions that occurred across the Western Australian wheatbelt in 2010, production of wheat and other winter crops in 2010-11 was around 43% lower than production for the previous season (ABARES 2011b).

The scale of the challenge for farmers to adapt to a changing climate will increase significantly as temperature rises, and will become more severe at 1.5 or 2 degrees above pre-industrial temperatures.

Figure 2. The long-term trend in Western Australia's average temperature, measured as the difference from the 1961 to 1990 average. This graph shows that from around 1950 there has been a steady temperature rise – approximately 0.8°C – in Western Australia. Most human-caused carbon dioxide emissions have occurred since 1950.



Source: Bureau of Meteorology.

Box 1: Risks to Perth's water supply

The 15% drop in rainfall in southwest Western Australia may not sound very dramatic. However, for urban water resources, the critical factor is runoff – the water that is captured in dams and other storages, rather than changes in rainfall itself. The relationship between the two is nonlinear; for a given change in rainfall – either increase or decrease – the consequent change in runoff is amplified two- or three-fold. Thus, a 15% reduction in rainfall could lead to a drop of up to 45% in amount of water that flows into the city's dams.

Figures 3 and 4 show the trends in annual stream flow into Perth dams from 1911 to the present. Although there is much variability from year-to-year, the average flow rate dropped to half its previous level – 177 gigalitres – over the 1975-2000 period. There have been further reductions in inflow over the past decade, with the 2006-2010 average only 57.7 gigalitres per year. The inflow in 2010 was 13 gigalitres, and in 2011, inflow up to August was less than half that normally expected (Water Corporation 2011).

The water supply for Perth, Mandurah and a number of other towns comes from a combination of surface, groundwater and desalination. A second desalination plant currently under construction will increase the contribution of desalination to the total supply to about 30% (Water Corporation 2011). The capacity of the new plant is being doubled in response to the recent very low dam inflows.

Figure 3. Change in water inflows into Perth dams.

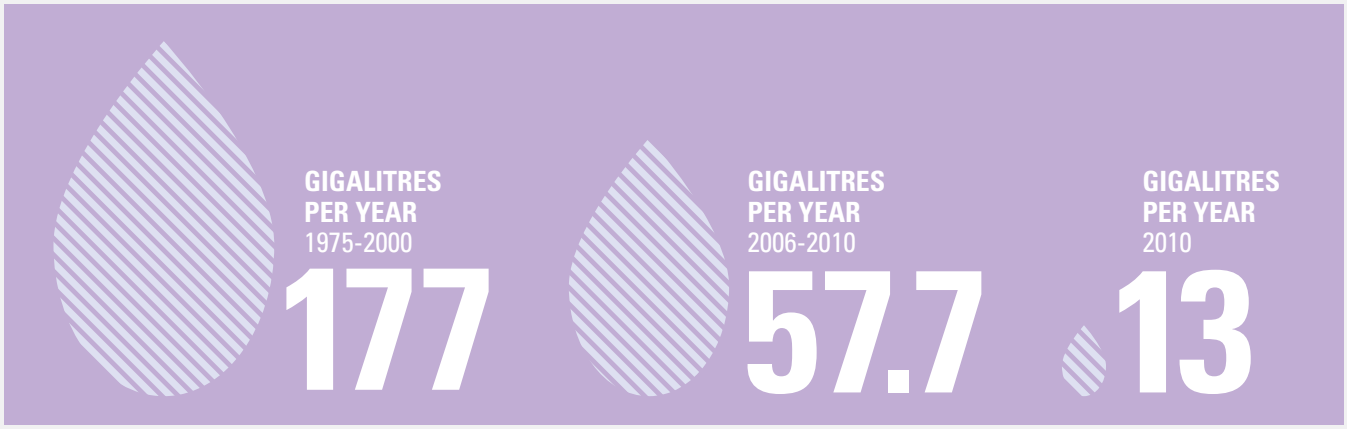
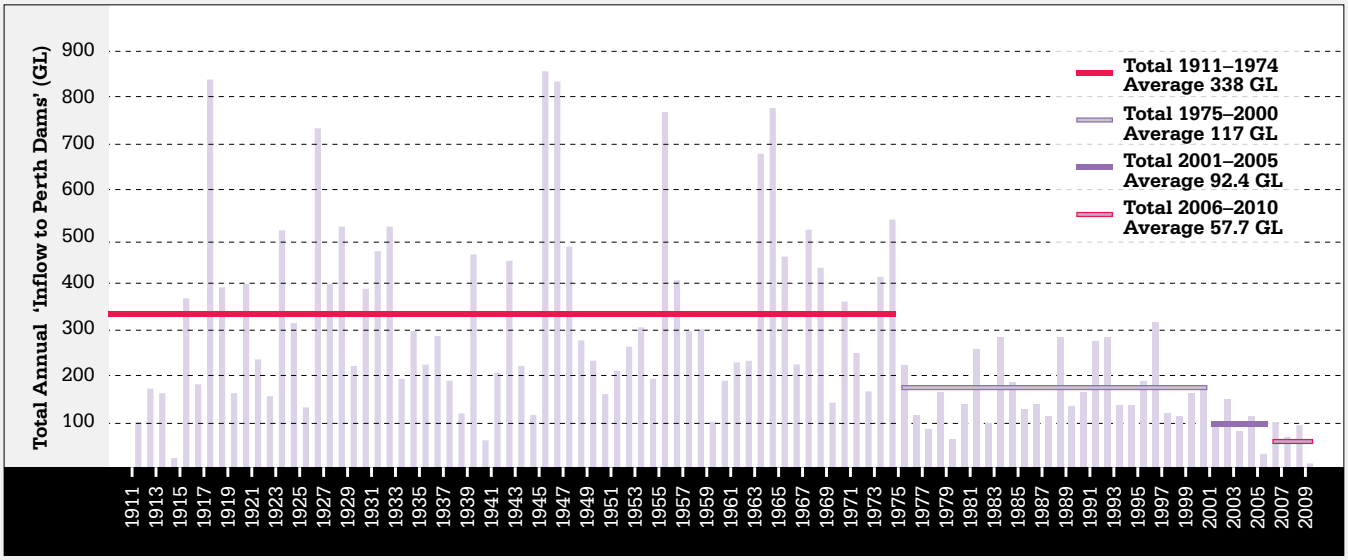


Figure 4. Trend in total annual stream flow into Perth dams 1911-2010.



Source: Western Australian Water Corporation.

5. This is the critical decade. Decisions we make from now to 2020 will determine the severity of climate change our children and grandchildren experience.

Without strong and rapid action there is a significant risk that climate change will undermine our society's prosperity, health, stability and way of life.

To minimise this risk, we must decarbonise our economy and move to clean energy sources by 2050. That means carbon emissions must peak within the next few years and then strongly decline.

The longer we wait to start reducing carbon emissions, the more difficult and costly those reductions become.

This decade is critical. Unless effective action is taken, the global climate may be so irreversibly altered we will struggle to maintain our present way of life. The choices we make this decade will shape the long-term future for our children and grandchildren.

Professor Will Steffen
Climate Commissioner

Professor Lesley Hughes
Climate Commissioner

With thanks to the Climate Commission science advisory panel; Professor Bruce Thom, Chair of the Australian Coasts and Climate Change Council and Professor Ove Hoegh-Guldberg.

Box 5: Opportunities in Western Australia

Western Australia has abundant potential for expanding renewable energy generation, from sources including wind, solar, wave, geothermal and bioenergy.

Wind is currently the main renewable source of electricity in Western Australia. The southwest has some of the best wind resources in Australia. Some of Australia's best solar energy resources are found in the Pilbara and northwest, and the midwest offers good resources in close proximity to areas of growing electricity demand and the electricity grid (Office of Energy).

Bioenergy sources are in earlier stages of investigation and development. A demonstration wave energy project is under construction near Perth. Mallee eucalypts, which have been established in the wheatbelt to help manage dryland salinity, could also provide biomass for electricity generation.

Reducing emissions from transport is also important. Perth has taken a lead amongst Australia's capital cities in extending its urban rail network, reducing road traffic and hence greenhouse gas emissions. The new line to Mandurah is a good example, greatly increasing the share of trips on public transport on that route (Figure 16).

Figure 16. The first train on the Mandurah railway line.

Photo credit: www.trains.chookman.id.au