

CLIMATE-READY VICTORIA

HUME



How climate change will affect the Goulburn Broken and North East and how you can be climate-ready



The Hume region has already become warmer and drier – a climate trend likely to continue into the future. Local residents, businesses and communities are changing the way they do things in response. Getting climate-ready involves understanding how climate change is likely to affect you and your region, and working out ways to adapt. Everyone can contribute to the Hume region's climate-ready future.

HUME HAS BEEN GETTING WARMER AND DRIER. IN THE FUTURE THE REGION CAN EXPECT:



temperatures to continue to increase year round



more hot days and warm spells



fewer frosts



less rainfall in autumn, winter and spring



more frequent and more intense downpours



harsher fire weather and longer fire seasons

HOW WILL THESE CHANGES AFFECT YOU, AND WHAT CAN YOU DO ABOUT THEM?

This publication highlights the impacts climate change will have on the Hume region. It gives examples of how people are already becoming climate-ready, with links to more detailed information.

While this publication is about adapting to climate change, reducing your carbon emissions by reducing energy use and switching to renewable energy sources is also important in getting climate-ready. For more information on reducing your emissions, visit www.climatechange.vic.gov.au.

OUR CHANGING CLIMATE

HUME AT A GLANCE

12 local government areas

approximately
267 000
5% of the state

40 283 km²
18%
of the state



RECENT CLIMATE

The climate varies greatly between the alpine regions and the floodplains along the Murray River. Summer average maximum temperatures currently range from 20°C in the alpine areas, to 31°C on the lower slopes and plains. Winter average maximum temperatures range from 4°C in the alpine areas to 12°C on the plains. Frosts can occur over the entire region between April and October. There is occasionally snow in the mountains above 1000 m.

Rainfall currently ranges from 2000 mm in the alpine areas to less than 500 mm on the plains. Most rainfall occurs in winter and spring. Summer thunderstorms are common, contributing to the risk of fires and floods.

For more information about some of the drivers of Victoria's climate, visit the [ClimateDogs website](http://ClimateDogs.com.au).

CLIMATE VARIABILITY AND CHANGE

Our climate varies – it always has and always will. This climate variability means that some periods are cooler and wetter than average (as was the case in the 1970s), while others are hotter and drier (such as during the Millennium Drought). However, due to climate change, the long-term average is changing. Future climate will be different from that in the past.

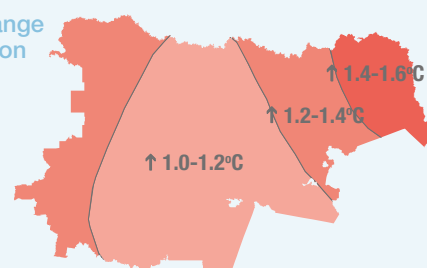
IT'S GETTING WARMER AND DRIER

Over the past 100 years, global surface air temperatures have risen by almost 1°C. Both the atmosphere and the oceans have warmed. Human activity is causing climate change, through our release of greenhouse gases from the burning of fossil fuels, land use change and agriculture. Atmospheric concentrations of carbon dioxide are now more than 40% higher than they were before industrialisation.

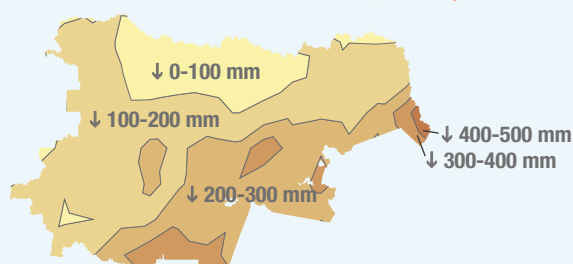
In the Hume region, the rate of warming has increased since 1960.

On average, rainfall has declined since the 1960s, especially in autumn. The harsh Millennium Drought (1996 to 2009) ended with two of the wettest years on record in 2010–11.

Temperature change in the Hume region since 1950



Rainfall change in the Hume region since 1950



HOW DO WE GET CLIMATE-READY?

Being climate-ready in the Hume region involves knowing the climate risks and impacts for the region, and making changes so that we can take advantage of the opportunities and reduce the negative impacts.

HUME CLIMATE RISKS



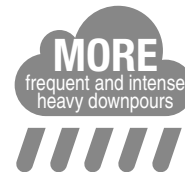
MORE
days of
extreme
heat



HARSHER
fire weather

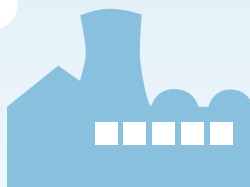


LESS
rainfall



MORE
frequent and intense
heavy downpours

GETTING CLIMATE-READY AT A GLANCE



KEY CLIMATE RISKS

Primary production

- ↓ rainfall
- ↑ temperature
- ↑ hot days
- ↑ fire weather

Infrastructure

- ↑ fire weather
- ↑ flooding
- ↑ hot days
- ↑ heatwaves

Tourism

- ↑ temperature
- ↑ fire weather
- ↑ heatwaves
- ↓ snow cover

Health and community

- ↑ heatwaves
- ↑ flooding
- ↑ fire weather
- ↑ solar radiation

Environment

- ↓ rainfall
- ↑ fire weather
- ↑ hot days
- ↓ snow cover

POTENTIAL IMPACTS

- Earlier flowering and planting times
- Changed distribution of pests and diseases
- Farm business affected by bushfire
- Changes in pasture growth
- Reduced water security

- Increased flood damage
- Increased maintenance costs
- Increased disruption to services

- Increased threats to tourism infrastructure
- Reduced snow depths and shorter season
- Risks to tourists unfamiliar with conditions

- More stress on health and emergency services
- More heat-related deaths, particularly among the elderly and disadvantaged
- Mental health effects
- Changes in disease occurrence

- Amplification of existing threats to flora and fauna
- Changes to habitat
- Altered disturbance regimes
- Contraction of alpine ecosystems
- Changing dynamics of invasive species
- Reduced snow depth and cover

CLIMATE-READY ACTIONS

- Consider enterprise diversification
- Plan for a secure water supply
- Regularly access long and medium range outlooks, as well as short range weather forecasts
- Re-sow pastures with varieties that account for changing seasonal and rainfall patterns

- Insure public assets
- Consider future climate when locating new infrastructure
- Increase road heights
- Increase stormwater capacity
- Diversify sources of power and water, including decentralised technologies

- Adopt appropriate cancellation policies
- Undertake business continuity planning
- Multi-skill staff
- Diversify activity offerings
- Consider enterprise diversification
- Prepare for changing seasonal demand

- Use cost-effective pedestal fans in heatwaves
- Implement/use rural mental health care programs
- Establish contingency plans for patient influxes in hospitals
- Increase green spaces and cool zones for heat stress

- Target new and emerging diseases and pests
- Increase green urban infrastructure and urban biodiversity
- Link habitats to allow species to move
- Consider moving selected populations to new areas

GETTING CLIMATE-READY

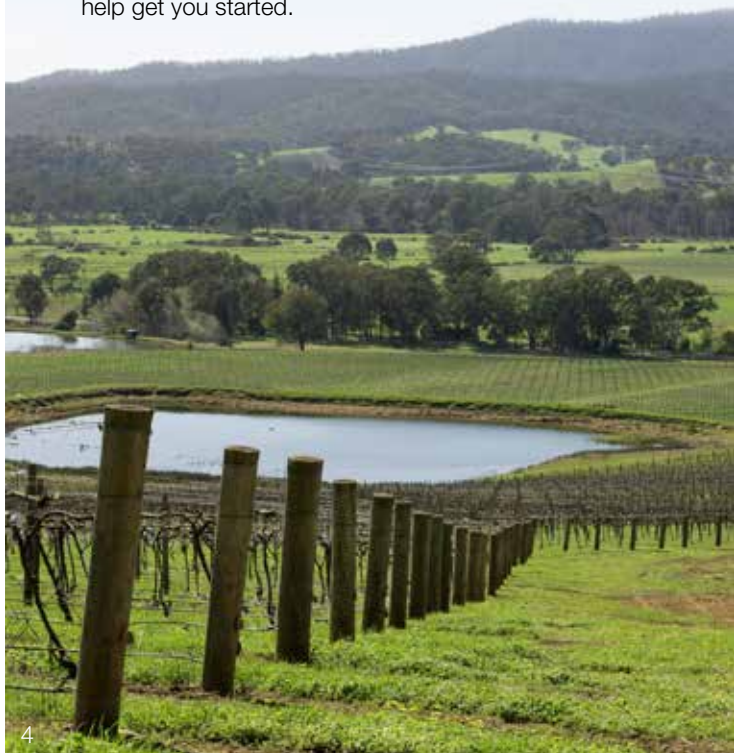
HOW CLIMATE-READY ARE YOU?

Getting climate-ready is an ongoing process, and there's no single recipe for success. Many of the risks we face are not new. However, there are likely to be changes in duration, frequency and severity of some weather events, as well as changes to the climate.

To determine what's important to you and what climate change responses might work for your situation, consider these questions:

- ▶ How might you – your health, property, business, community, industry – be affected by:
 - higher temperatures and more frequent heatwaves?
 - less autumn, winter and spring rainfall, more time in drought, decreased water availability or flooding?
 - harsher fire weather?
- ▶ How might your services, suppliers, clients or customers be affected?
- ▶ Are you making any long-term decisions now that will be impacted by future climate change?
- ▶ What action could you take now to prepare? What are others in your region doing? What benefits have they experienced?
- ▶ Can you prioritise actions that also have other benefits, such as emissions reduction, financial, community or environmental advantages?
- ▶ Does climate change present any opportunities you can take advantage of?

The information, case studies and links in this brochure can help get you started.



CLIMATE-READY NOW

Victorians have always been good at managing the ups and downs of climate. Now that we have a clearer picture of the way in which climate is likely to change in future, there's lots that we can do to become climate-ready. Decisions we make now will affect how well we cope with the changing climate, which in turn will affect future economic and employment conditions. Decisions range from simple to complex, and some will need to be made sooner than others. Your decisions may depend on the local climate in your part of the region.



There are many good examples of communities in your region and in Victoria preparing for and adapting to climate change. The **i** links you directly to the source or visit www.climatechange.vic.gov.au for a full list of links.



PRIMARY PRODUCTION

The Goulburn Valley area produces about a quarter of the value of Victoria's agricultural production. Irrigated and dryland agriculture, grazing, manufacturing (including food processing) and horticulture are all major employers.

Horticulture and vegetables are highly sensitive to reduced water availability. Changes in temperature will alter planting and harvesting times, and compress the times suitable to harvest. Pest and disease incidence is likely to change. Intensive animal industries may require more power and water to cool facilities and maintain adequate temperatures. While the total annual number of frost days is expected to decrease, an increase in spring frosts is possible, especially over the next decade or so.

Lower agricultural output would affect employment and regional economic activity. Modelling for the Shepparton region shows that a 13% reduction in irrigated agricultural production by 2070 would result in falls in regional output of \$287 million, employment of approximately 1700 and population of approximately 4000 compared to a scenario without climate change.



Through the Birchip Cropping Group, researchers worked with farmers to assess how different climate change scenarios are likely to affect cereal crop yields. The costs and benefits of different adaptation options were examined, including changed crop varieties and planting schedules, to see the extent to which farmers could offset the adverse impacts of climate change.



Dairy Australia's Dairy Climate Toolkit provides comprehensive details of the practices that profitably reduce greenhouse gas emissions from dairy farm systems, and adaptation strategies such as addressing heat stress and responding to changes in pasture.





INFRASTRUCTURE

Significant infrastructure includes the Puckapunyal and Bandiana Military Areas, Goulburn Valley food and fruit processing facilities, irrigation infrastructure and bioenergy plants. Transport infrastructure is critical to the functioning of the region. The interstate links of the Hume and Goulburn Valley corridors are the backbone of the region's transport network, each with major highways and rail networks connected to interstate cities and markets.

Transport infrastructure will be increasingly exposed to periodic flooding and increased heat loading. Long hot spells will weaken road surfaces and exposure to extreme heat events could result in road rutting and cracking, and bridge expansion joint cracking.



The Goulburn-Murray Water Connections Project is creating a stronger, more sustainable, future for irrigation agriculture across the Goulburn-Murray Irrigation District. Victoria and the Commonwealth are investing more than \$2 billion to create a network that delivers water when and where it's needed.



TOURISM

Tourism is a major economic and employment sector for Hume, with over 2.5 million domestic overnight visitors, and tourism expenditure exceeding \$1.3 billion per annum. The region includes alpine resorts, which are a major winter attraction. The Murray River corridor offers many summertime activities.

The ski industry is expected to face significant changes as a result of the warming climate. While snow making will offset some of the losses of natural snow, there will be fewer days where the temperature will be suitable for snow making. Increased fire weather and community perception of fire danger, and reductions in river flows and water availability may affect tourist numbers.



HEALTH AND COMMUNITY

The percentage of people overweight or obese is higher than the Victorian average, and there are also high rates of chronic disease, disability and high-risk health behaviours such as smoking. Over the next 10 years, the region's population is expected to expand a further 22% with growth around Shepparton and Wodonga, and significant growth in the proportion of people aged over 65.

Increased hot days and heatwaves will exacerbate existing health risks, putting greater pressure on hospitals and emergency services. Vulnerable groups may need assistance to manage the impacts of climate change. More frequent extreme weather events and impacts on the economy and jobs due to climate change may also affect the mental health of the community.



The community of Beechworth has started a resilience program as part of its school and early childhood program, bringing together Beechworth Health Service, the Country Fire Authority, local primary schools and early childhood education services. Funded through the Foundation for Rural and Regional Renewal, activities for children, educators and parents that foster resilience and a positive mindset have been delivered in conjunction with the Country Fire Authority's Bush Preparedness program.



ENVIRONMENT

The region boasts a range of important habitats, ranging from wetlands to alpine ecosystems.

In the mountains, diverse vegetation communities provide habitat for a wide array of native flora and fauna, including many endemic and threatened species. The Mountain Pygmy Possum, for example, is limited to high mountain habitats and will be highly sensitive to climate change impacts.

The Murray River is home to several species of fish that are sensitive to changed flow regimes, such as the Murray Cod and Macquarie Perch. Flooding along the Murray is important for maintaining the River Red Gums, and the riverine forests and waterways are important breeding sites for Superb Parrots, Squirrel Gliders, Brush-tailed Phascogales, Long-necked Turtles and Murray Spiny Crayfish.

Degradation of biodiversity will place greater stress on the personal and economic wellbeing of communities in Hume.



The Goulburn Broken and North East Catchment Management Authorities are developing adaptation plans to provide further information about the impacts of climate change on natural resources. The plans will also identify priority actions for adaptation and mitigation and will be available in 2016.

FUTURE CLIMATE

LOOKING AHEAD

Climate projections for the Hume region are based on sophisticated national and international **global climate models**. These models use the physical laws that govern the way the world's climate works to simulate the climate from high in the atmosphere to the depths of the oceans. The models run on some of the world's most powerful supercomputers, and successfully represent the important features of today's climate as well as those of past climate.

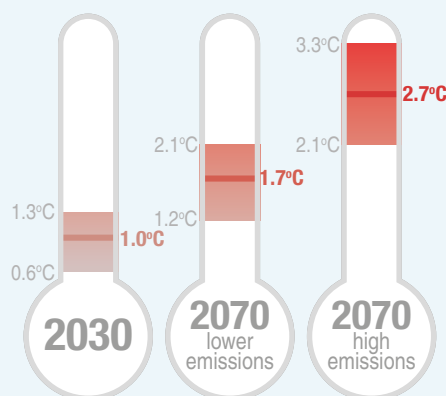
Maths and physics do not govern social and economic aspects of the future, so we don't know the impacts of population, the economy, policy decisions and technology on greenhouse gas emissions. To cover a range of possibilities, scientists use **emissions scenarios** called Representative Concentration Pathways (RCPs) to develop climate projections. These projections describe a **high emissions** future (using RCP8.5) and a **lower emissions** future (using RCP4.5). For the past 10 years we've tracked along the high emissions pathway. More information about how the projections were produced and guidance on their application are at climatechangeinaustralia.gov.au.

The climate is projected to continue to change over the coming century. The projections are given for **20-year periods centred on 2030 and 2070**, so the 2030 projections are for the period 2020–2039 and the 2070 projections are for the period 2060–2079. Given the similarity of the emissions scenarios up to 2030, only projections for the high emissions scenario for 2030 are used in this publication. Projections are represented as a change relative to the period 1986–2005.

UNDERSTANDING THE PROJECTIONS

The projections are presented as a **median (middle) value and a range** that excludes the lower and upper 10% of results.

For example, in 2070 under a high emissions scenario, annual average temperature is projected to rise by 2.7°C (2.1–3.3°C). In this case, the median temperature rise determined by all the models is 2.7°C; 90% of model results indicated a rise of at least 2.1°C and 90% of the model results indicated a rise of 3.3°C or less.



Projected annual average temperature changes for the Hume region

Our **confidence** in the projections is based on a combination of scientific understanding, past climate changes, evaluation of climate model performance and the extent of climate model agreement. Very high confidence indicates robust evidence and high model agreement.

very high confidence ****
high confidence ***
medium confidence **



TEMPERATURE

Average temperatures will continue to increase in all seasons ****

For the near future (2030), the annually averaged warming is projected to be around 0.6 to 1.3°C above the climate of 1986–2005. By the year 2070, the projected range of warming is 1.2 to 3.3°C, depending on future emissions.

There will be more hot days and warm spells ****

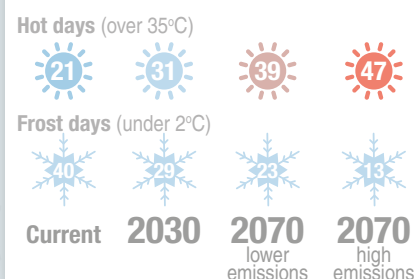
There will be a substantial increase in the temperature reached on hot days. There will be more hot days (greater than 35°C), and warm spells will last longer.

There will be fewer frosts ***

Frost-risk days will decrease.

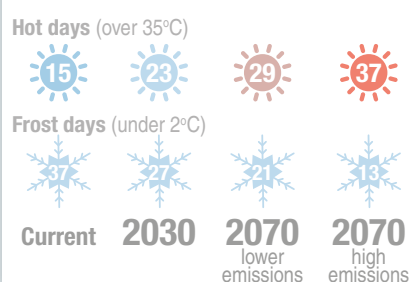
FUTURE CLIMATE WODONGA

Average number of days per year



FUTURE CLIMATE SHEPPARTON

Average number of days per year





RAINFALL

Natural climate variability will dominate any projected changes in the near future ***

In the near future (2030), year to year changes in rainfall will dominate trends caused by greenhouse gases. Recent research partly links the observed cool season rainfall reductions to climate change.

By 2070 there is projected to be less rainfall in the cool season * but no rainfall changes in the warm season ****

Overall, rainfall is likely to decrease, with the greatest decreases expected in spring and winter.

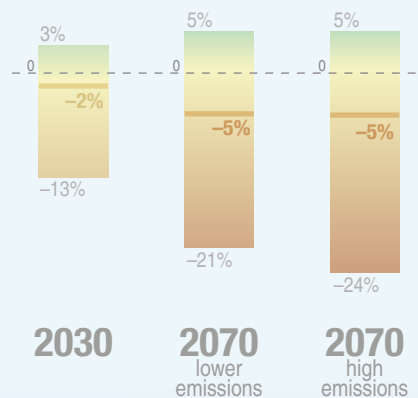
Conditions outside these projections are also possible, from either natural variability (such as extended drought) or climate changes that are outside the range we currently estimate.

Frequency and intensity of extreme rainfall events are projected to rise ***

Despite an overall trend of declining rainfall, more of the rain that does fall will be in increasingly extreme downpours. This is likely to lead to an increase in the incidence of flooding events, particularly in urbanised and small catchments.

Time spent in drought is projected to increase over the course of the century **

Projected annual average rainfall changes for the Hume region



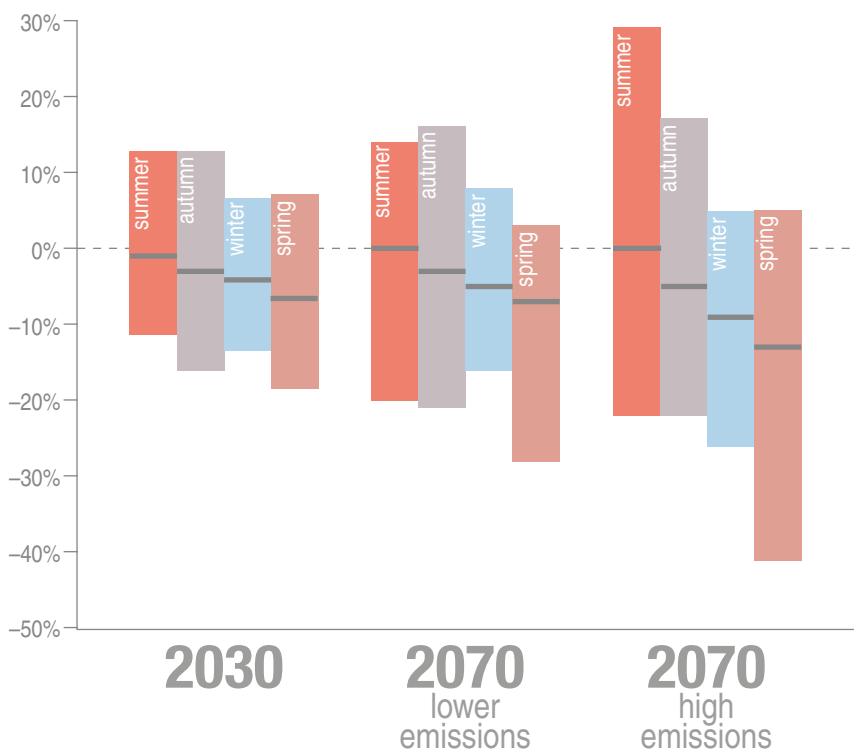
FIRE WEATHER

Fire weather is projected to be harsher in the future ***

Fire weather is a measure of fuel dryness and hot, dry, windy conditions. An increase in frequency of very high and extreme fire danger days is projected.

More detailed information on these and other climate variables is available at www.climatechange.vic.gov.au

PROJECTED SEASONAL RAINFALL CHANGE (%) FOR HUME



The bar indicates the range and the middle value is shown by the horizontal line.

HUME 2050

In 2050, under high emissions, the climate of Shepparton will be more like the climate of Griffith now; and Wangaratta and Benalla will be more like Dubbo.

To find out what the climate will be like in the future where you live, use the Climate Analogues tool on the Climate Change in Australia website at www.climatechangeinaustralia.gov.au. The tool matches projected rainfall and maximum temperature with the current climate experienced in another location for 20-year periods centred on 2030, 2050 and 2090.

ARE YOU CLIMATE-READY?

There are many resources available to help you get climate-ready.

A full list of links to projects mentioned in this brochure is available at www.climatechange.vic.gov.au.

There are similar brochures for other Victorian regions and a statewide brochure, available at www.climatechange.vic.gov.au.

To find out more about what the Victorian Government is doing to make the state more climate-ready, or for more information about Victorian Government climate policy, visit www.climatechange.vic.gov.au.

Information about the impacts of climate change on water availability and supply is available from the Victorian Climate Initiative website at www.cawcr.gov.au/projects/vicci/.

Information about the changes in our climate since the beginning of last century and trends we're seeing now is available from the Bureau of Meteorology website at www.bom.gov.au.

Information about the future climate and its impacts, and adaptation strategies, is available from the Climate Change in Australia website, produced by CSIRO and the Bureau of Meteorology, at www.climatechangeinaustralia.gov.au.



Climate-ready Victoria: Hume. November 2015.

Climate change projections in this publication have been generated by CSIRO on behalf of the Victorian Government, and are based on national projections released by CSIRO and the Bureau of Meteorology. The Bureau of Meteorology has kindly supplied data on climatic trends. CSIRO has reviewed this publication.

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Photo credits: Alpine Shire Council, Catherine Sutherland, Tourism Victoria, Destination Albury Wodonga

