Emissions Reduction Strategy 2024

Acknowledgement of Country

Mundadjalina-k ngala kaditj Noongar moort nidja Wadjak boodjar-ak kalyakool moondang-ak kaaradj-midi. Ngala Noongar Moort wer baalabang moorditj kaadidjiny koota-djinanginy. Ngala Noongar wer Torres Strait Moort-al dandjoo koorliny kwaba-djinanginy. Koora, yeyi wer kalyakool, ngalak Aboriginal wer Torres Strait birdiya wer moort koota-djinanginy.

Shire of Mundaring respectfully acknowledges the Whadjuk people of the Noongar Nation, who are the traditional custodians of this land. We acknowledge Elders past, present and emerging and respect their continuing culture and the contribution they make to the region.

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Foreword from Shire President

In the spirit of shared responsibility, the Shire of Mundaring has embarked on a transformative journey since 2016, driven by our commitment to environmental stewardship. Reflecting on accomplishments such as the installation of solar panels and the transition to energy-efficient systems, we take pride in the positive changes we've initiated within our community.

This report marks a significant milestone as we announce a new, aspirational goal: a 70% reduction from our 2016/17 emissions, by 2030. This ambitious target is not just a numerical challenge; it's a collective call to action, inviting our community to actively participate in shaping a future characterised by sustainability and resilience. So while this strategy has a strong organisational focus, we are asking our community to come along on the journey and contribute to a reduction in community emissions. Together, we can forge a brighter, greener, and more economically sound community where every energy-efficient initiative becomes a shared opportunity for success.

I look forward to a future where our collective efforts illuminate the path toward a more sustainable and thriving community. As we navigate the road ahead, guided by our shared commitment, the Shire of Mundaring stands poised to lead, inspire, and build a legacy of positive change for our community.

Shire President
Paige McNeil

Executive Summary

The science of global warming and climate change is well established (see Appendix 1) and the costs of climate disruption are increasing. Some further warming is inevitable in the next decade but to avoid crossing climate tipping points, it is essential to continue to reduce greenhouse gas emissions.

The Shire's carbon footprint is the sum of greenhouse gas emissions from Shire operations and activities that use energy or fuel (electricity, gas, unleaded petrol and diesel).

Shire of Mundaring adopted an Energy and Emissions Reduction Strategy in 2018, with a target to reduce greenhouse gas emissions by 30 per cent by 2030 (from the 2016/2017 baseline).

The past few years have seen record-breaking temperatures and more frequent heatwaves, as well as devastating fires and floods that are driving insurance costs higher.

In 2019 the Shire declared a climate emergency and called on the State and Commonwealth Governments to act to urgently reduce emissions, increase resources for firefighting and help local governments to adapt.

Since 2019 the risks and impacts of climate change have become more apparent both within Australia and around the world. The majority of Australians expect climate change will pose a serious threat to our way of life over the next 25 years. Concern is growing, especially for younger people who will face more severe climate disruption through their lives.

The Shire has already achieved significant emissions reductions for high energy use buildings and facilities, and the original 30 per cent target was achieved in 2023. The accelerated changeover to LED streetlights will further reduce the Shire's carbon footprint in 2024.

There are still opportunities to improve energy efficiency and add more renewable energy to community facilities such as Bilgoman Aquatic Centre. It will also be important to ensure that all new buildings and facilities are designed and constructed with sustainability and energy efficiency in mind.

This revised Energy and Emissions Reduction Strategy sets a new target of 70 per cent less than the 2016/2017 baseline by 2030, and identifies the actions that will help the Shire to achieve that target.

Development of a low-emissions fleet transition plan will provide a roadmap for shifting the Shire's vehicles and machinery to electric alternatives as they become available, practical and cost-competitive. The Shire will also continue to provide locally relevant information and support voluntary emissions reduction efforts by residents, schools and businesses.

Energy and Emissions Reduction Strategy 2018

Shire of Mundaring adopted an Energy and Emissions Reduction Strategy in 2018 with a target to reduce greenhouse gas emissions by 30 per cent by 2030 (from the 2016/2017 baseline).

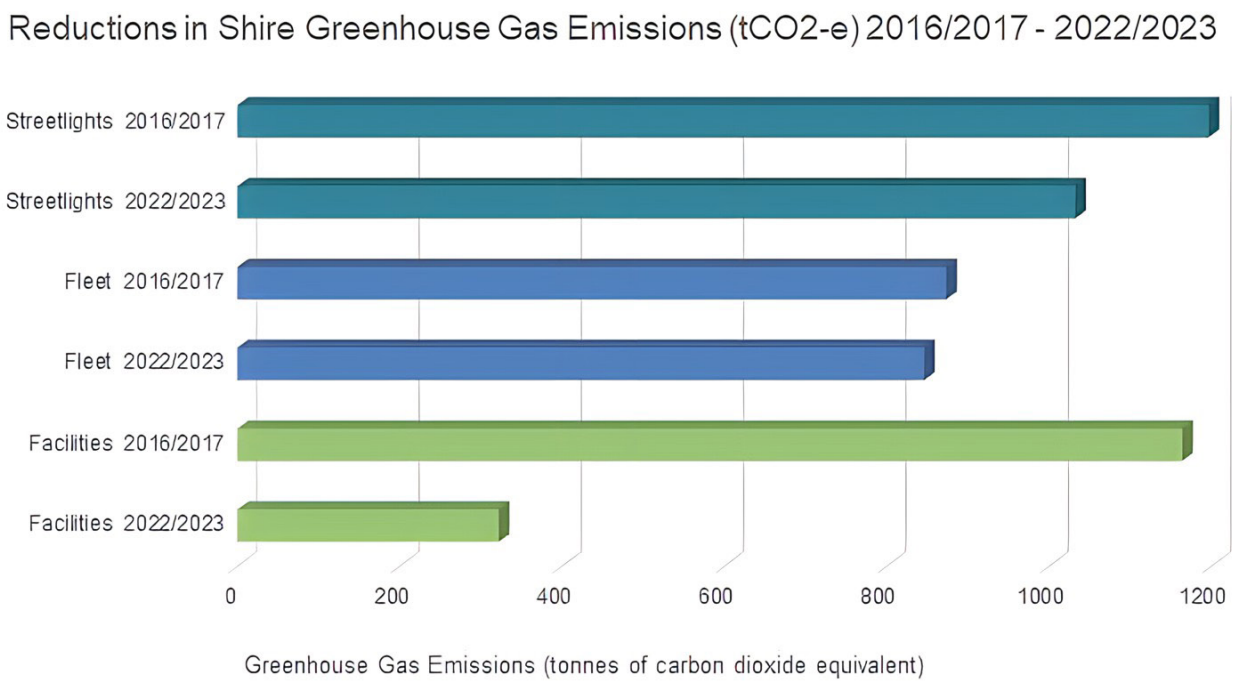
The Shire's carbon footprint is the sum of greenhouse gas emissions from Shire operations and activities that use energy or fuel (electricity, gas, unleaded petrol and diesel).

Actions that would also provide cost savings were prioritised and below are some of the measures that have been implemented by the Shire:

- Installation of solar panels at the Shire of Mundaring Administration Centre, Operations Depot, Mundaring Arena, Boya Community Centre, and Swan View Youth Centre.
- Gradual replacement of bottled gas with electric systems at Shire facilities.
- Gradual replacement of lighting in Shire facilities with more efficient LED.
- Smart lighting systems at the Shire of Mundaring Administration Centre, and Operations Depot, and sensor lights in some buildings.
- Amending Shire Purchasing Policy to require energy efficiency to be a key consideration in purchasing decisions.
- Joining a local government renewable energy power purchase agreement for high electricity use (contestable) sites.
- Accelerating roll-out of more efficient LED street lighting (commencing late 2023).

While the greatest reduction has been achieved in reducing emissions from Shire buildings and facilities, there have also been reductions in emissions from fleet and streetlights.

Shire sustainability initiatives support responsible management of water, energy, and natural resources.



2022/2023 reductions in Shire greenhouse gas emissions – streetlights, fleet and facilities compared to 2016/2017 baseline.

The Shire joined 50 other local governments in a renewable energy 'bulk buy' or power purchase agreement, facilitated by the WA Local Government Association.

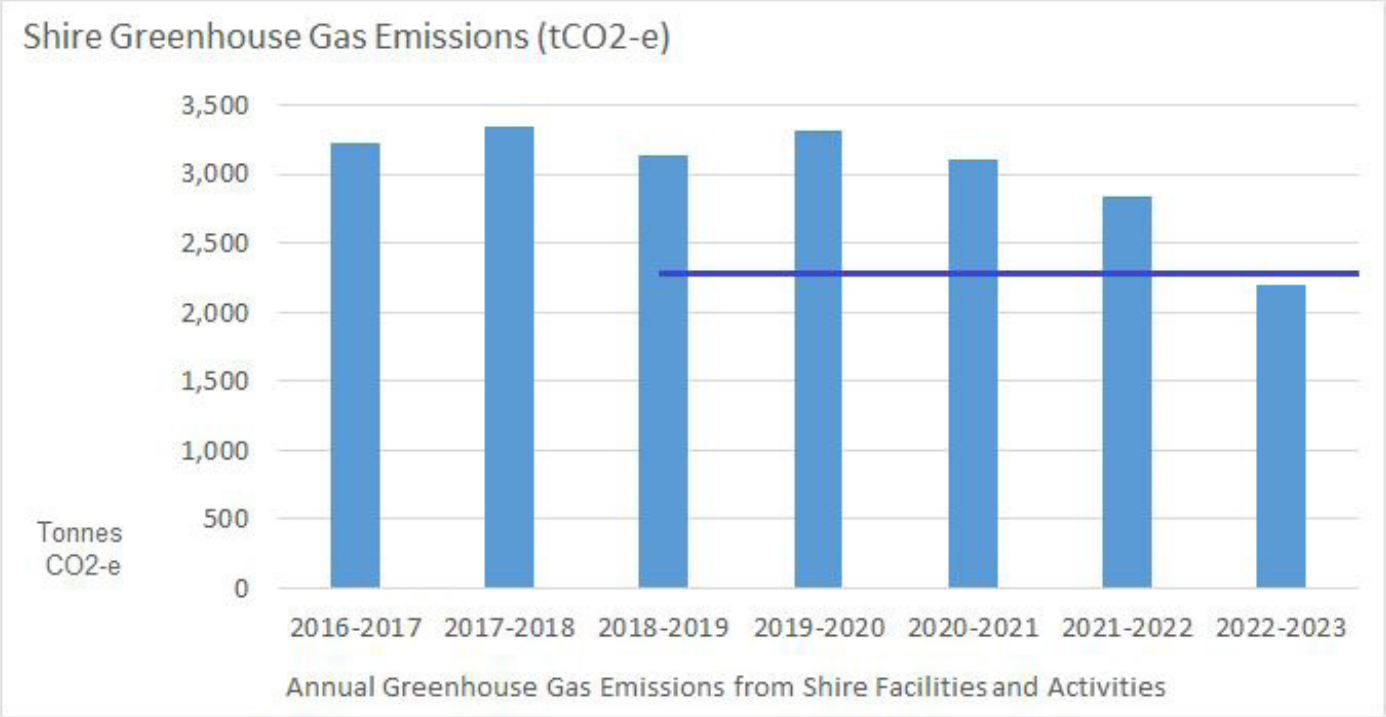
This came into effect in March 2022 and will expire in March 2025. This provided for significant emissions reduction from Shire facilities by using 100 per cent renewable energy for the Shire's seven highest electricity use (contestable) sites.

Following on from energy efficiency and rooftop solar initiatives, the power purchase agreement means that larger facilities like the Shire of Mundaring Administration Centre now operate on 100 per cent renewable energy.

Electricity and GreenPower prices have risen since the power purchase agreement came into effect. Future bulk buys with other local governments may also provide some protection against rising power prices after 2025.

Consolidation of community facilities into larger buildings, such as the proposed Mundaring Multi-Purpose Community Facility, may enable more of the Shire's electricity needs to be considered contestable and included in future renewable energy power purchase agreements.

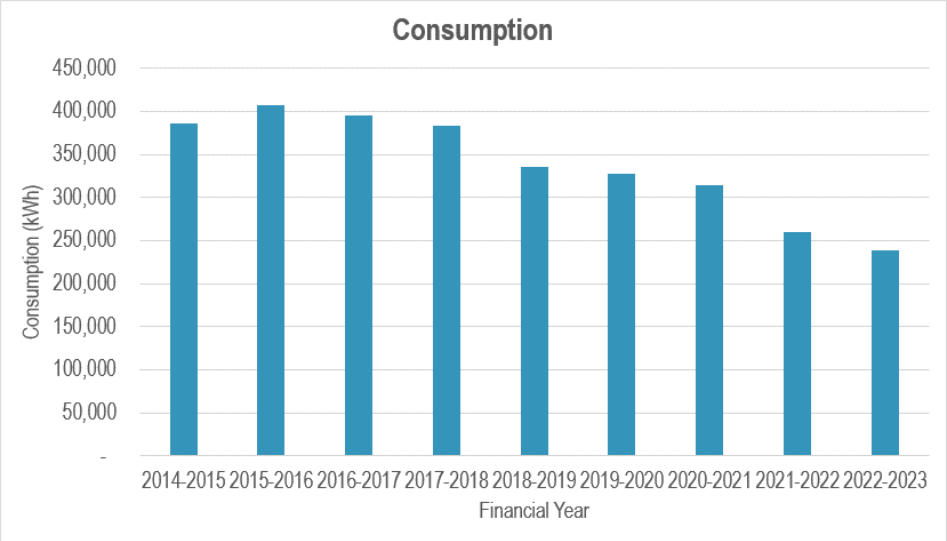
The range of measures implemented to date have achieved the target emissions reduction in 2023. Further reductions will occur during 2023/2024 as the conversion of streetlights to more efficient LED is completed.



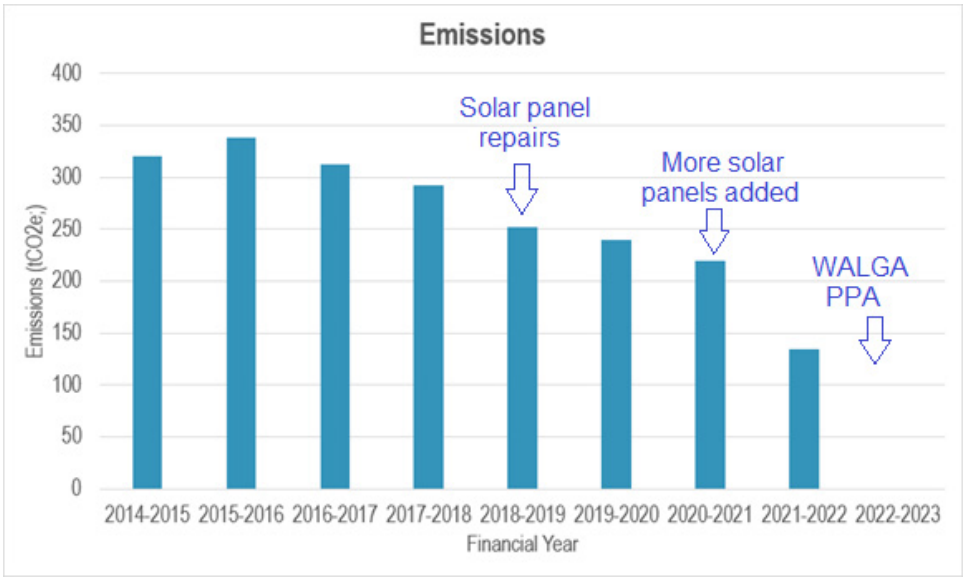
Shire of Mundaring annual greenhouse gas emissions showing 30 per cent target set in 2018.

Case study

As the Shire of Mundaring Administration Centre was the highest electricity use site in 2016/2017, it was targeted to reduce energy use and greenhouse gas emissions. Reductions in consumption and emissions are shown below.



Shire of Mundaring Administration Centre – reducing energy consumption with improved energy efficiency through introduction of night purging and other improvements to air conditioning, changes to LED lighting, and other improvements to energy efficiency of equipment.



Shire of Mundaring Administration Centre – reducing emissions through improved efficiency and switching to renewable energy (first repairing and then adding more rooftop solar panels, followed by joining WALGA renewable energy power purchase agreement in 2022).

Increasing Costs of Climate Change

Delays in reducing emissions will result in further increases in the global average temperature. This will be experienced through extreme weather and climate disruption at the regional and local level. These impacts are already being reflected in higher insurance and building costs for local residents and businesses.

Warming above 1.5°C increases the likelihood of the planet reaching irreversible tipping points such as mass death of trees and coral reefs, species extinctions, loss of ecosystems and collapse of polar ice sheets. These tipping points also risk an acceleration of warming and further impacts through feedback loops.

The Northern Jarrah Forest, which is central to the landscape and character of the Shire of Mundaring, has been identified as an ecosystem at high risk of transition or collapse from climate change. The forest is vulnerable to more frequent or intense drought and wildfire.

The State Climate Adaptation Strategy: Building WA's Climate Resilient Future (2023) identified existing and expected impacts:

- Since the 1930s, the number of days over 40°C in Perth has doubled, and the number of heatwaves has increased by 50 per cent.
- Western Australia's south-west has experienced climate-induced drying at one of the fastest rates in the world, and this is projected to continue.
- At the same time, extreme rainfall events across the state are becoming more frequent and intense, leading to localised flooding and infrastructure damage.
- Climate change is increasing pressure on every ecosystem, posing challenges for management of our natural environment, national parks, biodiversity and cultural assets.
- Bushfire weather is changing, with fires burning more intensely and bushfire seasons getting longer.
- Climate-induced extreme weather events have cost Australian communities an estimated $120 billion over the past 50 years, and this is expected to increase to $150 billion over the next decade.
- The south-west will continue to become drier in coming decades, especially during winter and spring, with less runoff and recharge and longer fire seasons.

There is already some additional global heating 'baked in' from past greenhouse gas emissions, and further delays will increase the impacts.

Each fraction of a degree warmer will increase the impacts of climate change. In addition to the cost and disruption caused by loss or damage of homes and infrastructure, there are significant mental health impacts for a community repeatedly exposed to bushfires and extreme weather events.

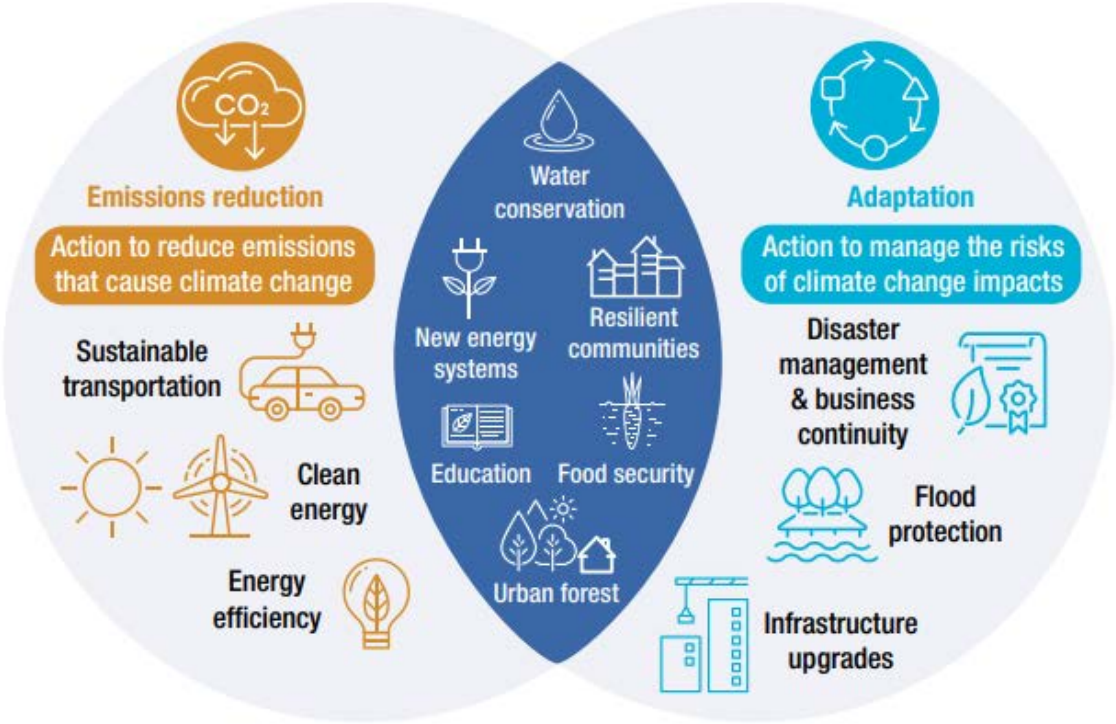
The Shire's Role in Reducing Carbon Emissions

As a bushfire-prone local government area the shire is exposed to direct and indirect impacts of the changing climate and has a responsibility to respond. This is explicit in the recently amended Local Government Act 1995.

This requires that the general function of a local government have regard to the following:

- To promote the economic, social and environmental sustainability of the district.
- To plan for, and to plan for mitigating, risks associated with climate change.
- In making decisions, to consider potential long-term consequences and impacts on future generations.
- To recognise the particular interests of Aboriginal people and involve Aboriginal people in decision-making processes; and
- The need to consider collaboration with other local governments.

There are some actions which can be beneficial for both mitigation and adaptation, as shown in the graphic below from the WA Climate Change Adaptation Strategy.



Source: Climate Adaptation Strategy: Building WA's Climate Resilient Future 2023.

At a global scale, the more greenhouse gas emissions are mitigated, the less we will be required to adapt to climate change. At the local level, the impacts of climate change are already being observed in changing rainfall patterns and longer fire seasons.

While the Shire also has an important role to play in adapting to the impacts of climate change, this Strategy is focused on greenhouse gas emissions reduction or mitigation.

The Shire will reduce greenhouse gas emissions following the principles below:

1. **Reduce energy demand:** implement energy saving measures and build or purchase more energy efficient facilities, vehicles and equipment.

2. **Renewable energy on the roof:** increase use of renewable energy by installing more solar panels at suitable Shire facilities and adding small wind generation or batteries where appropriate.

3. **Switch to low emissions vehicles:** transition the Shire fleet and equipment from mainly diesel to mainly electric as appropriate vehicles and machines become available and cost-effective.

4. **Purchasing power:** maintain or increase use of renewable energy from the grid through GreenPower or joint local government power purchase agreements.

5. **Encourage community action:** provide locally relevant information and opportunities that can support residents, schools and businesses to reduce their own greenhouse gas emissions.

Current Carbon Footprint

Greenhouse Gas Emissions from Shire activities

There are many different activities that the Shire is involved with that have a carbon footprint.

Examples of these are:

- Building and running Shire facilities
- Buying and operating vehicles and equipment
- Constructing and maintaining infrastructure (roads, footpaths, drainage etc)
- Lighting of streets and sports ovals
- Waste collection and processing of material for landfill, recycling or composting.

There is 'embedded energy' in the items and raw materials used by the Shire for buildings and infrastructure. There is significant energy used in waste collection and processing, but most of this is undertaken by other organisations. Based on Australian reporting protocols for greenhouse gases, the Shire's annual emissions are calculated on the fuel and energy directly used by the organisation (Scope 1 and 2).

National Greenhouse Gas Reporting terms	
Scope 1	Direct emissions released into the atmosphere by the organisation, such as from burning of diesel in trucks
Scope 2	Indirect emissions from using energy, such as the use of electricity produced by burning of coal or gas at another facility
Scope 3	Indirect emissions that are not from using energy, such as emissions used in producing goods and materials or delivering services purchased by the organisation

National Greenhouse and Energy Reporting Scheme (Clean Energy Regulator, 2023).

It is feasible for most organisations to calculate their annual Scope 1 and 2 emissions based on the sources of energy used throughout the year. It is far more difficult to calculate Scope 3 emissions as the information is rarely available for the range of products and services used by any organisation.

Scope 3 emissions for a local government (e.g. emissions to produce concrete used for buildings or footpaths) would be Scope 1 or 2 emissions for the company that made the product or supplied the service.

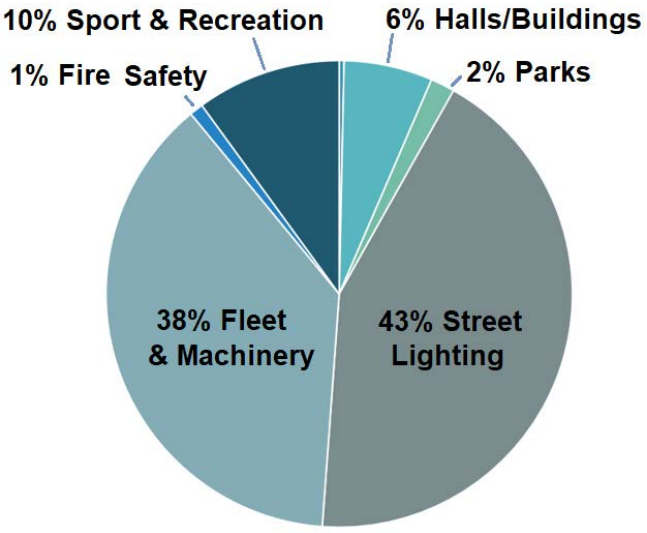
Scope 1 and 2 emissions for the Shire of Mundaring as an organisation have been monitored with assistance from the Eastern Metropolitan Regional Council (EMRC). While streetlights are typically owned by Western Power they are located within road reserves and electricity use is billed to the Shire, therefore they are included within the Shire's emissions monitoring and reporting framework.

Emissions reduction to date do not include the impact of the accelerated change to LED streetlighting as the roll-out which commenced in late 2023. While there has been some ad-hoc installation of LED streetlights by Western Power as older lights fail, the reduction in streetlight related emissions since 2018 is mainly due to a reduction in the 'emissions intensity' of the grid as more renewable energy has been added to the South West Interconnected System.

This chart shows the percentage of emissions by each asset group in the 2022/2023 reporting period.

Unmetered streetlighting is the largest contributor (43%), followed by Fleet (38%), Sport and Recreation (10%) and Halls and Buildings (6%).

For the most recent financial year, the Shire's carbon footprint has been calculated as 2,200 tCO2-e.



Shire of Mundaring greenhouse gas emissions (tCO2-e) sources for 2022/2023.

Community and Commercial Greenhouse Gas Emissions

The total of the greenhouse gas emissions generated within the district is far higher than what is generated by the Shire as an organisation but difficult to precisely measure.

Residents, schools, businesses and community organisations all generate greenhouse gas emissions through their use of electricity, fuels and gas. There are additional greenhouse gas emissions from consumption of goods and materials which can be reduced where they are produced using renewable energy or recycled materials.

Within the Shire, over 46 per cent of dwellings have solar panels installed on their rooftops with an estimated total installed capacity of almost 40,000kW. (Source: Australian PV Institute mapping - apvi.org.au).

This has risen from 31 per cent of dwellings in 2018 when the initial Energy and Emissions Reduction Strategy was adopted. The falling cost of solar panels means that they pay for themselves faster and then provide a cheap, clean source of power. However, households or organisations that are renting or in financial hardship may not have access to this option.

There are no local figures available on the adoption of electric vehicles, which has been accelerating as battery technology improves, purchase costs fall, and a wider range of models have become available to Australians.

As a percentage of the total vehicle fleet, electric vehicles are still a small proportion, but purchases of new electric vehicles have been increasing every year. Many people have underestimated the pace of change as vehicles enter a technology replacement curve.

The majority of dwellings within the Shire are single houses with their own garages or car parking spaces onsite. This can facilitate a shift to electric vehicles more easily than apartments and townhouses which have shared parking areas or limited space. The already high rate of installation of solar panels also means that more electric vehicles can run on renewable energy.

Waste can generate significant greenhouse gas emissions. The Shire plays an important role in facilitating recycling and contributing to broader waste minimisation and circular economy initiatives. Efforts to improve reuse, recycling and recovery rates will also reduce our collective carbon footprint.

While the Shire does not have an accurate measure for community greenhouse gas emissions and has not set a community emissions reduction target, there is still a need for locally relevant information that will support our community in their voluntary efforts to adopt more sustainable practices.

Emissions Reduction Target

Broader Targets

The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 nations at the UN Climate Change Conference (COP21) in Paris, France on 12 December 2015.

The goal of the Paris Agreement is to limit warming to less than 2°C, and pursue efforts to limit it to 1.5°C warmer than pre-industrial conditions.

These figures do not represent a 'safe' amount of global warming or climate change but passing the 1.5°C threshold risks unleashing far more severe climate change impacts. Most of the carbon budget for 1.5°C has already been used. To limit global warming to 1.5°C, greenhouse gas emissions must peak around 2025 and decline rapidly by 2030.

Australia has made an international commitment to reduce greenhouse gas emissions by 43 per cent below 2005 levels by 2030 and reach net zero emissions by 2050.

Western Australia has also set a goal to reach net zero greenhouse gas emissions by 2050 but has not set a State target for 2030. However, the State Government has set a whole-of-government 2030 target for its own operations, of 80 per cent below 2020 levels.

Shire of Mundaring Target

Shire of Mundaring has already reduced its greenhouse gas emissions by 30 per cent from the 2016/2017 baseline.

This was assisted by a small reduction in the emissions intensity of electricity from the grid as more renewable energy is included. The Shire has also commenced an LED streetlight changeover, which is expected to achieve another reduction of 15 to 20 per cent in 2023/2024 (noting that there may be delays in reporting this change dependent on Western Power data management).

Further reductions are achievable from actions such as increasing use of renewable energy in Shire facilities, using GreenPower for streetlights, and shifting some of the Shire's vehicle and machinery fleet from diesel to electric.

Further reductions in emissions intensity are expected as the grid becomes greener and coal power is phased out towards 2030. However, increases to overall energy demand may also come from requests to install air conditioning or additional lighting on existing facilities, or the development of new community facilities.

Some Western Australian local governments have set targets to achieve net zero emissions by 80% in 2030. For the Shire of Mundaring this is not feasible without purchasing carbon offsets. Our large area and extensive road and drainage networks require vehicles and machinery which cannot be rapidly changed to electric or hydrogen alternatives – although more options are becoming available.

While there is a global need for carbon sequestration and some projects are undoubtedly achieving both biodiversity benefits and locking away carbon in plants or soil, there is currently a lack of confidence in carbon offset certification. Carbon offsets can also be viewed as excusing or prolonging the use of fossil fuels rather than driving the transition to cleaner energy.

This Strategy therefore proposes a target that directs Shire efforts to reducing rather than offsetting emissions. This target may be achieved without the purchase of carbon offsets, although they may be considered in the longer term. The Shire's target is:

To reduce greenhouse gas emissions by 70 per cent by 2030 from 2016/2017 levels.

A range of new actions will be required in order to achieve this target, in addition to maintaining the success of previous initiatives.

Emissions Reduction Actions

Emissions Reduction Actions

The Shire of Mundaring will need to implement actions identified in the tables below in order to achieve the emissions reduction target.

Reducing energy use will reduce the Shire's exposure to rising energy costs as well as reducing greenhouse gas emissions.

There will be costs incurred for increasing use of renewable energy, and in particular transitioning to a low-emissions vehicle fleet. The capability and range of electric vehicles is increasing and costs are falling more rapidly than expected. Hydrogen vehicles are still very expensive but their potential may be explored through lease or trial arrangements later in the decade as charging infrastructure becomes available.

In some situations the higher up-front costs will result in longer term savings through lower operating costs. However, this will not always be the case, and there may be some costs that increase in order to adopt cleaner technology and reduce our greenhouse gas emissions to achieve the 2030 target.

Grant funding may also be available to minimise costs to the Shire for some of the actions identified below. The opportunity to access significant grant funds may influence the timing of certain actions, which have been listed below as ongoing, short, medium or long term.

Short term (2024-2026)

Medium term (2026-2028)

Long term (2028-2030)

There will often be more than one Shire Service involved in delivering an action and the Key Service Area listed will rarely be the only Service involved. The Key Service Area may also be varied based on capacity or organisational needs at the time of implementation.

Table 1 - Ongoing Actions

No	Action	Timeframe	Key Service Area	Budget/ Resources
1.1	Require energy efficiency and sustainability measures in tender criteria for future Shire buildings and facilities.	Ongoing	Building Assets	Capital Works
1.2	Monitor, clean and maintain renewable energy assets to ensure optimum performance, electricity savings and emissions reduction.	Ongoing	Building Assets	Staff time; Maintenance
1.3	Install energy efficient LED lighting, air-conditioners, appliances and equipment for Shire facilities.	Ongoing	Building Assets; Recreation & Tourism; Information Technology	Staff time; Operational
1.4	Maintain building management systems that reduce energy use (including night purging of warm air where possible).	Ongoing	Building Assets	Staff time; Maintenance
1.5	Install and maintain energy efficient bores, irrigation systems and equipment in Shire parks and reserves.	Ongoing	Operations	Staff time; Maintenance
1.6	Continue waste minimisation and recycling initiatives and showcase use of recycled, low-emissions and low-waste materials in Shire works.	Ongoing	Operations	Staff time; Operational
1.7	Monitor and report on Shire energy use and greenhouse gas emissions annually.	Ongoing	Planning & Environment	Staff time; Operational
1.8	Participate in emissions reduction networks and initiatives for sharing of information, collaboration on advocacy, or delivery of regional emissions reduction programs.	Ongoing	Planning & Environment	Staff time
1.9	Encourage schools, businesses, residents and community organisations within the Shire to reduce their carbon footprint, implement energy efficiency measures and use more renewable energy.	Ongoing	Planning & Environment	Staff time; Operational

1.10	Provide locally relevant information on passive solar design and encourage residents to build more energy efficient houses with solar panels and provision for future electric vehicle charging.	Ongoing	Planning & Environment; Building & Health	Staff time
1.11	Continue divestment from fossil fuels in financial investments.	Ongoing	Finance	Staff time
1.12	Advocate to state and federal governments for more rapid cuts to emissions through greater investment in renewable energy and transmission networks, energy efficiency measures, and charging infrastructure for low emissions vehicles.	Ongoing	Planning & Environment	Staff time

Table 2 - Short Term Actions (2024/2025 - 2025/2026)

No	Action	Timeframe	Key Service Area	Budget/ Resources
2.1	Direct a portion of savings from implemented energy initiatives into the Shire's Environmental Reserve Fund to provide for future energy efficiency and emissions reduction initiatives.	Short	Finance	Municipal reserves
2.2	Investigate opportunities to access funding through national carbon and nature repair markets to support local carbon sequestration initiatives, and share relevant information with residents.	Short	Planning & Environment	Staff time
2.3	Install initial electric vehicle charging stations at the Administration and Civic Centre, and Operations Depot, to enable introduction of electric vehicles to Shire fleet.	Short	Operations; Building Assets	Grants
2.4	Purchase initial electric vehicles and establish training requirements and work practices for wider use.	Short	Operations	Vehicle replacement budget
2.5	Develop a low-emissions fleet transition plan to provide for staged replacement of vehicles and machinery.	Short	Operations; Planning & Environment	Staff time; Operational
2.6	Trial electric mowers and small machinery to identify issues and work practices for wider use.	Short	Operations	Operational

2.7	Assess options and costs for purchase of renewable diesel for use within Shire fleet and machinery.	Short	Operations	Staff time
2.8	Identify energy efficient replacements for gas boilers and aging water heating and electrical systems at Bilgoman Aquatic Centre, and seek grant funding to implement.	Short	Recreation & Tourism; Building Assets	Capital works; Grants
2.9	Assess use, need and costs for replacement LED lighting and use-tracking technology for sports facilities, and seek grant funding to implement.	Short	Recreation & Tourism; Operations	Capital works; Grants
2.10	Undertake energy audits of higher energy use buildings and facilities to identify opportunities for new solar panels, prioritise energy efficiency improvements, and note where user behaviour could save energy.	Sort	Building Assets	Staff time; Operational
2.11	Provide energy efficiency training, reminders, prompts or resources to leased facility staff and club managers to reduce energy use.	Short	Building Assets; Recreation & Tourism	Staff time
2.12	Develop and deliver a behaviour change program for staff to reduce energy use and emissions.	Short	Planning & Environment; Building Assets	Staff time
2.13	Consider options to require better energy efficiency and more use of renewable energy of new buildings through Local Planning Scheme review.	Short	Planning & Environment	Staff time
2.14	Review options including collaborative Power Purchase Agreements to maintain use of renewable energy for high energy use sites.	Short	Building Assets; Planning & Environment	Staff time; Operational

Table 3 - Medium Term Actions (2026/2027 - 2027/2028

No	Action	Timeframe	Key Service Area	Budget/ Resources
3.1	Purchase electric and hybrid vehicles through fleet replacement program.	Medium	Operations	Operational; Grants
3.2	Install additional electric vehicle charging capacity to support fleet transition.	Medium	Operations; Information Technology	Capital Expenditure; Grants
3.3	Monitor battery costs, options and opportunities to add battery storage to Shire facilities where appropriate.	Medium	Building Assets	Capital Expenditure; Grants

3.4	Retrofit existing Shire buildings in line with sustainable design principles such as awnings, green landscaping and design, ventilation or insulation improvements, window tinting and window treatments.	Medium	Building Assets; Operations	Staff time; Maintenance
3.5	Assess options and costs to switch remaining decorative streetlights to LED.	Medium	Infrastructure Design	Staff time; Capital expenditure
3.6	Investigate potential for Shire revenue and increasing renewable energy generation by investing in electric vehicle charging stations, micro-grids serving adjacent facilities, solar farms or similar.	Medium	Building Assets; Recreation & Tourism	Staff time; Capital works

Table 4 - Long Term Actions (2028/2029 - 2029/2030)

No	Action	Timeframe	Key Service Area	Budget/ Resources
4.1	Trial hydrogen vehicles once refuelling infrastructure becomes available, and establish training requirements and work practices for wider use.	Long	Operations	Staff time, Operational
4.2	Assess costs of GreenPower and developments in LED street lighting within the region to consider further energy efficiency improvements to streetlights within the Shire, and use of GreenPower.	Long	Planning & Environment	Staff time; Operational
4.3	Investigate options for biodiverse carbon offsetting and/or carbon sequestration as a way for the Shire to offset its remaining emissions.	Long	Planning & Environment; Operations	Staff time; Operational

Monitoring and Reporting

The Shire will continue to monitor its energy use and greenhouse gas emissions and report to Council on an annual basis on progress in implementing this Strategy.

Council reports, agendas and minutes are publicly available documents, discussed at meetings that are open to the community to attend or view online. In this way residents and other stakeholders will also be able to monitor the Shire's work to reduce its own greenhouse gas emissions, and encourage community efforts to reduce their own carbon footprints.

Appendix 1

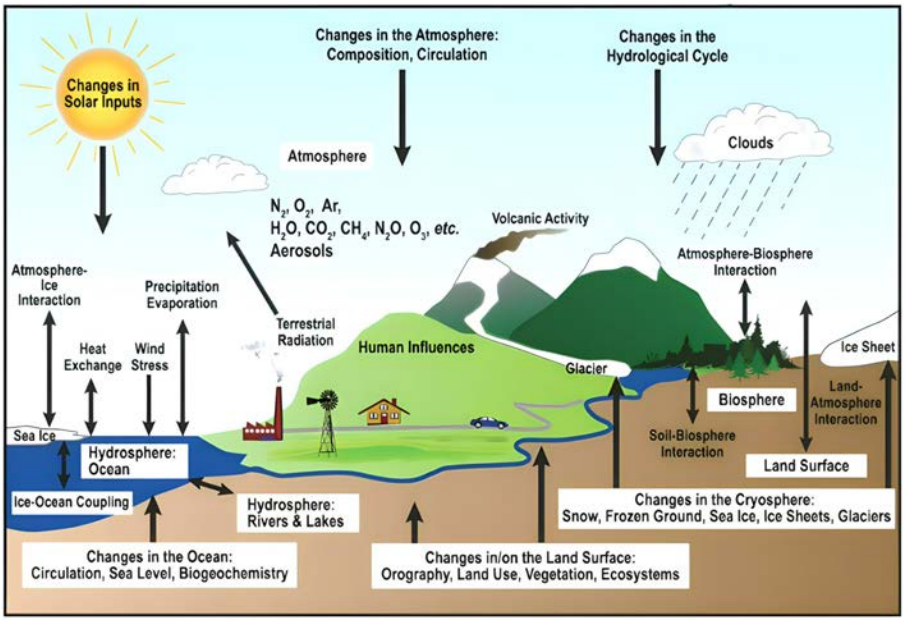
Science of Climate Change

The Earth has natural long-term cycles of cooling and warming and has been much warmer and much cooler in previous eras. Geological formations, tree rings, coral deposits and ice cores provide a record of the paleoclimate and have shown both warmer periods and ice ages in the distant past.

The Earth has been hotter and sea levels higher in the past, such as millions of years ago when dinosaurs lived. When the climate changes slowly, plants and animals can often adapt. The vast majority of human infrastructure, agriculture and settlements have been developed in only a few centuries in a relatively stable climate. Natural and human systems are both vulnerable to a rapidly changing climate due to the 'enhanced greenhouse effect.'

Sunlight is the main source of heat for Earth. The greenhouse effect is caused by gases in the atmosphere that trap some extra heat (like a blanket) that would otherwise be radiated into space. Carbon dioxide is an important greenhouse gas, and this has been understood and studied by scientists for over a century.

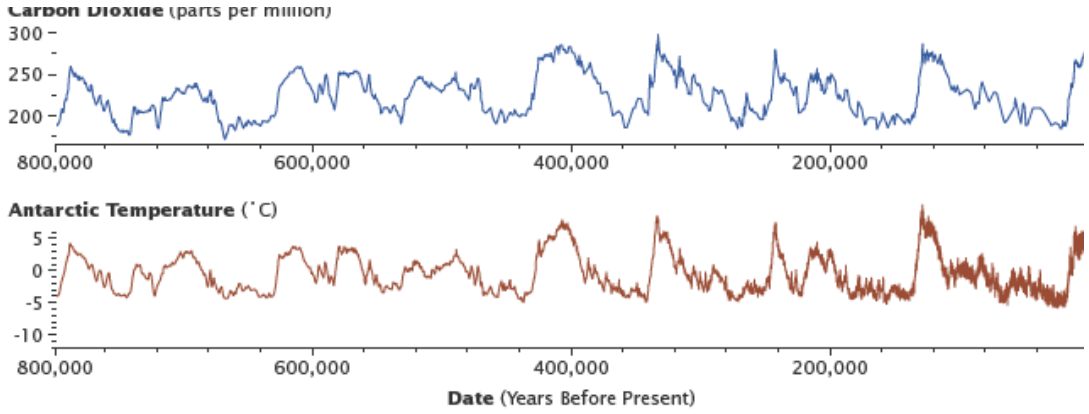
Carbon dioxide and other greenhouse gases like methane are naturally released into the atmosphere by wildfire, volcanoes, and animals. Carbon dioxide can be drawn back out of the atmosphere by dissolving in the ocean, being absorbed by growing plants, or reacting with weathering rocks. When there is a higher concentration of greenhouse gases in the atmosphere, the greenhouse effect is stronger (like a thicker blanket) and the planet retains more of the sun's heat each year.



Interactions between land, water and the atmosphere that influence the greenhouse effect and global climate (Intergovernmental Panel on Climate Change, 2007)

Paleoclimate records show the Earth slowly transitioning between ice ages and warm periods over long cycles of roughly 100,000 years. These changes between cooler and warmer states are prompted by gradual variations in the shape of Earth's orbit around the sun, then reinforced by feedback loops.

Deep ice cores from Antarctica are especially useful in measuring changes in carbon dioxide concentration before and after the industrial era. The ice holds information about the past climate as well as tiny air bubbles that are samples of the past atmosphere. The concentration of carbon dioxide in the atmosphere is strongly linked to temperature, shown below for the last 800,000 years.



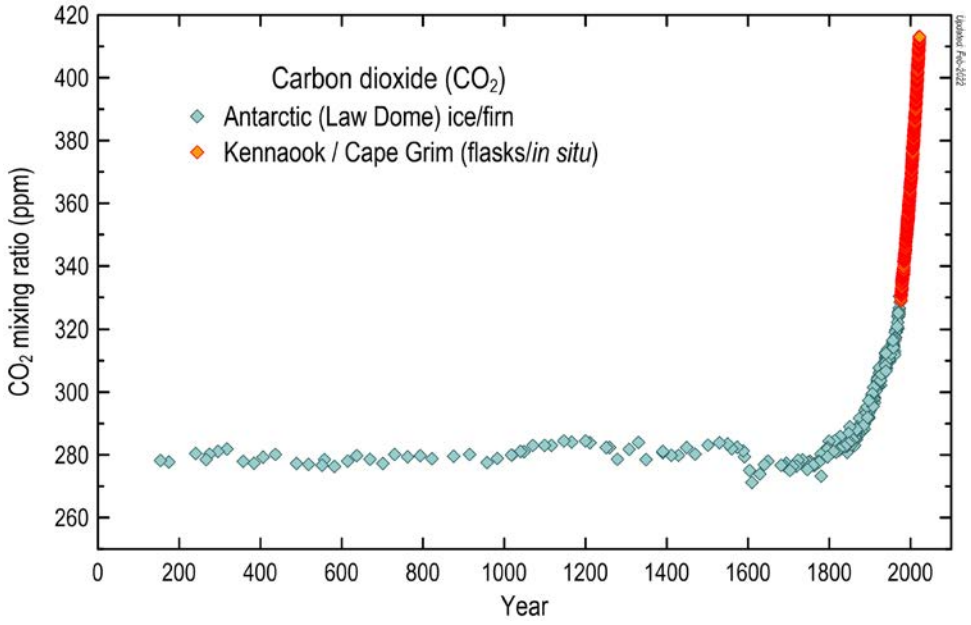
Levels of carbon dioxide in the atmosphere have corresponded closely with temperature over the past 800,000 years. Antarctic ice-core data show the long-term correlation until about 1900. (NASA, 2011).

In the pre-industrial era shown above, the climate varied through cycles of warming and cooling but carbon dioxide levels stayed below 300 parts per million (ppm). During ice ages carbon dioxide levels were around 200ppm, and in warmer interglacial periods the concentration was around 280ppm.

In the last three centuries the human population has grown rapidly, from less than one billion to over eight billion. Increasing population combined with industrialisation has resulted in clearing of over one third of the world's forests, and the burning of fossil coal, oil and gas from deep within the earth. The forests, oceans and other 'carbon sinks' have not been able to keep up with the rapid release of carbon through burning of vegetation and fossil fuels, so the greenhouse effect has been getting stronger and the global average temperature has been rising.

In the 1950s gas analysers were developed to measure and record carbon dioxide concentration of air. In the 1960s the 'Keeling Curve' was published showing an annual cycle of rising and falling carbon dioxide concentration, along with an overall trend of increasing concentration consistent with burning of fossil fuel. In the 1970s and 1980s the oil industry engaged their own climate scientists and published quite accurate projections of increasing greenhouse gases and global warming, then later sought to undermine public confidence in climate science.

International concerns about human-induced climate change increased in the 1970s, and the Australian Government began measuring greenhouse gases at a remote location in Tasmania, Cape Grim. In 2023 carbon dioxide levels measured at the Cape Grim Baseline Air Pollution Station reached 420 parts per million, and this is consistent with other atmospheric measurements around the world. The rapid increase in carbon dioxide levels since industrialisation is shown below, with 1,900 years of Antarctic ice core data before the Cape Grim atmospheric measurements began in 1978.

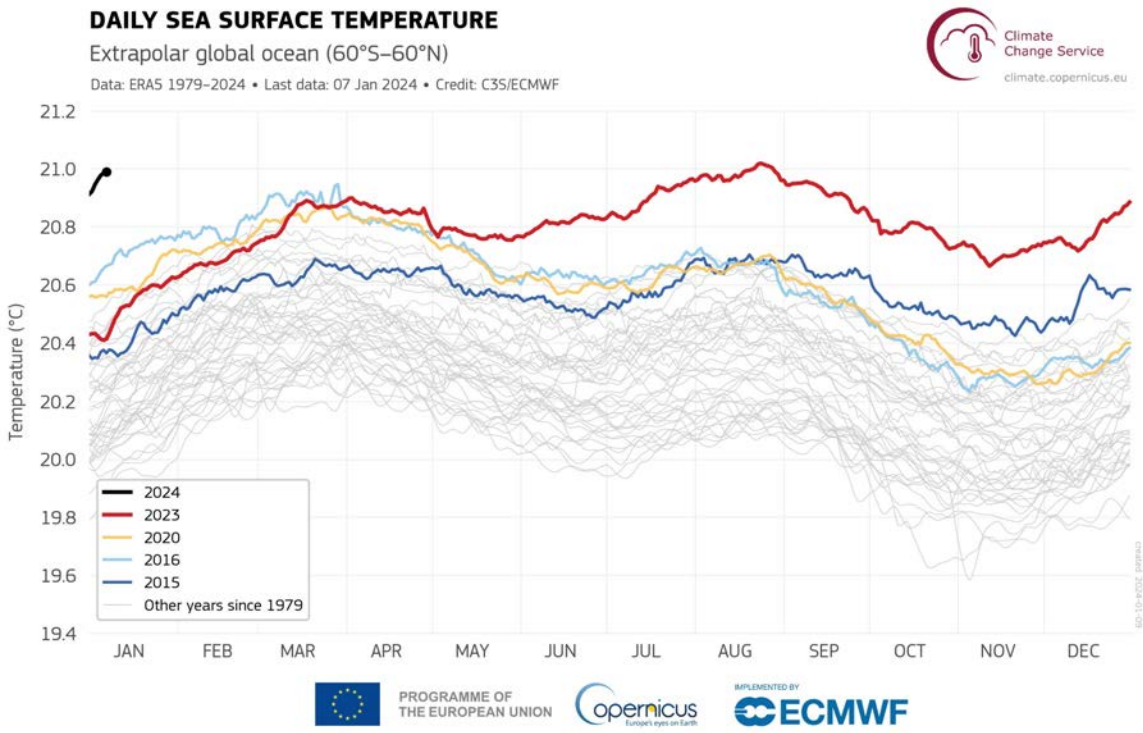


Atmospheric carbon dioxide concentrations (in ppm) over the last 2000 years, based on measurements of air trapped in Antarctic ice and firn (the compacted snow layer that eventually forms solid ice), shown in blue-grey, and the modern Cape Grim in situ record, shown in orange. (CSIRO & Bureau of Meteorology, 2022)

An international Intergovernmental Panel on Climate Change (IPCC) was formed in 1988 to review the science and publish reports on the causes and consequences of global warming. The IPCC has reported with increasing certainty over last four decades that the main cause of global warming is human activities, and that the consequences will be severe for communities, economies and ecosystems if critical thresholds are crossed.

The most recent IPCC Sixth Assessment Reports show high risks for biodiversity, wildfire damage, extreme weather events and tree mortality above 1.5°C. Unfortunately, due to the time taken for scientific research to be published and comprehensively reviewed, there is a risk that the IPCC reports are understating the extent of change that has already occurred, impacts on natural systems, and the risks of accelerating warming from feedback loops.

The increase in global average temperature of 1.5°C, 2°C or even 3°C will not be experienced as uniformly warmer local weather. A large amount of the additional heat energy has been absorbed by the world's oceans. This has risks for faster melting of sea ice near the poles and disruption of important ocean circulation currents, which influence global weather systems.



Daily sea surface temperature (°C) averaged over the extra-polar global ocean (60°S–60°N). Previous hottest years on record since measurements began shown in blue and yellow; however 2023 (red) recorded unprecedented heat. All other years between 1979 and 2021 are shown with grey lines. (Copernicus Climate Change Service, 2024)

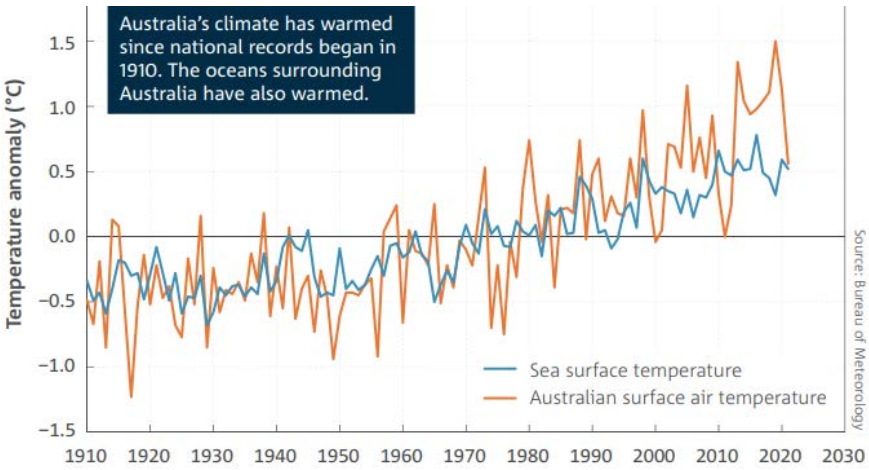
There are both positive and negative feedback loops that can increase warming and production of greenhouse gases, or provide for cooling and absorption of carbon dioxide.

The loss of snow and ice cover near the poles means that lighter coloured, reflective ice is replaced by the darker coloured rock or sea, which then absorbs more heat from incoming solar radiation and results in more loss of ice. This is an example of a feedback loop that will further increase warming. Another concerning feedback loop is melting of permafrost that can release large amounts of methane, a potent greenhouse gas.

Greenhouse trials show plants can grow faster in an atmosphere with higher carbon dioxide, which could provide for greater carbon sequestration in forests as well as higher crop yields. However, plants in both natural ecosystems and crops are vulnerable to drought and wildfire. This means that the overall impact of higher carbon dioxide levels is not simply more plant growth based on the carbon fertilisation effect.

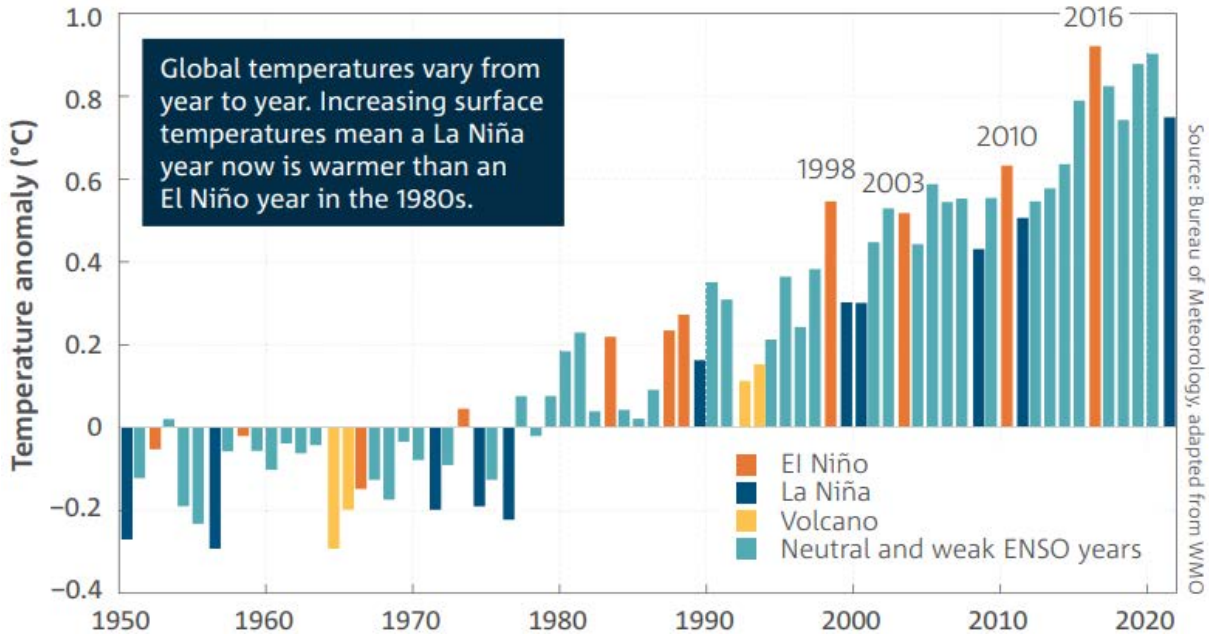
As the climate warms the increasing incidence and severity of wildfires (including in rainforest and Arctic areas) has become another concerning feedback loop for increasing atmospheric carbon concentration, as well as losing biodiversity.

The CSIRO and Bureau of Meteorology publish regular 'State of the Climate' reports which collate the climate changes observed to date for Australia and identify trends and predicted changes for the coming decades. The chart below shows despite regular fluctuations in air and sea temperatures, there is a strong warming trend for both in recent decades.



Anomalies in annual mean sea surface temperature, and temperature over land, in the Australian region (departures from the 1961–1990 standard averaging period). (CSIRO & Bureau of Meteorology, 2022)

In addition to global warming, there are other weather patterns and systems like El Nino and La Nina that influence how warm a particular year or season will be. These regional influences and impacts are now stacked on top of the warming climate.

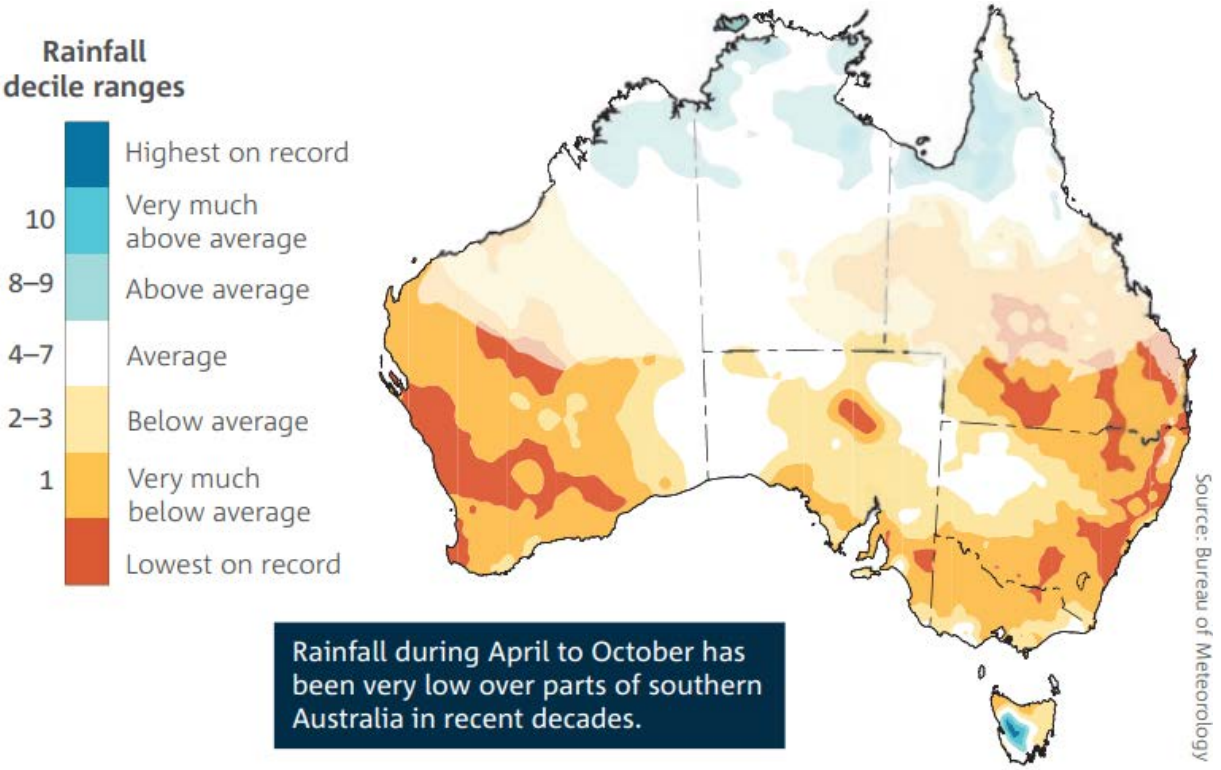


Annual global surface temperature anomalies of the Earth (land and ocean), 1950–2021 compared to the 1961–90 standard averaging period. (CSIRO & Bureau of Meteorology, 2022)

Major volcanic eruptions are associated with temporarily cooler global temperatures. While volcanoes do emit some carbon dioxide and other greenhouse gases, it is far less than human activities like burning fossil fuels. Very large eruptions push enough ash and dust into the upper levels of the atmosphere that they can reflect more incoming solar radiation for more than five years.

Volcanoes also have regional impacts that influence weather for years, such as the Hunga Tonga-Hunga Ha'apai eruption in 2022. Climate modelling predicts that the atmospheric impact of this eruption will slightly reduce summer temperatures in Western Australia until 2029. This means that the impacts of the warming climate on local temperatures and rainfall are expected to become stronger over the next decade.

Rainfall always varies from year to year, but in the south-west of Australia, April to October rainfall has declined since the 1960s. Rain on drier soil results in less streamflow, so watercourses may be smaller and flow for shorter periods. At the same time, increased variability in rainfall is expected to cause more flash flooding in many areas.



April to October rainfall deciles for the past 22 years (2000–2021). A decile map shows where rainfall is above average, average, or below average for this period compared to all years from 1900 (when reliable rainfall records began). Areas across northern and central Australia that receive less than 40 per cent of their annual rainfall from April to October are faded. (CSIRO & Bureau of Meteorology, 2022)

These trends are generally expected to continue as the climate warms, and our past records of weather and extreme events are becoming a less useful guide in planning for the future.

The CSIRO and Bureau of Meteorology report that Australia is projected to experience:

- Continued warming, with more extremely hot days and fewer extremely cool days
- Continued drying in the south-west of Western Australia, especially during winter and spring
- Longer periods of drought on average in the south and east
- A longer fire season for the south and east, and an increase in the number of dangerous fire weather days
- More intense short-duration heavy rainfall events, even in regions where the average rainfall decreases or stays the same
- An increase in the risk of natural disasters from extreme weather, including 'compound extremes', where multiple extreme events occur together or in sequence, thus compounding their impacts.

The Department of Water and Environmental Regulation is undertaking regional climate modelling for Western Australia through a Climate Science Initiative. Updated and finer scaled climate projections are expected in 2024 and 2025 to inform local climate adaptation planning.

This summary of the science of climate change has been prepared using publicly available information from credible sources, including the references below.

CSIRO climate change research and reporting for Australia
www.csiro.au

Bureau of Meteorology climate reports and summaries
www.bom.gov.au/

Australian Department of Climate Change, Energy, the Environment and Water
www.dcceew.gov.au

WA Government Climate Science Initiative and Climate Adaptation Strategy
www.wa.gov.au/organisation/department-of-water-and-environmental-regulation/climate-science-initiative

Australian Academy of Science climate change hub
www.science.org.au/climate-change-hub

NASA Climate Change observations and science
https://science.nasa.gov/climate-change

Copernicus European climate change monitoring
https://climate.copernicus.eu

Intergovernmental Panel on Climate Change (IPCC)
www.ipcc.ch

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