



GRAMPIANS REGIONAL ROADMAP TO NET ZERO EMISSIONS

Prepared by the Grampians New Energy Taskforce

MINISTERS FORWARD

On behalf of the Victorian Government, I am pleased to present the Victorian Regional Renewable Energy Roadmaps.

As we transition to cleaner energy with new opportunities for jobs and greater security of supply, we are looking to empower communities, accelerate renewable energy and build a more sustainable and prosperous state.

Victoria is leading the way to meet the challenges of climate change by enshrining our Victorian Renewable Energy Targets (VRET) into law: 25 per cent by 2020, rising to 40 per cent by 2025 and 50 per cent by 2030.

Achieving the 2030 target is expected to boost the Victorian economy by \$5.8 billion - driving metro, regional and rural industry and supply chain development. It will create around 4,000 full time jobs a year and cut power costs.

It will also give the renewable energy sector the confidence it needs to invest in renewable projects and help Victorians take control of their energy needs.

Communities across Barwon South West, Gippsland, Grampians and Loddon Mallee have been involved in discussions to help define how Victoria transitions to a renewable energy economy.

These Roadmaps articulate our regional communities' vision for a renewable energy future, identify opportunities to attract investment and better understand their community's engagement and capacity to transition to renewable energy.

Each Roadmap has developed individual regional renewable energy strategies to provide intelligence to business, industry and communities seeking to establish or expand new energy technology development, manufacturing or renewable energy generation in Victoria.

The scale of change will be significant, but so will the opportunities.

Each community has a part to play in embracing cleaner energy and the benefits it brings for a brighter future.



The Hon. Lily D'Ambrosio MP
Minister for Energy, Environment and Climate Change
Minister for Solar Homes

GNET CHAIRPERSONS FORWARD

As Chair of the Grampians New Energy Taskforce (GNET), I am delighted to present the Grampians Roadmap to Net Zero Emissions. This document is the culmination of an idea that was seeded in the early days of GNET in 2017. Our goal was to map our regional emissions and identify ways we could get the Grampians region to net zero emission by 2050 across a range of key sectors.

I would like to thank the Minister for Energy, Environment and Climate Change, Hon Lily d'Ambrosio MP, for supporting the idea of the roadmap and making funds available for its delivery. I would also like to thank all the members of GNET, who have provided ideas and constructive critiques as the project has progressed. Your engagement with the roadmap, and grasp of the opportunities it represents, bodes well for its life beyond the printed form.

This roadmap offers a singular opportunity for the Grampians region to lead the way in tackling climate change, by reducing our carbon emissions to net zero. It aligns with Australia's Paris target obligations, and the Victorian Government's strong commitment to reach net zero emissions by 2050.

GNET commissioned this roadmap to demonstrate that action to mitigate the effects of climate change can be taken at the regional level. It is a highly ambitious piece of work: net zero emissions strategies are usually pitched at the large (state or national) or small (community) level. However, the research commissioned for this report has revealed that acting at the regional level is both feasible and strategically smart for the Grampians region.

Through the process, a fascinating story emerged, that agriculture can be a hero for the region. The ability to sink carbon as an offset to agriculture emissions is only part of the opportunity. As our largest land manager, agriculture also has the opportunity to provide other offsets and reductions to assist other sectors such as transport, that will struggle to get to net zero emissions by 2050 with existing technologies. With our large agricultural output across the entire region and particularly in the Wimmera Southern Mallee, the Grampians are well placed to lead the way for Victoria, showing how regional emissions can be reduced if there is a collaborative effort across government, communities, business and industry. In fact, if we do everything outlined in this roadmap the region could be a net carbon sink as early as 2044.

The net zero emissions landscape is changing fast and will continue to evolve in response to community expectations, government policy and changing technologies. This roadmap is not the definitive answer for the region, but it is a starting point and contains thought provocations and ideas that community groups, industry and business can pick up and run with. I would love to see us coming together across the region, running with this and getting there before 2044.



Stuart Benjamin

Chair

Grampians New Energy Taskforce





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1. INTRODUCTION

The Intergovernmental Panel on Climate Change (IPCC) recommended in October 2018 that to minimise the effects of climate change, global warming must be limited to 1.5 degrees above pre-industrialised levels by achieving zero net greenhouse gas emissions by 2050. In the Grampians, as in every place, life revolves around weather patterns, around air and water quality, around animals, plants and unicellular species, and around a reliance on comfort and safety in the environment. Climate change threatens each of those balances.

The effects of a changing climate can be seen in longer fire seasons and more catastrophic fire events, as well as long term loss of farm productivity and increased vulnerability of the electricity network to extreme weather.

Recognition of the need to avoid the effects of climate change is growing. In November 2019, 11,000 climate scientists co-signed a letter in the journal *BioScience*, calling for urgently needed action worldwide. The Reserve Banks of Australia, England and France have all made statements in 2019 highlighting the growing financial and social costs of climate change that have already occurred. They have acknowledged that the global economy needs to shift to Net Zero Emissions. These responses are converging around a timeframe of mid-century for achieving decisive change. Leading governments and organisations are starting to take positive action. The Australian Capital Territory has legislated a target of Net Zero Emissions by 2050. Victoria's Climate Change Act 2017 has a goal of net zero greenhouse gas emissions by 2050, with interim targets for 2025 and 2030. Internationally, the United Kingdom and New Zealand have both legislated for Net Zero Emissions by 2050.

The Grampians region of Victoria extends from the Western edge of Melbourne, through the Central Highlands, Wimmera and Southern Mallee regions, all the way to the South Australian border. It comprises eleven local government areas (refer figure 1), and covers 49,000 square kilometres or 21% of the land mass of Victoria. Major towns include Ballarat, Bacchus marsh, Ararat, Avoca, Daylesford, Stawell, Horsham, Warracknabeal, Nhill and Edenhope. In 2017, the Grampians region had an estimated resident population of just under 244,000. Ballarat was the region's largest settlement, comprising over 43% of the population. Population growth is forecast for the Central Highlands area and population decline for the Wimmera Southern Mallee area.





The Grampians enjoys an economic gross regional product of \$11 billion. The largest contributing sector is agriculture. Renewable energy production, manufacturing, construction, and health and education services are also major contributors to the economy. This reliance on agriculture could be regarded as a vulnerability in the face of climate change. The Victorian Government anticipates that in the coming decades the Grampians region will experience high temperatures year-round, more frequent and more intense downpours, and less rainfall in autumn, winter and spring.

This roadmap shows how valuable it is for an agriculture-strong region to take early and effective action on carbon emissions. Early movers – regions and their businesses – will be better placed to capitalise on market opportunities arising from the transition to zero. The Grampians region is already a national leader in renewable energy, with a strong track record of innovation and collaboration across sectors. It is well positioned to lead in delivering outcomes for its communities and businesses, moving towards a Net Zero Emissions economy.



Figure 1.



2. VISION

The Grampians New Energy Taskforce has committed to a strategic goal of reducing greenhouse gas emissions from their current level (refer figure 2) to zero by the year 2050, across the entire Grampians region, in line with Victorian Government policy for the whole state.

This roadmap report explores what the Net Zero Emissions goal means, and why it might specifically be important for the Grampians. It discusses three different approaches the region might pursue – a Business as Usual approach, a Local Action approach, and a Collaborative Action approach. It discusses how these approaches might play out in key domains of the region’s economy. It also considers what the priorities are for action associated with these approaches.

The Grampians can achieve the Net Zero Emissions goal as early as 2044, if clear and targeted actions within the region are complemented by clear and targeted actions from government and industry beyond it. Local Action alone can achieve 76.5% of the target by 2050. A Business as Usual approach would achieve only 23.3% of the target by 2050.

This report brings together a large project of work that the Grampians New Energy Taskforce has led, including extensive public and expert consultations. It is underpinned by economic and scientific work prepared by Beyond Zero Emissions in partnership with Strategy Policy Research. The technical work includes detailed recommendations for pursuing the local action and collaborative action approaches, which are summarised here.

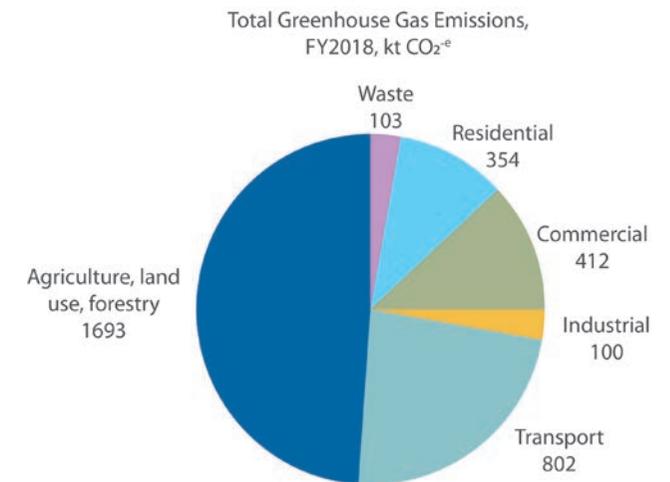


Figure 2.



3. WHAT DOES ZERO EMISSIONS MEAN?

The concept of Net Zero Emissions describes a balance between the amount of carbon released into the atmosphere and the amount of carbon taken out of it. For the Grampians, it means human society and the natural environment are emitting less carbon than they are drawing back from the atmosphere, across the region as a whole. In other words, we can measure the carbon that a region emits into the atmosphere and the carbon it draws back down. When the drawdown is equal to or greater than the emissions, the Region has achieved Net Zero Emissions.

What are the region's emissions?

They derive from human activity and from activity in the natural environment. Achieving the Net Zero Emissions goal requires taking account of both aspects. Typically, it invests in enhancing and replenishing natural resources and ecosystems to strengthen their drawdown of carbon, while at the same time reducing the greenhouse gas emissions that flow from human activity.

To date there has been little published work establishing

emissions or carbon capture at a regional level. For this roadmap report, then, it is still necessary to use national figures and apply them regionally. While that leads to an approximation rather than an absolute measure, it provides an important first step in establishing priorities and opportunities. The same data sets will also be comparable over time.

For the Grampians, achieving Net Zero Emissions requires changing behaviour across the region—not in all ways but in some critical, targeted ways. It means using homes and workplaces differently. It means making the best of technology to change energy use and transport options. It means using land in ways that contribute to achieving the goal.

The research behind this roadmap report has identified five domains of action that correspond to main aspects of the Grampians' economy. These domains structure the changes that we need to make, both in the region and with support from beyond, in order to achieve Net Zero Emissions. Section 5 of this report discusses them in detail.

5 Domains of action



1. Energy



2. Buildings



3. Industry



4. Transport



5. Land



Maintaining a Business as Usual approach, without taking innovative action to accelerate decarbonisation of the region's economy, would see the Grampians deliver only 23.3% of the emissions reductions needed to achieve Net Zero Emissions by 2050.

Clear and targeted action that is limited to the Grampians can deliver 76.5% of the emissions reductions needed to achieve Net Zero Emissions by 2050. This is what is called the Local Action approach. Drawing on efforts across the region, it would represent a major contribution to the effort against climate change, but Local Action alone cannot achieve the goal of Net Zero Emissions.

Clear and targeted action across the Grampians, combined with complementary action from government and industry beyond the region, can realise the goal of Net Zero Emissions by 2044, and contribute more than that in the subsequent years. This is called the Collaborative Action approach.



4. THREE APPROACHES TO ACHIEVING NET ZERO EMISSIONS





4.1. THE "BUSINESS AS USUAL" APPROACH

The world is changing in many ways, including human responses to the threat of climate change. Across the domains of action considered in this report, it is predicted that practices and technology mixes will tend to move towards a lower dependence on fossil fuels, based on current trends. These changes are uneven and not always predictable; however the overall result is a foreseeable reduction in carbon emissions across the Grampians for the years 2018-2050.

In this scenario, emissions are expected to fall significantly in transport and in the residential sector. Transport emissions are expected to fall, despite travel and freight demand growth, due to electrification of at least parts of the transport task. Abatement in the residential sector is due to the significant share of electricity in residential energy consumption, and the expectation that

emissions associated with that electricity generation will be very low in the coming decade and beyond even if no further action is taken beyond what is already known.

This scenario is called the Business as Usual approach. It entails making no strategic changes that would particularly change the rate of decarbonisation in the region's economy, beyond those changes that may be already observed underway. In other words, the Business as Usual projections up to the year 2050 display a considered sense of the trajectory the region is currently on, as modelled in the technical work. Figure 3 plots the year-by-year changes projected, decreasing gradually to 23.3% of current emissions.

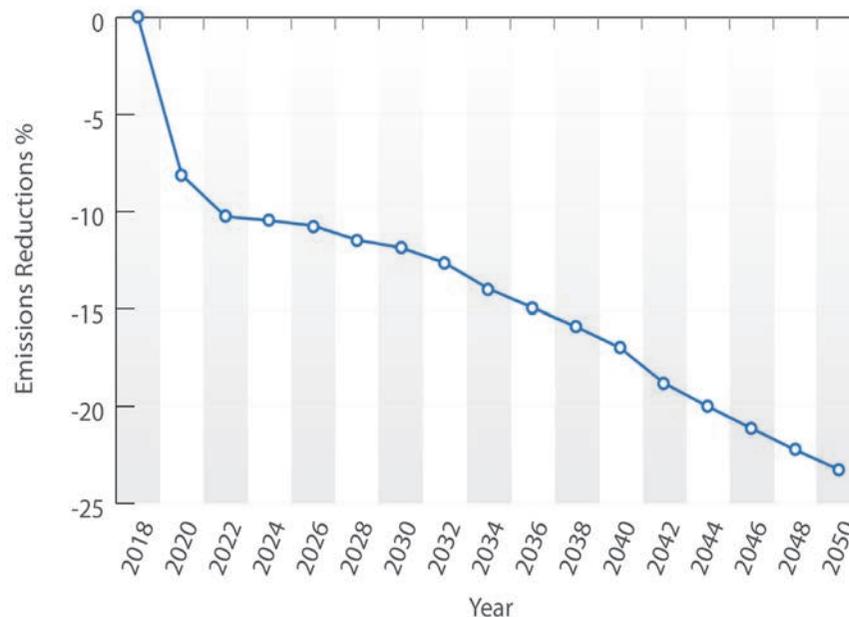


Figure 3. Business as Usual approach: Grampians Region total emissions reduction



4.2. THE "LOCAL ACTION" APPROACH



One point of comparison is to assess what clear, targeted changes are realistically achievable, then project their likely consequences for greenhouse gas emissions. The challenge for a localised study like this is to acknowledge that some achievable changes are effectively outside the control of the region, while others are achievable through local decisions and behaviours alone.

For that reason, the Roadmap models two alternatives to Business as Usual. The first is the Local Action approach. It relies on clear and targeted action at a local level, but it does not rely on changes to Business as Usual coming from outside the Grampians. The emissions reductions projected for this approach over the years 2018-2050 are much more significant than those associated with Business as Usual. Figure 4 shows the year projections, which reach 76.5% by 2050.

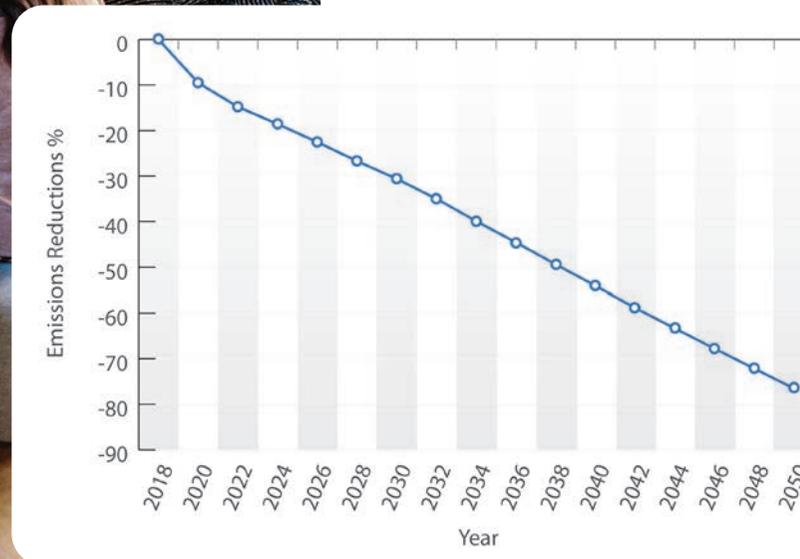


Figure 4. Local Action approach: Grampians Region total emissions reduction



4.3. THE "COLLABORATIVE ACTION" APPROACH

The third and final scenario builds on the potential offered by Local Action. The Collaborative Action approach goes on to factor in achievable changes that government and industry beyond the Grampians might adopt. It is an overtly optimistic scenario, in that it assumes state and national decision makers can be persuaded to complement a local campaign.

Figure 5 projections show that the Collaborative Action approach would achieve Net Zero Emissions by 2044. It would then continue to achieve net negative emissions in the subsequent years—so that the figure for 2050 would represent a reduction by 124% in relation to 2018 levels. The greatest single contribution of this approach is to enable very significant changes in land use, which ultimately leads all the domains of action in achieving net negative emissions by 2050 (it is projected that land use changes will achieve a reduction of 160.7% compared to 2018 levels).

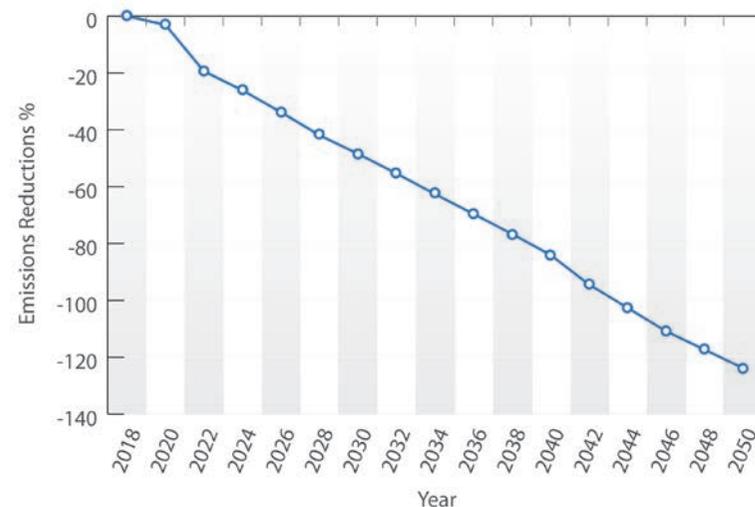


Figure 5: Collaborative Action approach.
Grampians Region total emissions reduction



5. FIVE DOMAINS OF ACTION

Each of the approaches discussed in Section 4 revolves around behaviours and practices, or “domains of action” in various aspects of the Grampians Region and its economy. To understand how the respective approaches work, it is necessary to understand what changes they would drive in each of the five domains. This section works through each domain, explaining how it might be affected by Business as Usual, by Local Action and by Collaborative Action.





5.1 ENERGY

The Grampians Region is already a leader in renewable energy, with major wind energy production zones and net renewable energy exports. These trends are set to expand in the future. With progressive expansion of solar uptake, and with a gradual increase in electrical storage, the region will meet most of its own electrical needs from renewables. It will also play a major role in enabling Victoria and the wider national energy market to reduce emissions.

Stationary energy means all fossil fuels (gas and coal) used in electricity generation and in the direct production of industrial heat, as well as geothermal energy. It draws

much attention in public discussions of carbon emissions and climate change; however, it is the least dynamic domain of action when strategies for achieving Net Zero Emissions in the Grampians are modelled. That is because a Business as Usual scenario will already see a very rapid drop-off in emissions from stationary energy consumption before 2023.

The region's electricity-related emissions are low, compared to the rest of Victoria. They will be much lower again in the future, given a continued expansion in renewable electricity generation. Figure 6 shows that emissions from electricity use in the Grampians are projected to fall early and significantly under any of the approaches discussed here.

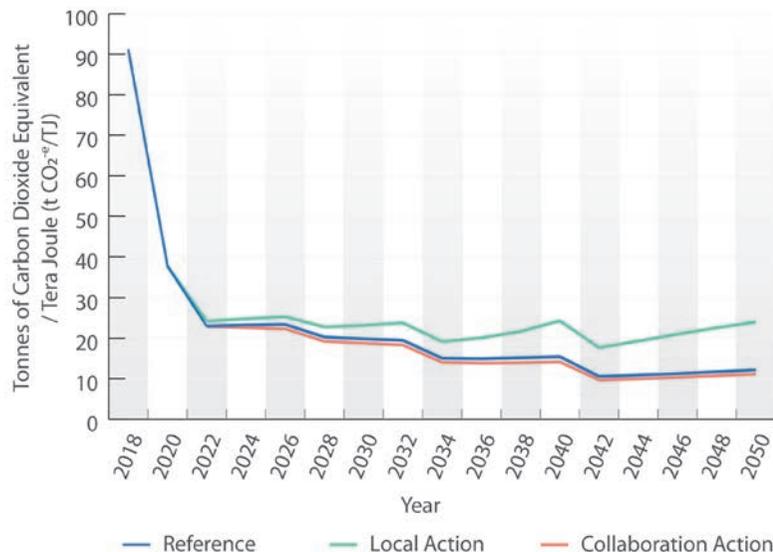


Figure 6: Electricity Emissions Intensity by Approach



Figure 6 points to an interesting quirk of the Collaborative Action approach: in the years after 2022, it will lead to higher electrical demand than the Local Action or Business as Usual approaches. This is allowing for the use of electric vehicles, and for the replacing of fossil fuels in stationary energy applications. In other words, the Collaborative Action approach involves sacrificing some reduction of electricity emissions in order to make much greater reductions in other domains of action.

In any case, emissions associated with electricity use are not expected to fall to zero under any approach discussed here. The largest gains under the Local Action and Collaborative Action approaches will be found in other domains.

Recommendations for Local Action

- The City of Ballarat continues to pursue a trial of hydrogen fuel.
- Households and businesses can transition from gas to electricity—for example induction cooking, solar heat-pump hot water and smart timers.
- People can maximise energy efficiency by assessing appliances, hot water systems, cooking and space conditioning devices and the usage of these facilities.
- Local communities can investigate microgrid opportunities for self-sufficient, reliable and affordable power.
- People can add solar panels to their home and business buildings.
- Community leaders can run education programs to reduce energy usage.
- Energy providers can use data analytics to help people identify inefficiencies in their buildings, appliances and equipment.

Recommendations for Collaborative Action

- Local authorities can work with state and federal governments and with infrastructure providers to upgrade the region's existing power grid.
- Local organisations can engage with governments and energy companies to establish community benefit programs.



5.2. BUILDINGS

Whereas the projected carbon emissions associated with energy consumption do not vary hugely between approaches, those associated with the construction and usage of buildings do. The projections are based on likely changes to commercial and to residential buildings. For the Grampians, that involves buildings across a wide range of economic circumstances, as well as a wide range of climatic conditions, including the potential for bushfire.

Importantly, it involves a growing buildings sector. Total floorspace in the Grampians is estimated to grow from 7.3 million square metres in 2018 to almost 10 million square metres in 2050. Given the switch from fossil fuels to renewable sources for electricity production already underway, the main variable between the three projected approaches is the use of fossil fuel gas as an energy source.

This period will see a rapidly falling intensity of emissions around electricity consumption, as discussed in Section 5.1. A great portion of this shift will be due to the uptake of rooftop solar electricity, which has been profound for both residential and commercial sectors.

Under a Business as Usual approach, greenhouse gas emissions associated with the construction and usage of buildings would be expected to fall by more than half from 2018 (504 kilotonne (kt) of carbon dioxide equivalent (CO₂-e)) to 2025 (236 kt of CO₂-e). After 2025, however, it is likely that emissions will begin growing again, in line with an increased usage of gas.

In other words, from 2025 onwards, emissions from gas will dominate total emissions associated with building usage and construction. Since gas consumption is forecast to rise under this approach, emissions will also rise in the years 2025-2050. As an indication, Figure 7 sets out the Business as Usual projections for commercial buildings.

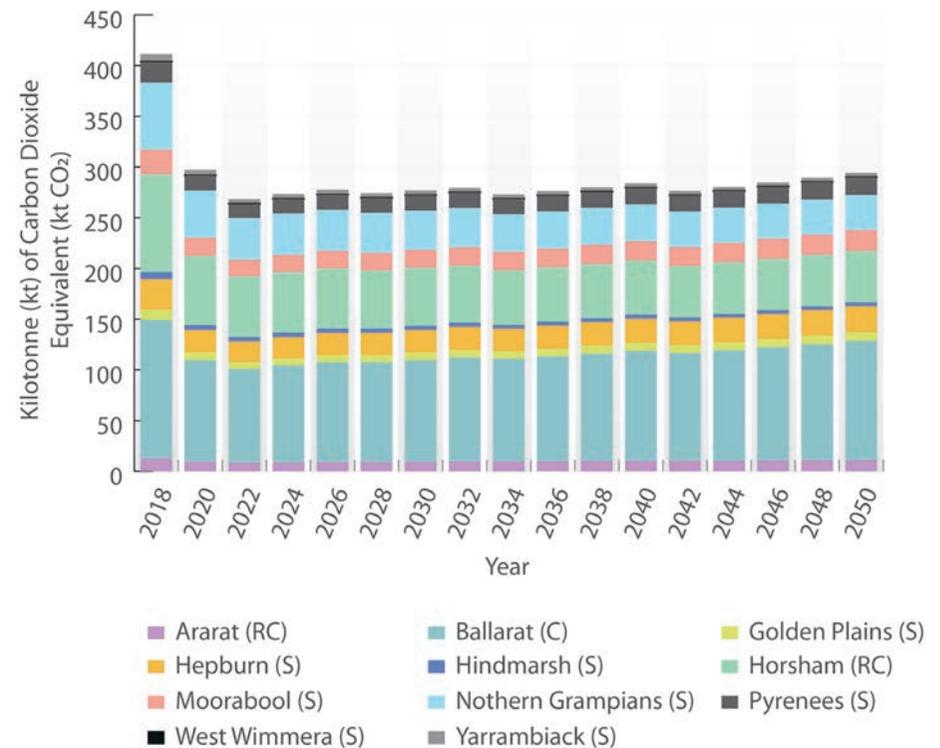


Figure 7: Commercial buildings greenhouse gas emissions, Business as Usual Approach, by local government authority



The medium-to-long term outlook for the Grampians is a region with a surplus of renewable electricity. The Local Action and Collaborative Action approaches are aimed at maximising this advantage, by looking for ways to reduce reliance on all fossil fuels in the usage and construction of buildings. A particular focus is on maximising the uptake of solar power.

Some people are not yet aware of the greenhouse gas implications of consuming fossil methane. Some may still associate electricity consumption with the use of brown coal in the Latrobe Valley, and so are inclined to assume that gas is a more climate-friendly option. That is a misleading comparison if the electricity is largely or entirely renewable in origin, however. By 2025, generating electricity will emit significantly less carbon than burning gas.

The region's surplus of renewable electricity highlights that the largest, fastest and very likely most cost-effective abatement opportunity is to use that electricity to replace the burning of fossil fuels, including natural gas, in households, business and industry.

Other strategies for natural gas replacement are being explored, including hydrogen produced with renewable

electricity. It is possible that hydrogen systems may become a significant feature of Australia's future energy system. That said, there is a need to reduce emissions as rapidly as feasible. Replacing gas consumption with renewable electricity is an effective strategy that is available now and, unlike hydrogen, is a proven approach. Figure 8 projects how this strategy could play out, charting the likely emissions for commercial and residential buildings over the years to 2050.

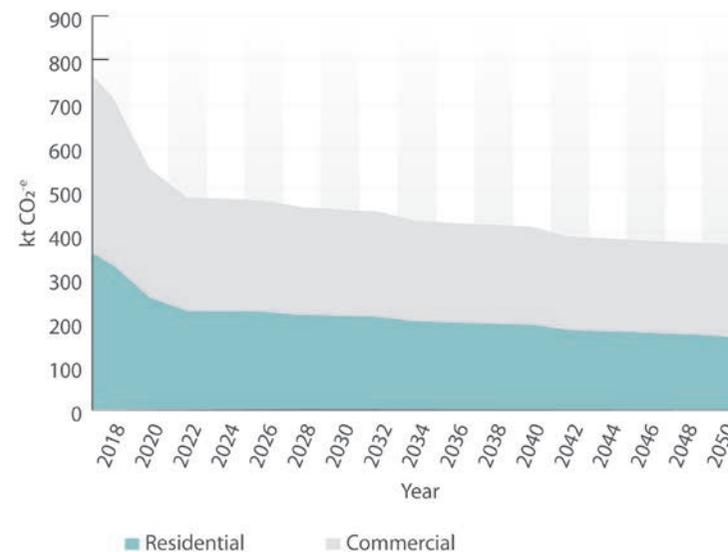


Figure 8: Stationary Emissions, Local Action approach



Under the Local Action approach, emissions associated with the construction and usage of buildings would be expected to fall significantly by 2050: a reduction of more than 52% for the residential sector and just under 50% for the commercial buildings sector, relative to 2018.

An opportunity for the region would be to create regionally adapted information sheets and sources, and to conduct awareness raising and information campaigns to promote the benefits of renewable electricity. These would need to be differentiated for different sectors and markets—ultimately any move away from fossil fuel energy sources such as gas will need to be financially viable for households and businesses. Successful transition even on a regional scale will likely require policy changes and transitional support from state and federal governments.

Other challenges include rented buildings, both residential and commercial, where the owner may have little incentive to install solar or improve the thermal efficiency of the building, as the tenant will be the primary beneficiary—at least in the short term. The tenant is likely to have little incentive or ability to invest, particularly if lease terms are short or do not allow such “modifications,” and if they face “make good” provisions at end of

lease. Currently the state government offers significant subsidies for residential solar installations, particularly with a view to making rooftop solar viable for low income households. Continuing and promoting these subsidies would likely accelerate a move away from fossil fuels.

There are particular challenges for solar on apartment buildings or other strata-titled developments. The complexities of collective decision-making in such buildings can exacerbate other issues, such as many apartment buildings having a smaller available roof-area relative to their floor area and energy demand. While apartments represent only 2.5% of all dwellings in the Grampians Region, that is still over 2,200 households that may face challenges in accessing the benefits of solar energy.

Finally, regardless of the financial benefits of solar systems or improving thermal efficiency to reduce energy consumption, lower-income households may not be able to afford the capital cost. There is a case for considering how all households can be included within the clean energy transition, and not be excluded from its benefits. One of the goals of the Victorian Government’s Solar Homes program is to address domestic solar system affordability.

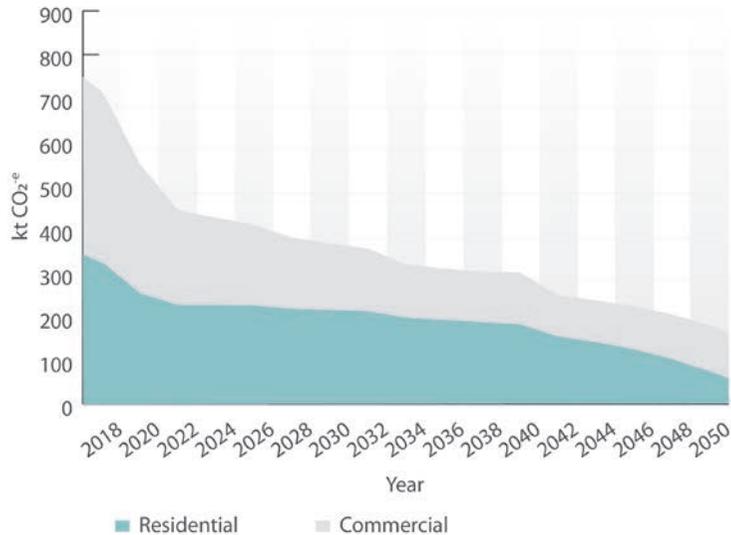


Figure 9: Stationary Emissions, Collaborative Action approach

These are widespread challenges throughout Australia, which can most effectively be addressed in partnership with state and federal governments. With willing cooperation from other agencies and from industry, the extent of emissions reduction under the Collaborative Action approach would be very significant, as Figure 9 projects.

By these projections, emissions reductions under the Collaborative Action approach would reach almost 79% for residential buildings by 2050 (compared to 2018 emissions), and over 74% for commercial buildings.

Recommendations for Local Action

- Individuals and organisations can promote and facilitate solar uptake.
- Individuals and organisations can raise awareness and support for fuel switching.

Recommendations for Collaborative Action

- State government can mandate higher standards for energy performance in housing, including enhanced planning schemes and housing developments.
- State or federal financial support can assist landlords to meet rental standards for the energy usage of buildings without lifting rental charges.
- State or federal governments can support the upgrading of existing buildings, including business solar facilitation and innovative finance for solar uptake.



5.3 INDUSTRY

Industry can expect to reduce its emissions in the short term, however focused action will be required to keep reducing emissions in the years beyond 2025. Many of the opportunities to reduce emissions will be around the use of renewable electrical power, rather than fossil fuel gas. This section focuses primarily on mining and manufacturing, which are industries associated with intensive energy use. Section 5.4 deals with transport, including the transport industry.

Much as with buildings, the Business as Usual approach will see an almost 50% reduction in emissions over the years 2018-2025, then a levelling out, before a gradual rise in emissions over the years 2031-2050. Combining the electricity and gas projections above, Figure 10 shows the greenhouse gas emissions projections for mining and manufacturing industries across the region under Business as Usual. Emissions will fall in the early years, due to the declining emissions intensity of electricity use, and then flatten out as they become dominated by emissions associated with natural gas consumption. The projections here are largely driven by the Australian Energy Market Operator's expectations about gas consumption across Victoria.

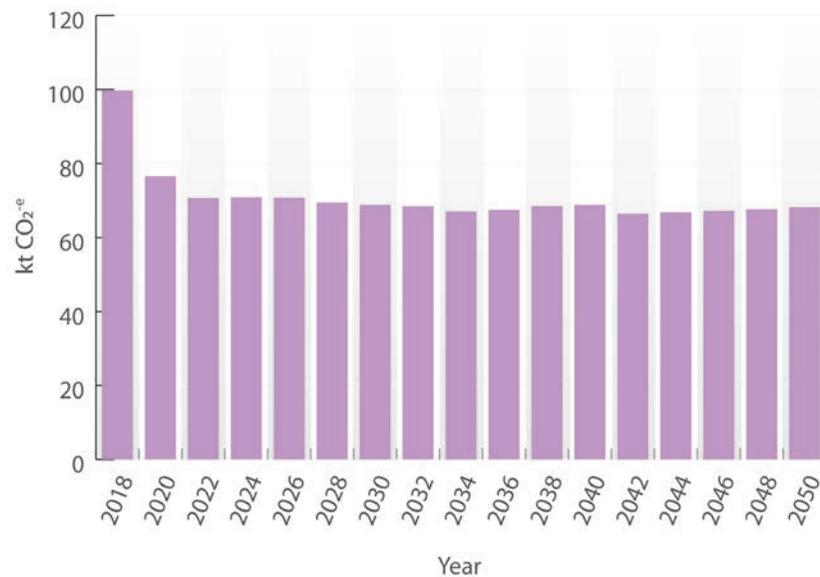


Figure 10: Industry Sector Greenhouse Gas Emissions, Business as Usual approach



The Local Action approach is predicated on enabling and encouraging business enterprises to shift their energy usage from gas-sourced power to alternative energy. Initially, in 2021, it is modelled that ten enterprises would switch to alternative energy, with that number growing annually by five enterprises per year. By 2050, that could see almost 2,500 industrial enterprises moving from gas to alternative energy, out of an expected total of nearly 3,700 enterprises in the Region at that time.

Based on average energy use per site, this switching could see a reduction in Regionwide gas consumption of more than 800 terra joules (TJ) by 2050. That reduction, in turn, would lead to an increase in electricity consumption of around 270TJ by that time. With the significant reduction in the emissions intensity of electricity consumption anticipated over this timeframe, total emissions in the sector would be expected to fall by almost 71%, as Figure 11 reveals. This fall in emissions intensity of electricity would be supported by industry moves to generate electricity on-site through solar or bioenergy sources, or to procure it from large-scale wind and solar farms within the region.



Under the Collaborative Action approach, stronger policy settings and government incentives would lead to a faster rate of (electrical) energy efficiency improvement, averaging 2% per year. In addition, incentives under state-based schemes – on top of continued market and technology trends – would be likely to see an acceleration in fuel switching.

Collaborative Action means pursuing stronger policy incentives to lower emissions and accelerate efficiency improvements, specifically renewable energy and fuel switching. The Grampians can achieve emissions reductions of between 70% and 80% by this approach. Potentially, even greater savings – including Net Zero Emissions – could be achieved with further technology or market breakthroughs. An increase in energy storage in the Region would lead to fewer or no electricity imports, therefore fewer or no emissions.

The Collaborative Action approach would aim for 50 enterprises to switch to renewables in 2021. A further five enterprises would shift to renewables per year, meaning all the Region’s mining and manufacturing enterprises would switch to renewables by 2050. This fuel switching would be expected to increase electricity demand by some 400TJ by 2050. However, due to the large share of emissions-free electricity in the region, emissions would be expected to fall by nearly 80% by 2050, reaching very low levels (22 kt of carbon dioxide equivalent), as Figure 12 projects.

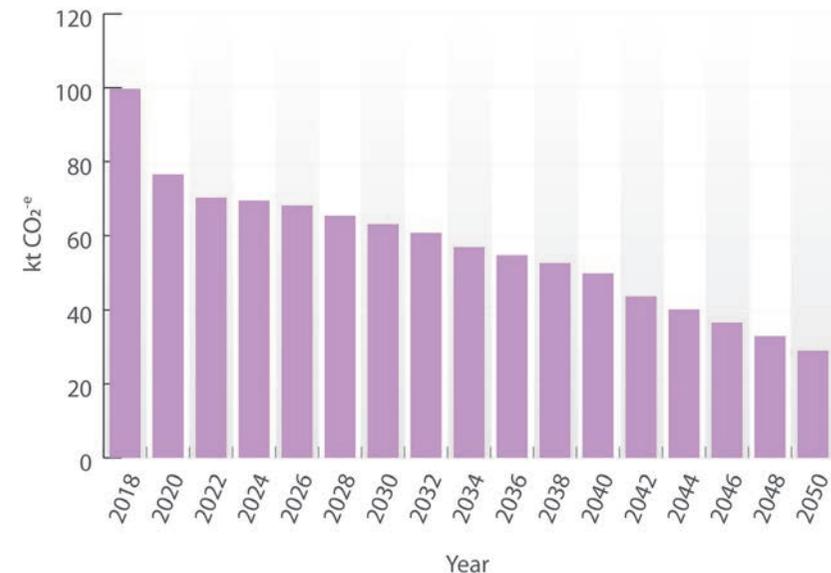


Figure 11: Industry sector greenhouse gas emissions, Local Action approach



Increases in emissions from industry in the Grampians, as in Victoria generally, will predominantly arise from the use of natural gas. To date, gas has offered a lower-cost and lower-emissions alternative to electricity generated from brown coal. However, gas is now a relatively high-emissions pathway when compared to the use of renewable electricity. The Business as Usual projections show that a long-term reliance on gas will lock the region's industries out of meaningful emissions reductions beyond the year 2025. Strategies under the Local Action and Collaborative Action approaches are aimed to sustain the momentum with reductions up to 2050 and beyond.

Recommendations for Local Action

- Businesses can pursue “fuel switching”—to switch their power source from gas to renewable electricity.
- Industry can make wider use of renewable electricity Power Purchase Agreements, especially in manufacturing, and local organisations can promote a greater awareness of this option.

Recommendations for Collaborative Action

- The Region can work with governments, industry and researchers to develop innovative storage strategies, including potential use of renewable hydrogen or biogases.

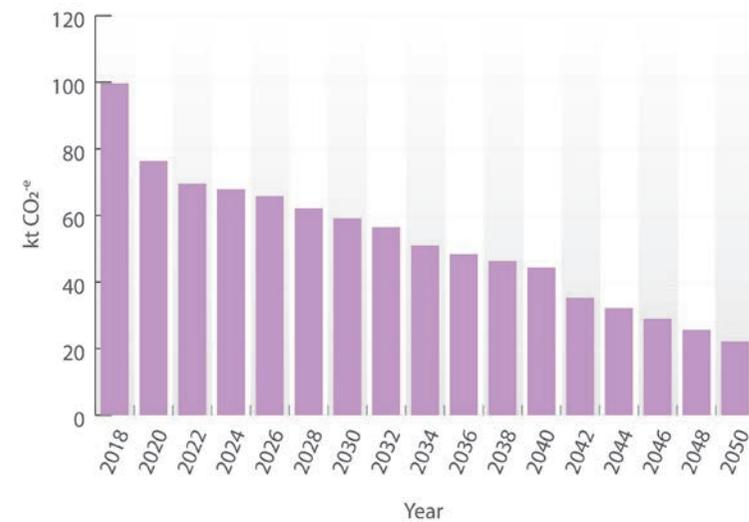


Figure 12: Industry sector greenhouse gas emissions, Collaborative Action



5.4 TRANSPORT

Transport plays a vital role in the Grampians. Transport activity is beneficial for economies but brings with it direct and indirect costs. The environmental costs of transport include the emission of greenhouse gases (along with other pollutants) from the petrol and diesel burnt by the internal combustion engines of vehicles. Some of these emissions can be reduced by changing local decisions and behaviour, but the most significant reductions can only come with changes to technology and to state and federal regulation.

Transport emissions have been generally rising across all of Australia's regions for decades. This is due to increases in transport activity along with ongoing use of liquid fossil fuels to power the vehicles that perform transport tasks. Passenger transport tasks are rising with population increases and freight transport tasks are increasing with rising economic growth and consumption of goods. The great bulk of this increasing transport task is performed by diesel and petrol vehicles – so emissions are also increasing.

At the same time, emissions from other sectors – such as electricity generation – have been falling. Transport's share of total emissions is growing in Australia and consequently also in the Grampians.

While motorised transport activity will continue to grow as populations and economies grow, the growth in emissions is no longer an automatic consequence. Transport emissions will fall significantly, even under Business as Usual, due to global shifts in vehicle technologies and a modest trend to use cars a little less per person.

Figure 13 projects the Business as Usual emissions for passenger and freight transport over the years 2018-2050. It shows the likely impact of three trends now under way:

- electrification of vehicles.
- improved efficiency standards for petrol and diesel vehicles.
- shifts in behaviour (from private cars to public transport, from passive to active transport, and trip avoidance).





Local Action would involve a switch by councils to electric (EV) light vehicle fleets by 2025. This is assumed to prompt a slight increase in the rate of EV uptake among private car owners, responding to municipal leadership. Note that this action could be integrated with broader state or commonwealth government purchasing policy.

On freight, Local Action could see councils working together to develop a procurement framework that requires local transport service providers (couriers, freight companies, etc) to use Net Zero Emissions vehicles. Councils could work with local large businesses to enact the same policies.

Meanwhile, Local Action also means per person use of cars would drop slightly as councils take measures to encourage active transport options. Informed by applicability studies in each location across the region, more pedestrian crossings, pedestrian-friendly speed limits in towns, increased development of bike lanes and pathways, and some changes to urban road availability could encourage shifts in behaviour away from private car use. Importantly, the region could reconfigure its education and health precincts for people-centred and active travel outcomes rather than promoting car use.

Figure 14 shows the region's projected transport emissions under the Local Action approach. It shows a substantial improvement on the passenger travel emissions for Business as Usual, as well as some improvement on the freight emissions.

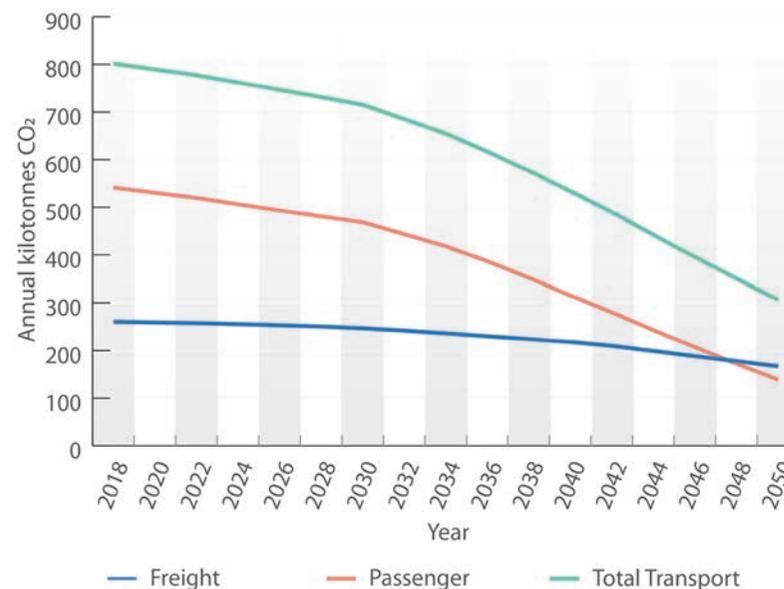
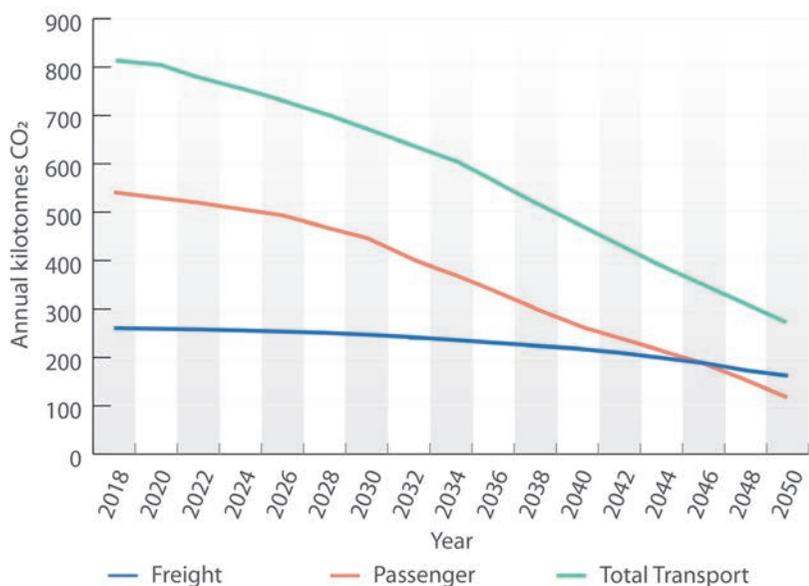


Figure 13: Grampians transport emissions under Business as Usual



The Collaborative Action approach complements local efforts with state and federal initiatives that would change transport technology and behaviour very significantly. It would require the Victorian and Australian Governments to become major funders of active travel infrastructure.

At the same time, the entire rail network could be electrified by 2040. Buses could become fully electric by 2050. Public transport networks could be extended, and per person charges could be reduced to drive increased patronage.

Collaborative Action would encourage households and industry to switch to Net Zero Emissions vehicles through a fast rollout of public EV infrastructure, as well as public planning and partial support for hydrogen and EV infrastructure for heavy vehicles. This could be matched by other incentives to promote the use of EVs, such as increases in fuel taxes and registration price increases for non-Net Zero Emissions vehicles, although these measures would need to minimise costs to consumers.

These Collaborative Actions are within the capacity of government and industry, but will need to be balanced against other policy considerations such as affordability. Figure 15 illustrates how much emissions reduction they can drive. While the end result is not quite zero, it represents a more than 90% drop in emissions by 2050, compared to 2018.

Figure 14: Grampians transport emissions under Local Action

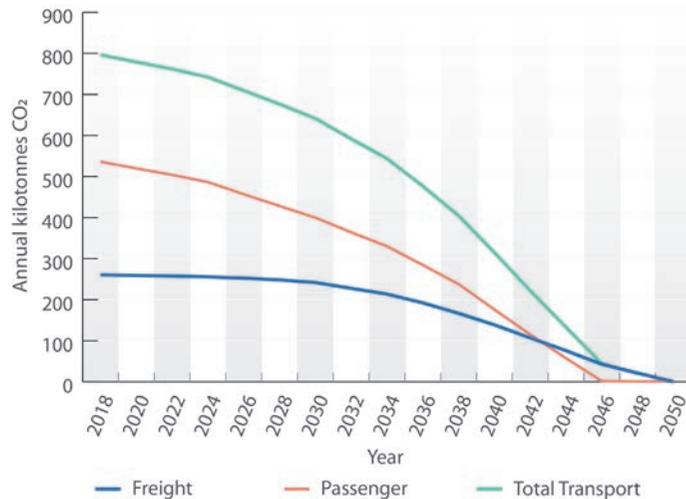


Figure 15: Grampians transport emissions under Collaborative Action

Recommendations for Local Action

- Households and businesses can prioritise electric vehicles when they next purchase a car.
- Transport planners can develop local and regional electric vehicle charging networks, leading communities to install further charging points.
- Households and workforces can give greater consideration to public transport options in planning their regular and incidental journeys.
- Individuals can make active travel a greater part of their lifestyles.
- Transport planners can create and implement a region-wide plan for active transport.
- Local industry can run community education programs about electric vehicles for individual and industry use.

Collaborative Action can eliminate the daily use of diesel and petrol vehicles by 2050. This will require concerted efforts, but some of the implementation measures will be popular if the consumer experience is superior. Public support for EV infrastructure and hydrogen for heavy vehicles will likely be forthcoming. There will be various ways of achieving zero transport emissions, but the task of shifting from fossil fuel to electric transport will require significant policy interventions at the state and national levels. For that reason alone, this will be a challenging approach to fulfil.

Recommendations for Collaborative Action

- Regional councils can work with providers of public transport and other stakeholders to increase public transport options across the Grampians.
- Regional councils can work with state and federal governments and other stakeholders to electrify all the region's train journeys by 2040 and all bus journeys by 2050.
- Regional councils can work with governments and industry to create a zero-emissions heavy vehicle task force to set targets for industry uptake of Net Zero Emissions heavy vehicles.
- Local and state transport planners can work with industry and researchers to develop logistics solutions based on circular economy principles, which involve less long-haul transport and more short haul transport, and which tend to use smaller electric vehicles.



5.5. LAND - AGRICULTURE

The Grampians Region covers 48,627 square kilometres. Farms and the wider agricultural industry are a vital part of the fabric of the Grampians, and a key driver of the economy. There is no question that farming enterprises need to be profitable and sustainable in order to sustain the region's livelihood. Not only is agriculture a key industry for the region, but it is of great significance for the roadmap report to reach Net Zero Emissions. In fact, land usage is the single most powerful element of the roadmap report.





Under the Business as Usual approach, the agricultural industry will need to manage the effects of increasingly variable weather conditions as the climate changes. This potentially includes reduced rainfall quantity and reliability along with hotter summers and higher evaporation. Farmers will continue to adapt and improve their practices to maintain and increase productivity. Additional challenges will also be presented to the industry through globalisation, such as international competitiveness and widescale industry transitions. These efforts will require support at various levels of government, harnessing research and development to facilitate dynamic change.

At the same time, population increases and rising income in countries like China and India mean that global demand for agricultural product, such as grain and meat, is expected to rise. Rising demand will keep delivering an incentive to farmers to continue their enterprises even in the face of climatic challenges.

The Business as Usual scenario envisages changes in the emissions intensity associated with electricity generation, but not widespread changes to land use emissions. There are and will continue to be innovative technologies available, but Business as Usual will not see their increased widespread adoption in agricultural practice above the current rate. Figure 16 shows the emissions projections under this approach: rates of emissions reached an upper limit in 2018 and will remain more or less level from 2019 until 2050.

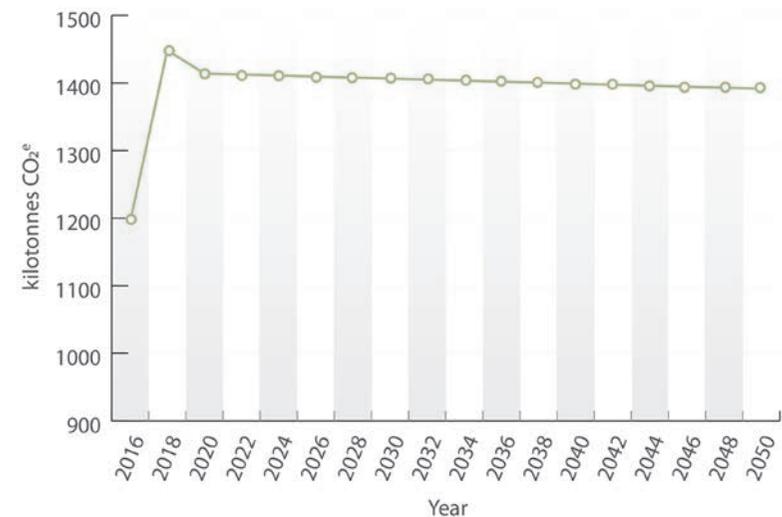


Figure 16: Grampians agricultural emissions - Business as Usual



The greatest opportunity for the land sector to draw down carbon and at the same time boost ecosystem health is to return low to unproductive cropping and grazing land back to native tree and shrub species.

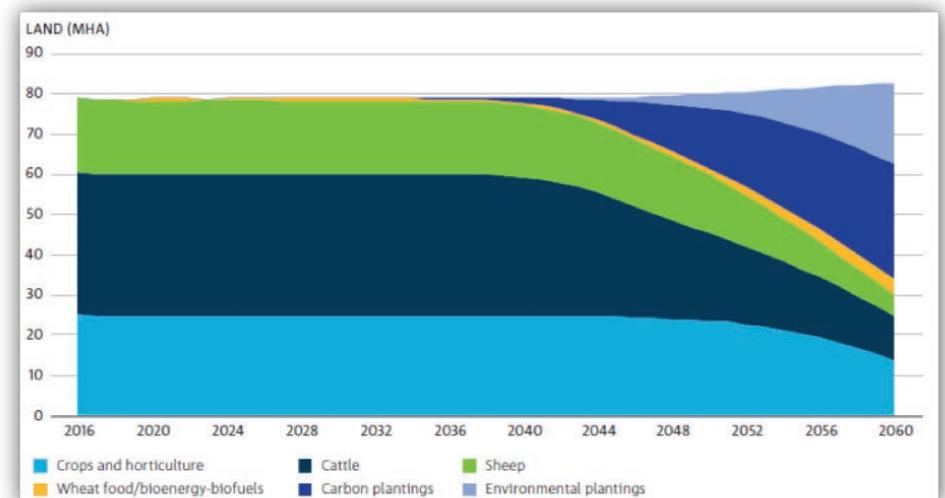
The CSIRO have advocated this approach. Across Australia's total agricultural lands, they envisage that land use solely allocated to crops and grazing needs to be reduced to less than 50% of current levels by 2060. Much of this usage would be replaced by areas of native species aimed at environmental improvement and carbon sinks. The CSIRO's recommendations for land use to 2060 respect global settings generally, and are specifically in line with Paris climate change commitments to limit warming to 1.5 degrees.

This outlook is based on a considerable land use change across the nation with the amount of cropping land dropping by 40%, and the allocation of land to livestock reduced by 70%. It is important to note that this work was conducted on a national level, and a significant amount of further work needs to be undertaken to modify the logic and apply it at a regional level. Whilst successful implementation of this model at a

national level would result in significant land use change, the amount of agricultural output is not expected to decrease—in fact in some cases it is expected to increase, resulting in higher profitability for farmers. From a regional perspective it is expected that given the relative rainfall, and productive soil types that the region is well placed to not only increase agricultural productivity, but also benefit from any economic diversification offered through carbon capture and renewable energy production.

The CSIRO's advice is for a more selective and responsive use of the land, in all its variety. Trees and shrubs should be planted on land of lesser quality, and along waterways and hills, to sequester carbon and increase ecosystem health. This is sometimes known as “mosaic farming.” Figure 17 sets it out graphically.

Figure 17: Land use change under CSIRO's Outlook Vision (Cooperative Global Context). Source: CSIRO, 2019





Land use, therefore, should be carefully allocated according to optimal, fit for purpose land use. This would see the most productive land (fertile soils in flat areas of at least medium rainfall) used for intensive agriculture (horticulture, orchards, cropping). Livestock would be the main product in areas of medium-productivity land (low to high rainfall on moderately fertile soils). The least productive land – poorer soils, shallow soils, steep slopes and waterways/gullies would support a mix of carbon and biodiversity plantings. On a regional level, given the relatively ‘high’ rainfall, amount of productive soil and ‘mixed’ farming enterprises, ***successful implementation will require significant further work and planning on a localised level, coupled with further research into the carbon capture potential of regional soil types and crops.*** In addition there is opportunity for industry to reduce emissions and diversify through production of waste to energy processes, and alternative fertiliser production. Both options would contribute to the economy of the region, whilst reducing emissions.

A widely recognised example of this model is Jigsaw Farms, near Hamilton (www.jigsawfarms.com.au). They report the push for Net Zero Emissions has required no compromise to their venture’s commercial performance. It reached carbon neutrality with about 19% of the farm covered with trees. This approach will not be viable for other areas of the region, where different soil types and business models are used. It is however a good example of a place based, economically viable model of carbon neutral farming. For other farmers, the answer to making a viable business out of their carbon sequestration appears to lie more in boosting depleted soil carbon and organic-matter levels. A key to success will be the industry as a whole and as individuals working collaboratively to assist in offsetting each other’s emissions.

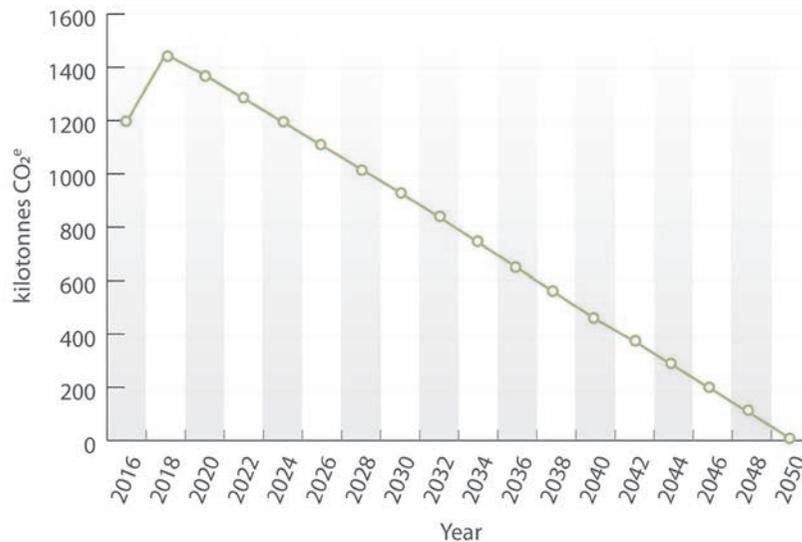


Figure 18: Grampians agricultural emissions - Local Action approach

As Figure 18 shows, Local Action can make a huge difference to agricultural emissions across the Grampians – comparing it with Figure 16 is very revealing – but it will not be enough to achieve a Net Zero Emissions target. It is imperative not only for implementation to be successful, but also for the prosperity of the regional economy that farms can increase their profitability. The region’s land sector alone cannot bear the costs of taking up available opportunities. Evidence-based research, market demand and financial incentives are required to an extent that can only arise from a widespread community and government recognition of the economic value natural assets.

The Collaborative Action approach means a recognition that state and federal governments must strengthen their resolve and implement holistic cross-sectoral policies. Education and research institutions can support the Grampians and its communities in understanding the challenges and the opportunities, of transition to a zero emissions economy helping the region to keep innovating and strengthening. National and international industries need to engage with change in the Grampians. The Grampians region can play a key role in leading and advocating for change – and is well positioned for energetic and determined action.





5.5. LAND - WASTE

Another important component of land use is waste management. Like Victoria as a whole, the Grampians region is working towards a circular economy attitude to waste. This attitude prioritises products and systems designed to use, reuse, recycle or repurpose people's already-used materials in some way. It replaces the attitude that waste is a useless by-product of people's activities, needing permanent disposal.

Under a Business as Usual approach (refer Figure 19), waste will continue to grow as population grows. The Local Action approach would extend existing good practices – such as crop stubble use on farms and green waste collection at some sites. It would also complement them with focused investments in bioenergy, including technologies for combustion/incineration, pyrolysis, gasification, transesterification and anaerobic digestion.

The Grampians region can play a key part in leading a new cultural consensus around land use. As a non-metropolitan region, its communities are more directly exposed to climate change than many others in Australia. The communities thus have a major stake in driving change to our patterns of land use. The region has already taken important steps – recognising that an all-sector approach to reach Net Zero Emissions by 2050 is needed.

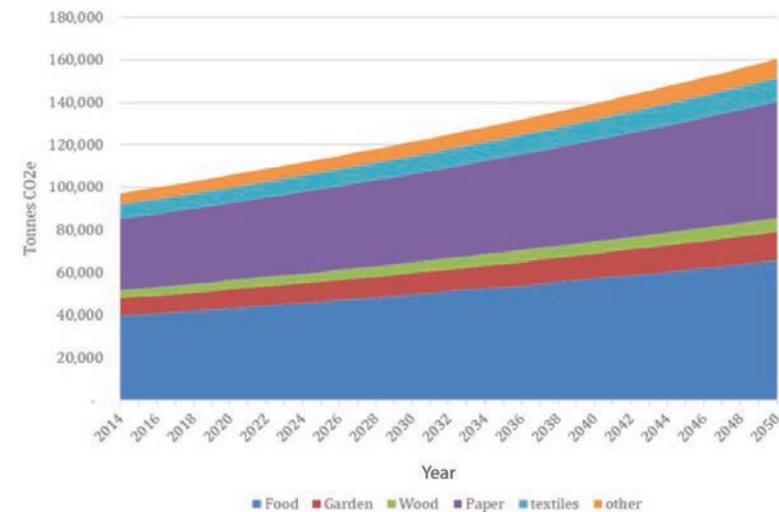


Figure 19: Waste emissions - Business as Usual



5.5. LAND

The benefits of a cooperative and integrated approach to the transition will be an extraordinary transformation, but it is within our collective abilities to collaborate to achieve it. As Figure 20 shows, the projections for a Collaborative Action approach would take the region's net agricultural or land emissions down to well under zero by 2050, a reduction of 160.7% on 2018 levels.

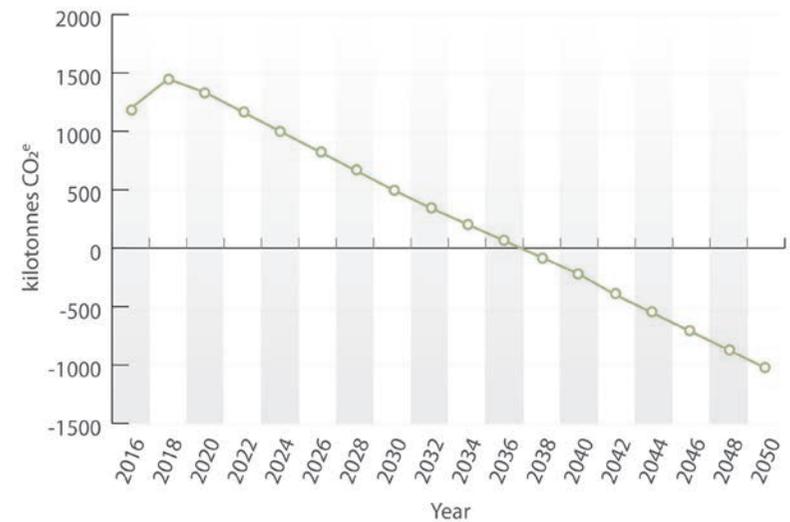


Figure 20 - Grampians Land Use Emissions
- Collaborative Action Approach



Recommendations for Local Action

- Landholders can pursue trials of (and research into) diversified farming techniques, including:
 - Ways to make mosaic farming work in the Grampians.
 - The carbon capture potential of the region's crops and soils.
 - Shifting intensive farming to renewable energy.
- Local authorities can enable and encourage the uptake of circular economy principles, including:
 - Waste to Energy trials (including bio-waste).
 - Bio-waste to Fertiliser trials.
 - Community education on recycling and waste reduction.
 - Investigate the viability of locally produced fertiliser using renewable energy.

Recommendations for Collaborative Action

- Local, state, and federal government can work with industry and researchers to develop technological solutions to livestock and crop emissions, including:
 - Modifying livestock feed to lower livestock emissions.
 - Converting bio-waste to fertiliser.
 - Increasing and enhancing biodiversity through strategic projects such as Greening Australia's 'Habitat 141' initiative.
- Develop science and engineering programs on food production and the circular economy, in conjunction with universities.
- Local, state, and federal authorities can collaborate to develop circular economy planning and building settings and standards that:
 - Ensure the use of renewable energy.
 - Mandate efficiency standards for energy, water and materials usage.
 - Maximise opportunities to reduce and re-use locally produced waste and by-products.

6. CONCLUSIONS

People in the Grampians have an opportunity to reimagine their ways of life, especially their interactions with the region's industries and infrastructure. While this change can be both exciting and unsettling, given the challenge that climate change already poses to ways of life, it is imperative the region seizes this opportunity. The region needs to make the most of what it offers – including major economic opportunities – while at the same time supporting the entire community to help drive the needed changes.

A Business as Usual approach will go some way to reducing the region's greenhouse gas emissions, especially due to changes in electricity generation. Overall, it will bring year 2050 emissions down to 76.7% of their 2018 levels, a reduction of 23.3%.

A Local Action approach will go much further in reducing emissions. By redesigning infrastructure and encouraging a transition from gas power to renewable energy, it can bring year 2050 emissions down to just 23.5% of their 2018 levels, a reduction of 76.5%.

Building on Local Action by working with governments, industries, and agencies outside the Grampians, it can bring the region's emissions to zero by the year 2044. Driven especially by the potential for leadership in renewable and alternative energy, agriculture and land use, this approach can deliver year 2050 emissions that are reduced by 124% on their 2018 levels. In other words, the Grampians could serve as a global leader, by transitioning to an innovative Net Zero Emissions economy.

