

Wine
Australia

Safeguarding the future for Australian Wine

An Emissions Reduction Roadmap
September 2023

About Wine Australia

Wine Australia is an Australian Commonwealth Government statutory authority, established under the Wine Australia Act 2013. We're funded by winegrape growers and winemakers through levies and user-pays charges and the Australian Government, which provides matching funding for research and innovation investments.

Wine Australia supports a competitive wine sector by investing in research and innovation, growing domestic and international markets and protecting the reputation of Australian wine.

Acknowledgements

We would like to sincerely thank everyone who has contributed to the development of the Emissions Reduction Roadmap and Guide. The time and advice you've given to this important project is greatly appreciated.

- Expert Reference Panel members including John Ide (Hill-Smith Family Estates), Lachie Thomas (Tahbilk), Michael Parks (Treasury Wine Estates), Richard Smart (Smart Viticulture), Sarah Braude (Casella Family Brands), Sheri Robinson (Haifa Australia), Tim Hackett (Henschke), Cath Oates (Oates Ends), Mardi Longbottom (AWRI), Anna Hooper (AGW), Mark Gishen (SAWIA), Alex Sas (Wine Australia) and Sharon Harvey (Wine Australia)
- Edge Impact, and particularly the project lead, Julian Marchant
- Members of the committees and Board of Australian Grape & Wine
- South Australian Wine Industry Association
- The Australian Wine Research Institute
- Australia's grapegrowers, winemakers, business owners and supply chain partners, who attended webinars, workshops and meetings, submitted to interviews, fielded phone calls and responded to surveys. Thank you.

How to use this document

This document reports the total greenhouse gas emissions (emissions) generated by the Australian grape and wine sector and provides an emissions reduction pathway. It also demonstrates the activities and areas of the wine supply chain that can help to reduce emissions over time.

At Wine Australia, we know that sustainability is a long journey. That's why the Roadmap is a starting point that will serve as a foundation for a more ambitious plan in the future, reflecting our commitment to ongoing improvement and safeguarding a future for Australian wine.

This document is supported by a reference manual, the Emissions Reduction Guide, which winegrape growers and winemakers can use to take action in their own businesses.

The Roadmap does not consider:

- emissions generated through individual businesses that are not representative of the broader sector, i.e., capital expenditure for major infrastructure, such as cellar doors, winery kitchens and restaurants etc.
- emissions for activities or sectors where the data is not available, is inconclusive or represents too small a sample size.
- the current or future carbon storage potential of soils or vegetation, beyond that of the harvested grapes used for making wine.



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Climate change is threatening our livelihoods and the future of our planet. We must act now to mitigate its impacts and ensure the economic viability of our sector. **That's why we must decarbonise to safeguard the future of Australian wine.**

As a sector, we must act now in a coordinated and unified way to reduce our emissions in alignment with Australia's national targets, the best practice of the global climate science community and the expectations of our key wine markets - domestically and internationally.

In the 2020-21 financial year period, the Australian wine sector emitted 1,770,997 tonnes of carbon dioxide equivalent (t CO₂-e) to the atmosphere, excluding soil emissions and fermentation emissions. This is roughly equivalent to the emissions produced from a full jet plane doing 609 laps of the world¹.

The Roadmap explains why we must decarbonise and how the Australian grape and wine sector can help contribute to a lower carbon future for Australia. It identifies our impacts and highlights opportunities that we can collectively take to drive action. First, it focuses on reducing emissions within our areas of control by 2030, where there is a realistic opportunity

for the sector to reduce its emissions by over a third (42 per cent) by targeting emissions generated in the vineyard, in the winery and through the supply chain.

The sector's journey to net zero by 2050 will require collaboration and partnerships across our sector and other industries, integrating emerging technologies and greater emissions reduction performance from high-emitting supplier industries. This includes glass manufacturing and transport sectors. Based on the information and technology available today, offsets are likely to be required for the sector to achieve net zero by 2050. However, we're committed to identifying the latest technological advancements to ensure the sector first avoids, reduces and replaces before offsets are considered.

Alongside the Roadmap, we have created a practical guide (Emissions Reduction Guide) to help winegrape growers and winemakers reduce emissions in their businesses, no matter where they are in their decarbonisation journey.

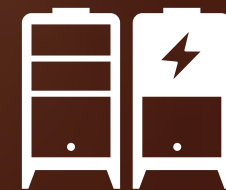
Achieving the full potential of the reduction opportunity to 2030 and safeguarding a future for Australian wine will require a focus on:



Using data to inform emissions reduction business decisions



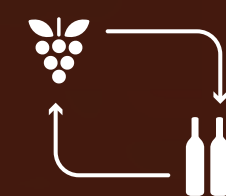
Reducing and eventually eliminating the use of fossil fuel vehicles, both in vineyards and wineries and through supply chains



Operating efficient grape and wine production sites powered by renewable electricity



Optimising low emissions transport and distribution networks now and increasingly in the future



Collaborating with the wine supply chain to reduce emissions from high emitting materials and services.

¹ "Greenhouse Gas Equivalencies Calculator | US EPA available at: <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator#results>"



The roadmap identifies the 2020-21 baseline emissions and key sources of emissions in the Australian grape and wine sector.

2020-21 Emissions

1,770,997* Tonnes of carbon dioxide equivalent (t CO₂-e)

≈ approximately equivalent to the emissions produced

609 Laps around the world

*excluding soil emissions and fermentation emissions.

The greatest source of emissions

49% of total emissions



Industrial Processes and Supply Chain

This includes emissions associated with products and services from suppliers, such as the extraction of raw materials, production and manufacturing of goods and their transportation to market.

29% of total emissions



Transport

This includes the transport of grapes from vineyard to winery, and of packaged wine to Australian and major overseas markets in Europe, North America and Asia.

Despite emissions from grape and wine production being less than that of transport and packaging, there are still significant emissions associated with vineyards and wineries. That's why it's important for winegrape growers and winemakers to take action to drive down their emissions. Reducing emissions within vineyard and wineries is crucial to helping us reach our 2030 ambition.

Winery Operations

12% of total emissions



Winery

Emissions include electricity, fuels, refrigerant leakage, wastewater treatment and employee commuting.

Vineyard Operations

10% of total emissions



Vineyard

Emissions include electricity, fuels, fertiliser use and employee commuting.



Emissions Reduction Opportunities

To help guide the sector to reduce emissions, 11 emissions reduction initiatives were identified and modelled via a marginal abatement cost curve and an emissions reduction waterfall chart. Modelling compares a 2021 emissions baseline to a 2030 target year emissions projection.

	Mitigation scenario	Modelled total emissions reduced by 2030 (t CO ₂ -e)
Electricity	Grid decarbonisation	159,993
	100 per cent renewable electricity purchase	85,967
	On-site solar generation	7,782
Glass	Increased use of lightweight bottles	123,081
	Lower energy glass production	48,909
Transport	Reduced emissions road transport	114,801
	Reduced emissions shipping	21,157
Energy Efficiency**	Use of electrodialysis units for cold stabilisation	3,641
	Electrification of diesel-powered vineyard irrigation systems	946
	Use of flotation for juice clarification	687
Supply Chain	Supply chain decarbonisation	14,384

Table 1: Emissions reduction opportunities

For more information on the 11 emissions reduction initiatives, please refer to Part VI: Appendix

** The stated total emissions abated using energy efficient infrastructure is influenced by the increase in renewable energy sources into the mains supply electricity grid and the use of 100 per cent renewable electricity.

The top three modelled initiatives that will drive the greatest reduction of emissions are:

- 1**

The expected increase of more renewables into each state's electricity grid (grid decarbonisation) will result in a reduction of 159,993 t CO₂-e.
- 2**

Transition to 40% of wine bottles being lightweight by 2030 will result in a total emissions reduction of 123,081 t CO₂-e.
- 3**

The uptake of lower and reduced emissions road transport will produce an emissions reduction of 114,801 t CO₂-e.

Part I

Introduction

‘Climate change, if unchecked, is an urgent threat to health, food supplies, biodiversity, and livelihoods across the globe’

– John F. Kerry, United States Special Presidential Envoy for Climate.

Climate change represents one of the greatest threats to global society.

At Wine Australia, we know that climate change is already impacting the grape and wine community across the country.

Increased climate variability, more frequent weather extremes and a generally hotter and drier climate are creating an increasingly challenging environment for grape and wine production. There is increased urgency in the conversation around reducing the impacts of climate change.

With a focus on ensuring continued market access for the sector, we want to continue to support a prosperous grape and wine community and grow domestic and international markets, whilst protecting the reputation of Australian wine.



A pathway to reducing our sector's emissions to 2030

We're launching this Emissions Reduction Roadmap to present pathways to significantly reduce our emissions by 2030 and identify the opportunities ahead to 2050.

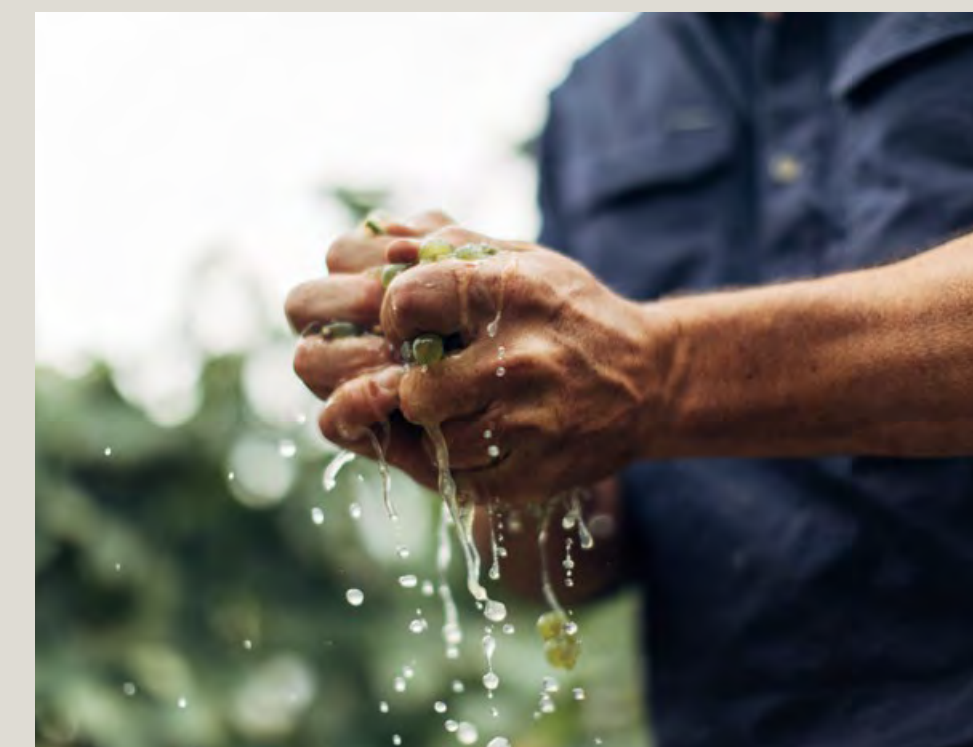
We know international and domestic markets, consumers, investors and our grape and wine community want to better understand and reduce the GHG footprint of Australian wine. That's why the Roadmap is designed to help you understand the sector's emissions and what we all can do to decarbonise.

The Roadmap identifies the sector's current emissions footprint, allowing winegrape growers, winemakers, suppliers and others within the sector to understand our collective impact. For our suppliers, it identifies hot spots within the supply chain and initiatives to achieve emissions reductions. For winegrape growers and winemakers, it outlines opportunities to reduce emissions.

Since June 2022, we've been working with global sustainability advisory, Edge Impact, to develop the Roadmap. An evidence-based approach has been used to establish credible pathways to reduce emissions for the entire sector. This included:

- a deep analysis and calculation of the sector's emissions footprint, based on data collected throughout the sector²
- a cost-benefit analysis to prioritise the emissions reduction actions and initiatives that will reduce the costs of business and reduce emissions
- identification of the key initiatives growers and winemakers can take to reduce their emissions.

To support the Roadmap, we've also developed the Emissions Reduction Guide to provide practical support to winegrape growers and winemakers to reduce their emissions.



Our commitment to decarbonise

We believe that together with the grape and wine community, we can safeguard the future of Australian wine. The Emissions Reduction Roadmap is an important step on our journey to help contribute to a sustainable Australian wine sector.

In the financial year 2020-21, the Australian grape and wine sector contributed 1,770,997 t CO₂-e to the atmosphere. We know that reducing the sector's emissions will ensure continued access to current and emerging wine markets in Australia and overseas, whilst addressing the key risks associated with climate change.

The Roadmap signals our intent to decarbonise. It is designed to keep us - as a sector - accountable, whilst providing a framework for tracking our progress. This will ensure we progress year on year to reduce our emissions.

Dedicated to continuous improvement through a data-led approach, we'll review the sector's emissions impact at least every five years (initially in 2025 and 2028) to determine the emissions reduced within the sector. In 2030 we'll assess the trends in our sector against our target and review emerging technologies to determine the decarbonisation plan for 2050.

² using the 2020-21 financial year as a baseline



Foreword

Following more than a year of research and extensive stakeholder consultation, Wine Australia is proud to present the Emissions Reduction Roadmap for the Australian grape and wine sector. The Roadmap projects that we can achieve a 42% reduction in emissions by 2030 and outlines a pathway to net zero by 2050. Australian Grape & Wine joins Wine Australia in its commitment to support our industry and its supply chain so that we can achieve these targets.

This Roadmap is a welcome development amidst the increasing urgency to tackle climate change by reducing greenhouse gas emissions. It is our response to today's challenging landscape where producers and organisations are feeling regulatory, market and social pressures to reduce the carbon footprint of both their own operations and the goods they produce.

These pressures are set to grow – sustainability credentials will soon be a ticket to play, rather than a marketable add-on. Transition to a low-carbon future will become a part of doing business, and we need to be ahead of that curve. We should aspire to be growing grapes, making wine, packaging it and distributing it in a way that doesn't impact future generations.

While the challenges are significant and complex, and involve the whole supply chain, the Emissions Reduction Roadmap (and its companion resources) aims to provide practical advice on the why, what, and how of emissions reduction. With a focus on what is achievable by 2030, it provides a range of cost-effective tools to support grape and wine producers, no matter what their starting point.

The Roadmap demonstrates our sector's shared commitment to decarbonisation and invites our partners in the supply chain and beyond to be part of collective action. It demonstrates to our customers, consumers and markets that we intend to proactively address emissions in the wine sector and to contribute to wider agricultural, state and federal government and international targets.

This Roadmap is part of our Environment, Social and Governance (ESG) investment plan for the wine sector, a clearly articulated strategy to help safeguard the future of Australian wine. The Roadmap supports our collective vision to be globally recognised as a world leader in sustainability.

This is a Roadmap for the sector, by the sector.

Martin Cole
CEO, Wine Australia

Lee Mclean
CEO, Australian Grape & Wine

**Wine
Australia**



Part II

The path to decarbonisation

‘Climate change does not respect borders, it does not respect who you are – rich and poor, small and big. Therefore, this is what we call “global challenge”, which requires global solidarity’

– Ban Ki Moon, Former Secretary-General of the United Nations



Our vision for 2030 is to have a united approach to decarbonisation, resulting in a 42 per cent reduction of emissions across the Australian grape and wine sector.

That's why the Roadmap:

- 1 Establishes a baseline for tracking progress in reducing emissions
- 2 Demonstrates the key emissions sources - in the vineyard, in the winery and through the supply chain
- 3 Incorporates data-driven analysis of effective emissions reduction initiatives over time
- 4 Will be used to grow our sector's understanding of efficiency gains and cost reductions.

To 2030

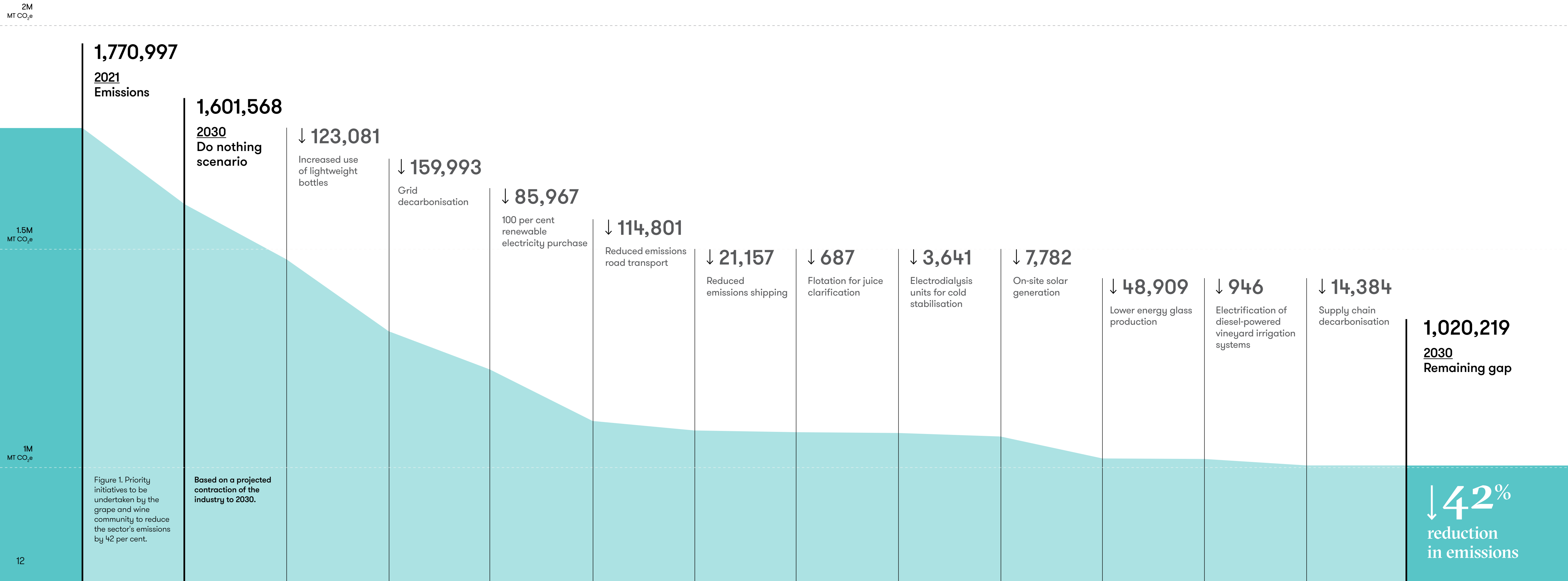
In this decade of action, we're striving for a significant reduction in emissions of 42 per cent by 2030

Through prioritising initiatives that reduce emissions from direct sources, electricity use, transport and supply chain materials, we project a 42 per cent reduction in emissions by 2030 from a 2021 baseline.

To ensure a united approach towards reducing emissions in the sector, we are relying on sector-wide collaboration and action to achieve a gradual and systematic transition to a lower carbon economy.

The modelling of emissions reduction initiatives indicates that by 2030, the total emissions generated by the sector can see a 42 per cent reduction, when compared to a business-as-usual scenario (emissions generated should the modelled initiatives not occur).

The greatest impact can be achieved by an increased uptake of renewables into each state's electricity grid (grid decarbonisation), increased use of lightweight glass bottles and transition to reduced emissions road transport. However, all the initiatives in the waterfall chart below will have an impact on sector emissions, and are presented in no particular order. Many can be deployed immediately. Some initiatives, such as use of electric tractors, are likely to have a greater impact after 2030 when the technology meets market requirements, and were not modelled here.



Why decarbonise?

Climate change is recognised as the biggest threat to the grape and wine sector globally. The Intergovernmental Panel on Climate Change has stated that Australian land areas have warmed by 1.4°C in just over a century⁴.



Taking action on climate change means addressing the emissions that cause it, as well as managing the physical impact on grape and wine production. Both are crucial in safeguarding the future of Australian wine.



Our sector is already experiencing increased climate variability, more frequent weather extremes and a generally hotter and drier climate. It's not only affecting us here in Australia, but grape and wine producers around the world. The impact on how we grow grapes and produce our wines are well documented, and we need to act now.

⁴ https://www.ipcc.ch/report/ar6/wg1/downloads/factsheets/IPCC_AR6_WGI_Regional_Fact_Sheet_Australasia.pdf

Why decarbonise?

There are three benefits to decarbonising:



Being sustainable is efficient

Understanding the key sources of emissions within your business will help you to target inefficient processes.

Simple, low-cost initiatives can assist businesses to improve efficiency of heating and cooling systems, lighting, winemaking, irrigation and transport.



Reducing emissions will save you money

Every time you turn on a light, operate machinery or drive a vehicle, you are most likely either directly or indirectly generating emissions and spending money to do so.

There are a range of actions you can take in your business to reduce the costs of electricity, gas, fertiliser use and irrigation. Our Emissions Reduction Guide will help you to target key emissions sources and in the process reduce the costs of business.



Continued and growing access to wine markets

International wine markets are increasingly requiring or requesting sustainability information related to grape and wine production. Price and quality are still important but not enough to guarantee access to markets with discerning and environmentally conscious consumers. Not meeting the carbon reduction requirements of key wine markets restricts where Australian producers can sell their wine.



The cost of inaction

Without a credible and data-driven emissions reduction plan, more robust reporting and urgent action to reduce emissions, the long-term sustainability of the Australian grape and wine sector is at serious risk.

Risk

Exclusion from international wine markets

Backlash from domestic consumers and retailers demanding products that do less harm to the environment

Damaged reputation and lack of trust

Outcome

Severely limits the sector's growth and profitability

Negatively impacts the viability of the sector and results in a significant loss of revenue

Loss of credibility and negative publicity which will affect sales, growth and profitability

With these risks and outcomes in mind, it is critical that we work together and act now in accordance with the Roadmap to decarbonise the sector and safeguard a future for Australian wine.



Part III

Key findings



The emissions footprint of the Australian wine sector

Winery and vineyard emissions from activities directly controlled by winegrape growers and winemakers make up 22 per cent of emissions for the sector.

Despite emissions from grape and wine production being less than that of transport and packaging, there are still significant emissions associated with vineyards and wineries. That's why it's important for growers and winemakers to take action to drive down their emissions.



Packaging & other winery & vineyard goods and services

- Packaging 44%
- Vineyard chemicals 3%
- Winery chemicals 1%
- Other inputs & general waste 1%

Transport

- Downstream transport 25%
- Grape transport 3%
- Input transport 1%

Winery

- Electricity 11%
- Fuels 1%
- Refrigerant leakage <1%
- Wastewater treatment <1%
- Employee commuting <1%

Vineyard

- Electricity 5%
- Fuels 4%
- Fertiliser use 1%
- Employee commuting <1%

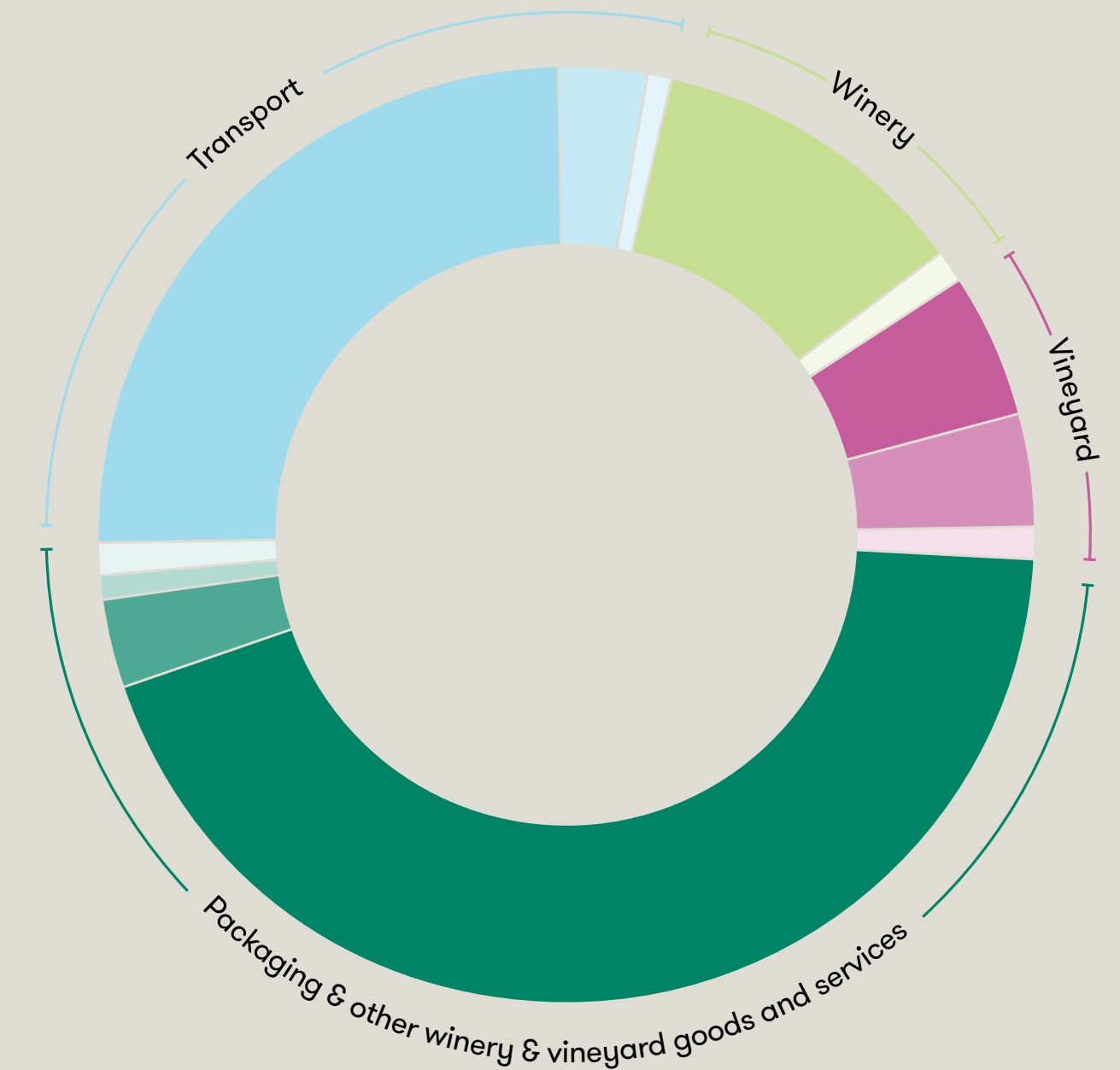


Figure 2. The breakdown of emissions of Australian wine from grape production to the packaging end-of-life

Emissions sources for vineyards and wineries:

- ⚡ Electricity usage within the winery and vineyard
- 🌿 Winery and vineyard chemicals and fertiliser use in the vineyard
- 🚰 Vineyard fuel usage

The majority of the sector's emissions come from packaging and transport

Like others in agriculture, the majority of the Australian grape and wine sector's emissions come from its supply chain. In our sector this is primarily within transport and packaging. That's why supply chain decarbonisation is crucial to assist us as a sector to produce, package and transport reduced emissions wine.



Packaging

Packaging emissions include the production and sale of packaging and its treatment at end-of-life, including recycling or waste to landfill.

Use of glass bottle packaging is a challenge for the wine sector. Glass bottles are traditionally heavy, energy-intensive to make, transport and recycle, and require raw materials for their manufacture. However, they continue to be used because of their suitability as a vessel for wine, the perceived quality of wine bottled in glass and limited alternative options.

There is a strong opportunity for growers and winemakers to leverage relationships with their product and service suppliers to reduce emissions. This can include introducing initiatives such as using lightweight glass and lower energy glass production.



Transport

Transportation emissions include the freight of goods and services to vineyards and wineries, the movement of grapes from vineyard to winery and the freight of packaged wine to market. There are two key challenges concerning the transportation of wine.

1 Transportation of large quantities of wine

Australia's geographic separation from its key overseas markets means that wine must be shipped over long distances. However, delivery of wine to domestic markets can also involve significant travel. Rapid uptake of electric trucks and alternative non-fossil fuels within shipping will reduce transport emissions.

2 Packaging inefficiencies of the glass wine bottle

Due to the traditional shape of glass wine bottles, there is excess space during distribution. Improving packaging design efficiencies for transportation and sale, or shipping wine in bulk (and bottling in market), provide clear opportunities to reduce the emissions associated with transport of finished wine.



Our emissions footprint can be broadly broken down into four key categories – packaging, transport, winery and vineyard.

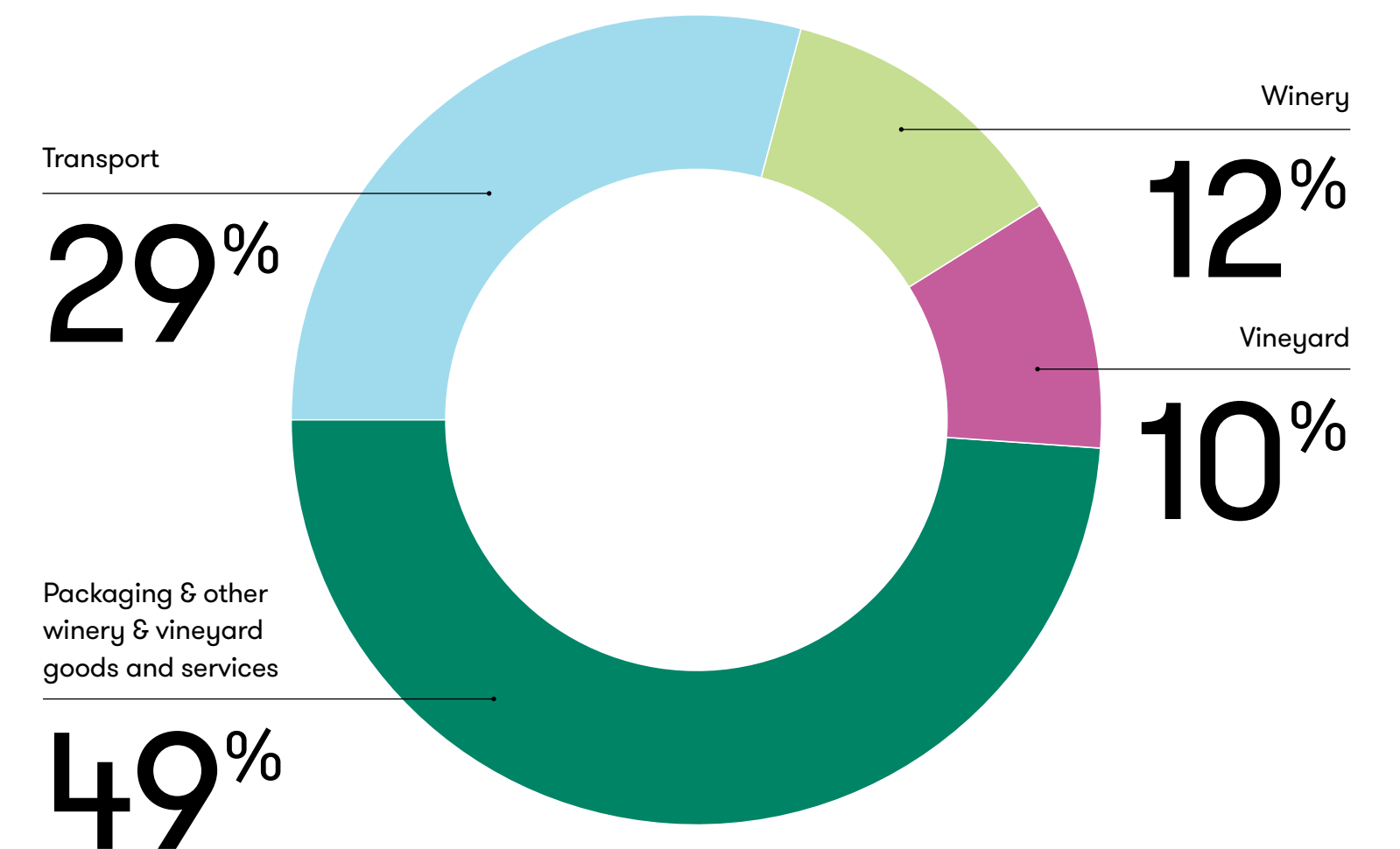
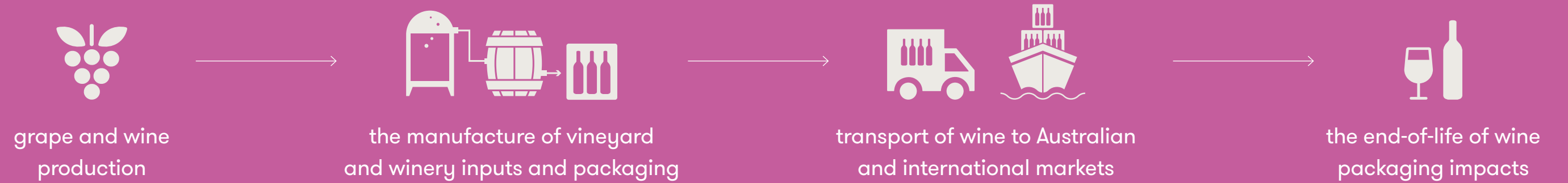


Figure 3. Breakdown of emissions by source

Wine sector emissions by scope

The Australian grape and wine sector currently emits roughly the same emissions as a full jet plane doing 609 laps of the world, on an annual basis⁵.

In its 2020-21 production cycle, the Australian grape and wine sector contributed a total of 1,770,997 t CO₂-e to the atmosphere. This value was determined through analysis of current emissions data collected throughout the sector, and includes emissions from:



What's in our calculations

Our calculations include all emissions across direct vineyard and winery emissions (scope one), indirect vineyard and winery electricity emissions (scope two) and indirect vineyard, winery and supply chain emissions (scope three).

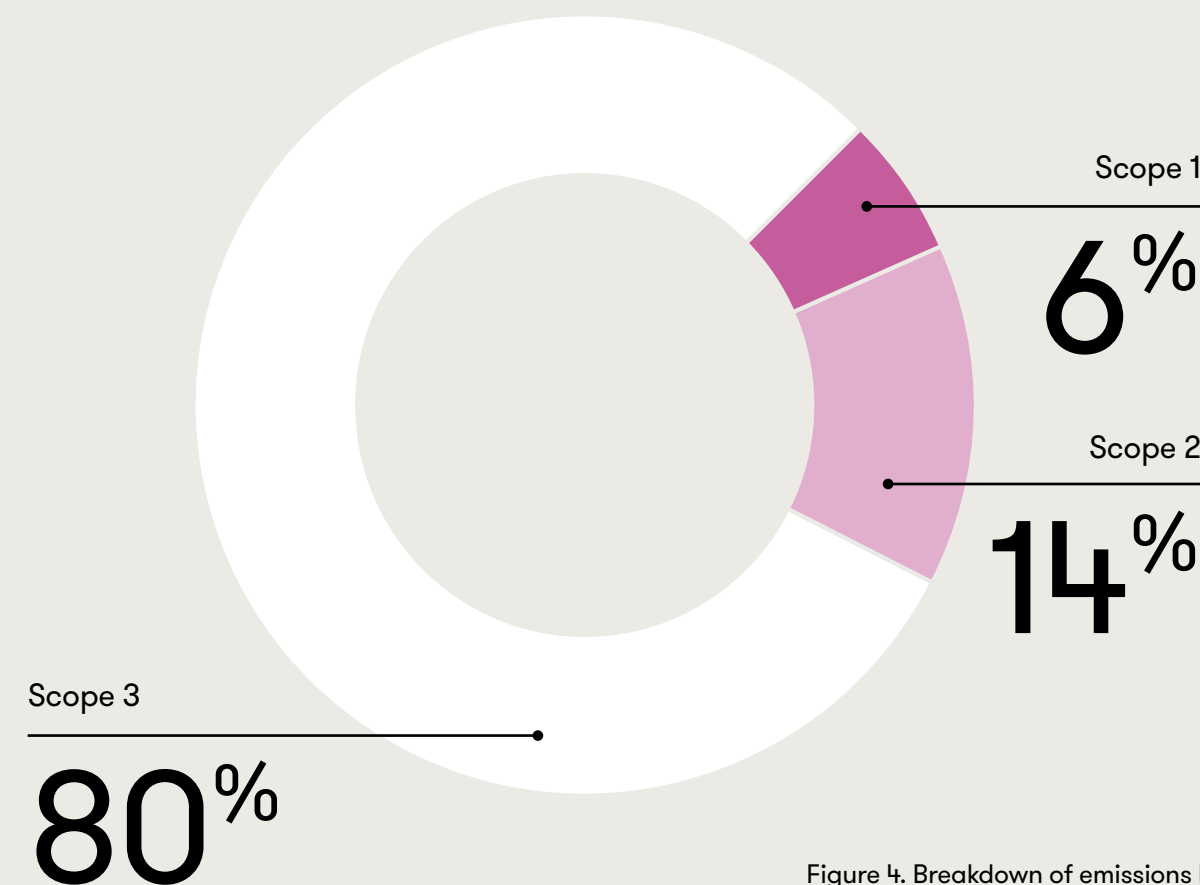
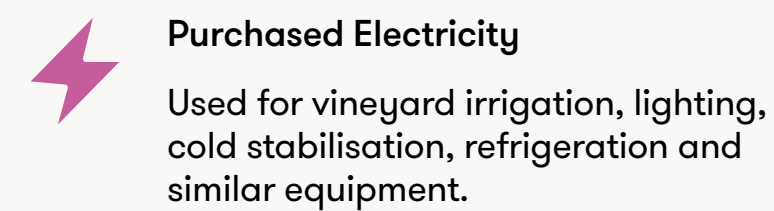


Figure 4. Breakdown of emissions by scope

Scope 1:
Direct Vineyard & Winery Emissions



Scope 2:
Indirect Vineyard & Winery Emissions



Scope 3:
Indirect Vineyard, Winery and Supply Chain Emissions

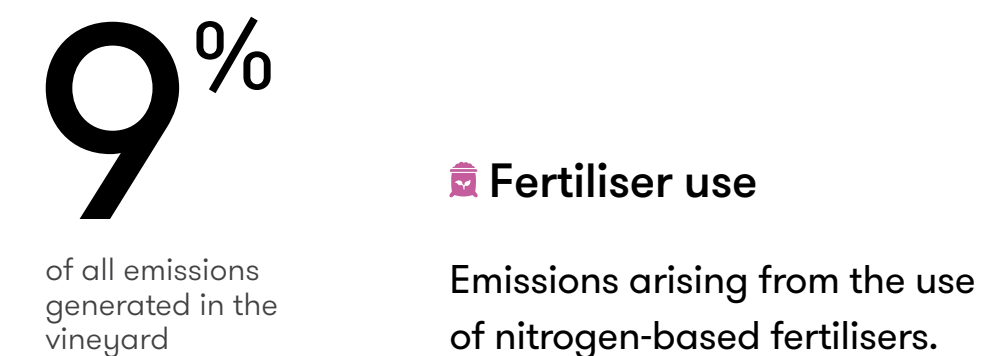
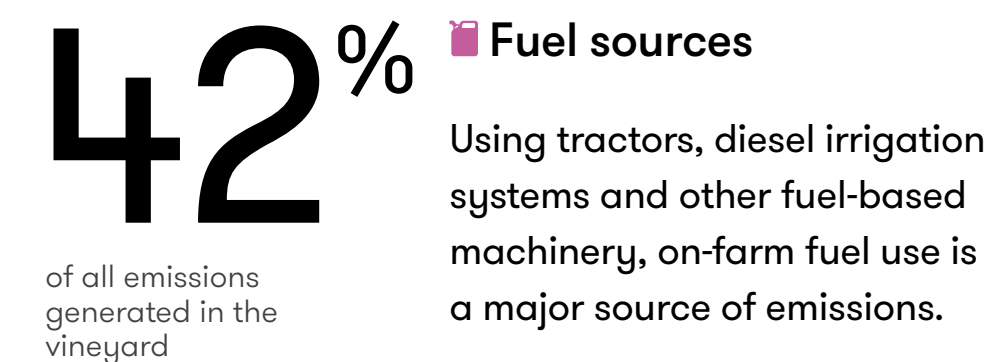
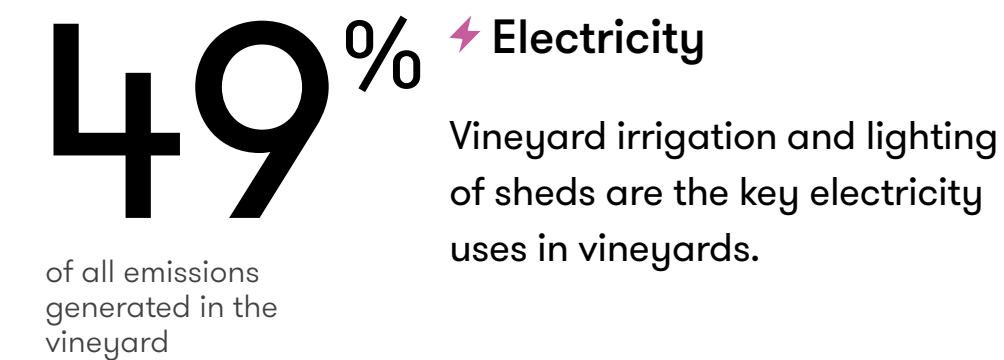


⁵ "Greenhouse Gas Equivalencies Calculator | US EPA available at: <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator#results>"

Vineyard and winery emissions

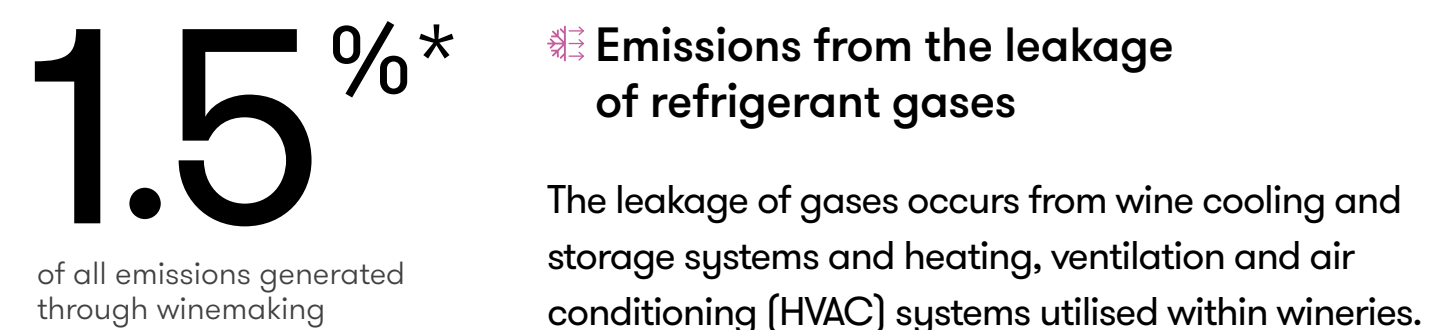
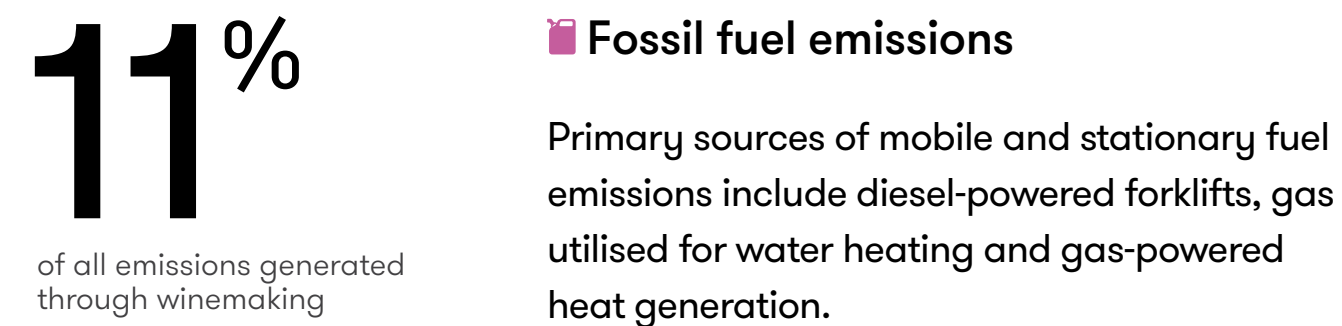
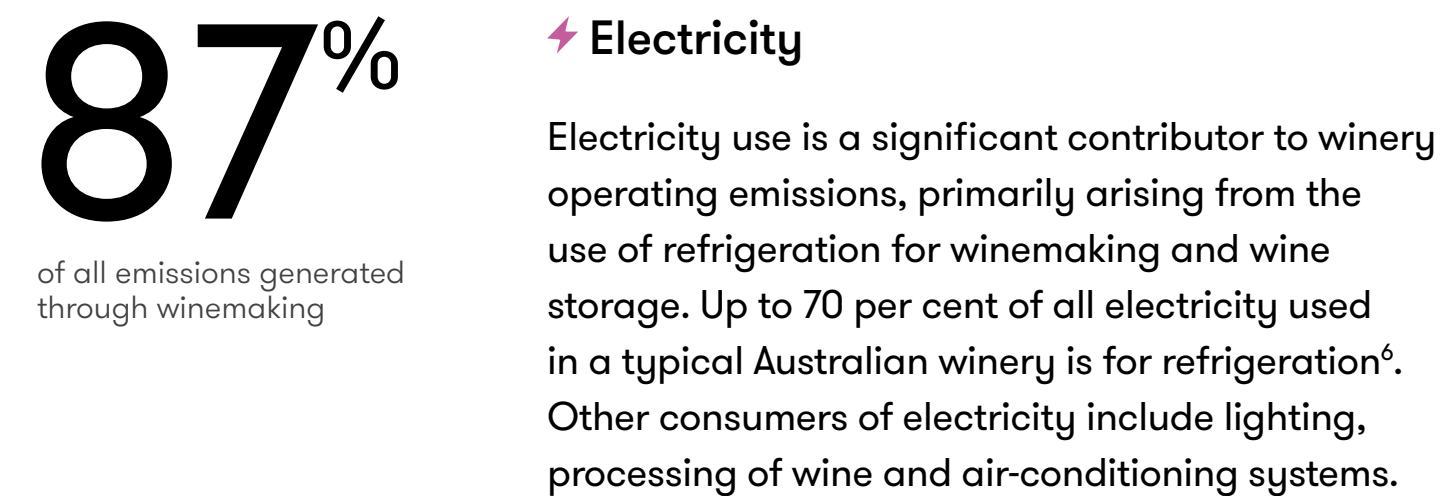
Vineyard

These are the highest direct emission sources related to the production of winegrapes. It excludes indirect emissions sources, such as the manufacture and transport of vineyard inputs (i.e., fertilisers and chemicals), the transport of grapes to winery and emissions arising from soils.



Winery

These are the key direct emission sources from the production of wine. It excludes the extraction of raw materials, processing and transport of all grape and wine purchased goods and services, transportation, fermentation emissions and packaging of wine.



*Wastewater treatment represents 0.5% of all winemaking emissions



To take rapid action to decarbonise, winemakers should focus their efforts on increasing electricity efficiency, with the opportunity for emissions reductions through switching to non-fossil fuel alternatives and actively working with suppliers who are taking action to decarbonise.

Vineyard managers will benefit from focusing on both electricity and vineyard fossil fuel sources. Increasing efficiencies in irrigation and tractor use are simple measures to reduce consumption and therefore emissions. Other recommended actions include converting all diesel and petrol powered infrastructure to electric equivalents, as they become available, and investigating the use of vineyard solar or the purchase of renewable electricity.

⁶ South Australian Wine Industry Association (2014) Winery Energy Saver Toolkit, Version 1.1

Biogenic emissions

A key source of emissions for the Australian wine sector arises from land use and the short-term carbon cycle.

However, we know that grapegrowers and winemakers have limited control over the short-term carbon cycle and that the breakdown of organic matter, which produces carbon dioxide, is a natural process.

Most of the natural carbon on earth is part of an existing long-term carbon cycle which takes place over thousands of years. It's this carbon that exists in fossil fuels, minerals, and rocks.

Short term or biogenic carbon naturally exists in plants, animals, the atmosphere and oceans. It cycles in time frames from months to centuries. These short term cycles include the flow of carbon from plant material to the atmosphere, which is then recaptured by plants through the process of photosynthesis.

We see the process of biogenic emissions in vineyards and wineries. In vineyards, carbon dioxide is absorbed by grapevines and emitted during the breakdown of organic matter within soils and vine prunings. In wineries, biogenic emissions are generated by fermentation of grapes and breakdown of grape marc and lees, the biological waste product from winemaking.

It is important that we first focus on reducing emissions from fossil fuel sources, the extraction and use of which is the primary cause of climate change.

The baseline emissions calculation for the Australian grape and wine sector therefore does not include soil emissions, fermentation emissions or emissions from breakdown of crop residues (vine prunings and grape marc).

However, in the interest of transparency and to understand the opportunity that capture of fermentation emissions and soil carbon sequestration provide, we calculated the emissions arising from biogenic sources.




Biogenic emissions source	Total 2020-21 financial year annual emissions
 Soil Emissions	287,047 tonnes CO ₂ -e
 Crop Residue	3,355 tonnes CO ₂ -e
 Fermentation Emissions	156,075 tonnes CO ₂ -e

Table 2. The total annual emissions produced through biogenic emissions sources



In summary

With a strong emissions baseline established and the hot spots identified, there is **significant opportunity for the Australian grape and wine sector to decarbonise**. The emerging themes and opportunities are:

1 Sustainability standards are coming

With market and retailer standards specific to sustainability emerging, wine businesses will need to increase data capture, validation, transparency and reporting - particularly regarding the intensity of emissions produced per tonne of grapes and kilolitre of wine produced.

2 A circular approach to decarbonising

As Australia strives to become more circular – an approach that maximises resource efficiency and eliminates waste – there is an opportunity for the sector to trial new packaging, reuse and recycling, such as locally sourced lightweight glass or recycled PET bottles.

3 Transparency in the supply chain

To reduce scope three emissions, it is important for meaningful and purposeful relationships to be built between growers, winemakers, suppliers and partners. This will allow for greater collaboration and transparency in the supply chain and drive collective action.

4 Continuous benchmarking

An established emissions baseline allows the sector to benchmark its performance over time and better understand and communicate common high emitting practices and sources within the vineyard, winery and through the supply chain.

5 Vineyard and winery emissions reduction

Emissions from vineyard and winery operations are under our direct control and can be acted upon immediately. Support and information for winegrape growers and winemakers is critical.

6 Guidance and support for the sector

Upskilling and mentoring are required to continue to increase understanding of the practical and cost-effective actions that will assist growers and winemakers to simultaneously reduce costs and emissions.



Part IV
Opportunities
for the sector

**‘Being sustainable is
being more efficient
in your operations’**

– Lachie Thomas, Tahbilk winery

The decarbonisation of the Australian grape and wine sector is critical to **safeguard the future of Australian wine, domestically and internationally.**

That's why we need a united approach, based on sector-wide collaboration and action, to achieve a gradual and systematic transition to a lower carbon economy.

However, reducing emissions isn't just good for the planet, it is an efficient way of operating, leading to potential financial benefits. For example, reducing the number of tractor passes, the amount of electricity consumed and selecting locally sourced goods and services have both economic and environmental advantages. Potential benefits are:

Cost savings

Associated with the generation of your own electricity and a reduction in energy usage, as well as overall efficiency gains.

Market access

Alignment with the global need to reduce emissions will help ensure long-term market access to increasingly sophisticated wine markets.

Efficient operations

Operational efficiencies and reduced waste through infrastructure and behaviour change.

Emissions reduction themes

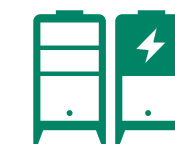
Based on the data and factors in the Roadmap, we've identified five key themes to help the sector reduce their emissions.



Using data to inform emissions reducing business decisions



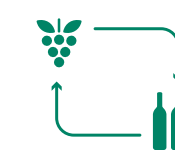
Reducing and eventually eliminating the use of fossil fuel vehicles, both in vineyards and wineries and through supply chains



Operating efficient grape and wine production sites powered by renewable electricity



Optimising low emissions transport and distribution networks now and increasingly in the future



Collaborating with the wine supply chain to reduce emissions from high emitting materials and services.

Emissions reduction initiatives

The Roadmap projects a 42 per cent reduction in emissions by 2030.

To realise this vision, there are key initiatives that winegrape growers and winemakers can implement now to start reducing their emissions and realising financial and operational benefits.

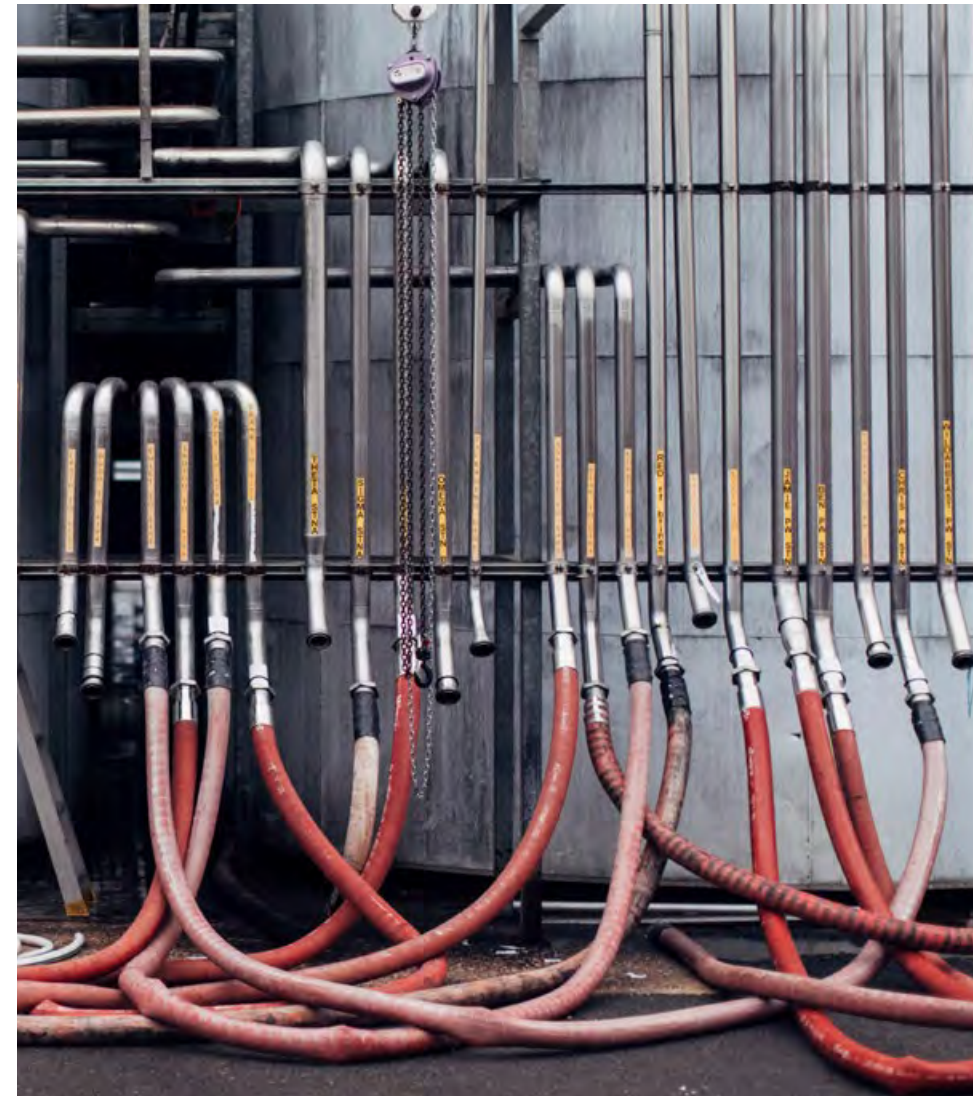
We've identified 11 emissions reduction initiatives that have been refined and carefully considered within the challenging environments, growers and winemakers face daily, based on what they can directly and indirectly control. These initiatives are aimed at targeting key emissions sources within the wine supply chain. They aim to strike a balance between actions that growers and winemakers can commit to now, and those that are projected to occur in the future and outside their control.

To determine the financial and environmental viability of the 11 initiatives, we used a marginal abatement cost curve to determine the cost benefit associated with each initiative and its potential to reduce emissions. All 11 initiatives will reduce emissions. However, there are three key initiatives to highlight.

Greatest emissions reducing initiative

Initiative

Grid decarbonisation



↓ **159,993** Emissions saved at 2030 compared to 2021 (t CO₂-e)

How it reduces GHG emissions

Every Australian state is transitioning to the increased use of renewable electricity into the mains supply grid. This assists all grape and wine production businesses to reduce emissions associated with electricity use.

Strongest financial and emissions reducing benefit

Initiative

Increased use of lightweight bottles



↓ **123,081** Emissions saved at 2030 compared to 2021 (t CO₂-e)

How it reduces GHG emissions

One of the main sources of emissions within the grape and wine supply chain is the manufacture of glass. Through reducing the amount of glass used for each bottle, there is a reduction in the emissions per glass bottle produced.

Cost effective and reduces emissions

Initiative

Reduced emissions road transport



↓ **114,801** Emissions saved at 2030 compared to 2021 (t CO₂-e)

How it reduces GHG emissions

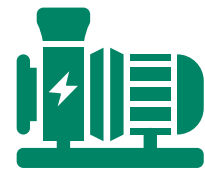
Road transport is the primary means of moving goods (supplies, grapes, bulk wine and packaged stock) to and from vineyards and wineries. The road transport sector has already started the transition to zero emissions vehicles with the trialling of both electric- and hydrogen- powered trucks.

Emissions reduction initiatives

Scope one: Direct Vineyard and Winery Emissions

Initiative

Electrification of diesel-powered vineyard irrigation systems



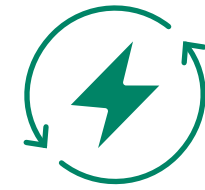
Converting water pumps from fossil fuel to electric

Target area: Reduced use of diesel/petrol for water pumps
benefits vineyard

Scope two: Indirect Vineyard and Winery Emissions

Initiative

100 per cent renewable electricity purchase



Purchase of renewable energy for use in vineyards and wineries

Target area: Electricity
benefits vineyards and wineries

Initiative

Grid decarbonisation

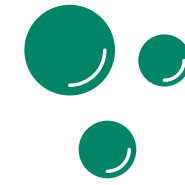


Transition to renewable grid electricity according to Australian state government targets

Target area: Increased renewable electricity within each state's mains supply electricity grid
benefits vineyards and wineries

Initiative

Electrodialysis units for cold stabilisation



Reduction in winery electricity usage and an alternative to cold stabilisation across larger wine production sites

Target area: Reduced winery electricity demand
benefits wineries

Initiative

Flotation for juice clarification

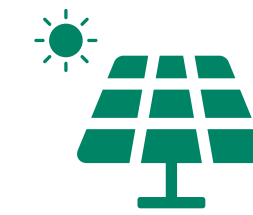


Reduction in winery electricity usage and an alternative to cold settling

Target area: Reduced winery electricity demand
benefits wineries

Initiative

On-site solar generation



Generation of electrical energy on site from solar panels

Target area: Creates renewable electricity to be utilised on-site for grape and wine production
benefits vineyards and wineries

Scope three: Indirect Vineyard, Winery and Supply Chain Emissions

Initiative

Increased use of lightweight bottles



Utilising reduced weight 750ml glass bottles for wine glass bottling

Target area: Glass, a key emissions source
benefits wineries

Initiative

Reduced emissions shipping



Reduced impact of shipping wine to international markets through the use of more energy efficient fuels

Target area: Transportation of wine via sea
benefits wineries

Initiative

Reduced emissions road transport



Reduction of transport emissions throughout the supply chain by using zero emissions energy sources

Target area: Transportation of goods and produce to and from vineyards and wineries, including wine to domestic markets
benefits vineyards and wineries

Initiative

Lower energy demand glass production



Reduced-energy glass manufacturing as an alternative to gas-fired glass production

Target area: Lower energy wine bottles
benefits wineries

Initiative

Supply chain decarbonisation



A reduction in supply chain emissions as grape and wine supply chain businesses seek to reduce their emissions

Target area: Purchased goods and services of grape and wine production businesses
benefits vineyards and wineries



To implement these, and other emissions reduction initiatives, we encourage winegrape growers and winemakers to seek support through the Emissions Reduction Guide, which contains more practical information.

Part V

What's next



The Pathway to 2050

At Wine Australia, we're committed to safeguarding the future of Australian wine.

The Roadmap has identified a clear pathway to 2030, where more than 40 per cent of emissions can be reduced. To kick-start action, we have identified two key priorities for the sector.

- 1 Determine the primary sources of emissions in the vineyard and the winery**
- 2 Provide an action plan, to support grape and wine producers to adopt low emissions business practices.**

However, we know there's a longer and equally important road to 2050. That's why the Roadmap outlines a three-phased approach for the wine sector to continue emissions reduction to 2050. This has been developed by modelling the emissions reduction potential of key initiatives with consideration of the challenges winegrape growers and winemakers may face and is informed by extensive input from key industry experts.

The three-phased approach allows for the staged implementation of initiatives. First to prioritise areas within our control, then to focus on areas we influence and finally future opportunities through emerging technologies.

As a sector, and as per best practice carbon management, our focus will be to ensure we first avoid, reduce and replace before offsets are considered. By taking these steps, we can achieve our goal of safeguarding the future of the Australian wine sector while also benefiting from emerging commercial opportunities and reducing costs.



Areas within our control



Vineyards and Wineries

Reducing emissions generated from direct sources and electricity within vineyards and wineries.

Areas within our control targets the emissions arising from the areas where winemakers and growers have direct control - vineyard and winery operations. This includes direct emissions from diesel-powered vehicles and machinery and the use, sourcing and generation of electricity. Business operators will benefit from aligning cost savings with emissions reduction and shifting away from fossil fuel use.

- **Quantification of individual business operational emissions**
- **Uptake of renewable electricity**
- **Winery energy efficiency, production efficiencies to reduce fuel usage**
- **Production of electricity through on-site solar**
- **Electrification of ageing fossil fuel powered assets, such as water pumps, frost fans and forklifts.**

Areas we influence



Supply Chain

Tackling supply chain emissions to achieve significant and measurable reductions.

Areas we influence focuses on supply chain engagement, seeking greater collaboration and partnerships between individual businesses across the sector. When considering large capital upgrades, business operators can drive down emissions by purchasing energy-efficient infrastructure and assets, such as refrigeration, filtration units and water pumps. Additionally, we acknowledge that decarbonisation in our high-emitting scope 3 industries, such as glass manufacturing and transport, will accelerate as market forces come to bear and they strive to meet their own emissions reduction targets.

- **Increasing the use of lightweight glass bottles, and/or low-emissions alternative packaging options**
- **Consideration of key capital expenditure purchases and their potential to reduce emissions**
- **Reduction in transport emissions from shipping and trucking**
- **Availability of lower-emissions inputs and services for vineyard and winery operations**
- **Improved availability of data on scope 3 emissions sources**

Areas of future opportunity



Emerging Technologies

Leveraging the rise of emerging technology to transition to a lower carbon world.

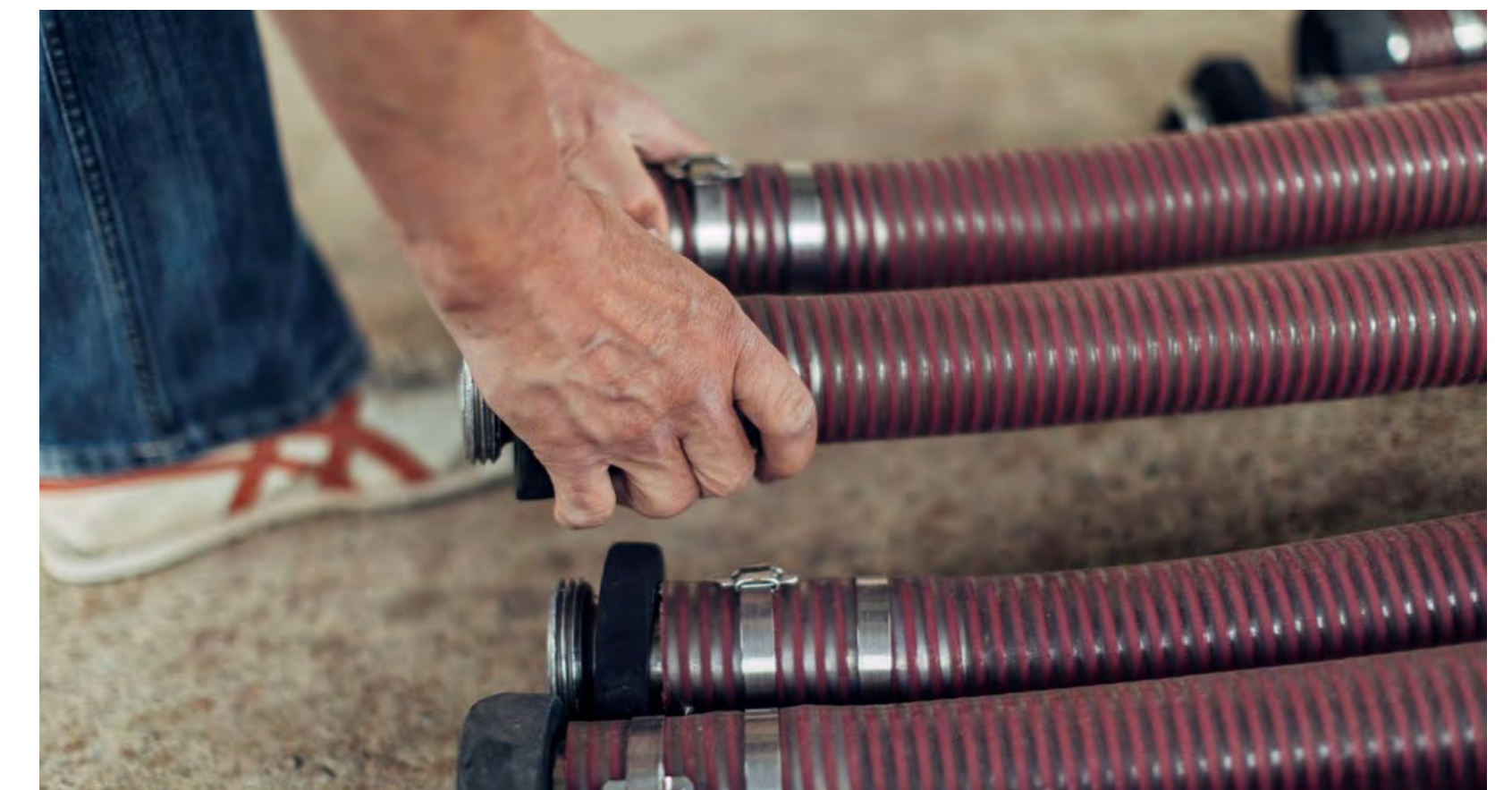
- **Increased uptake of new technologies, such as electric tractors and renewable energy battery storage**
- **Lower energy demand glass manufacture**
- **Continued decarbonisation of grape and wine supply chains**
- **Expansion of the range of tools available to quantify, report and disclose emissions from wine business operations**
- **Extension of AI and autonomous technology to aid in increased precision of vineyard and winery inputs.**

Nature-Based Solutions

- **The capture and storage of carbon in vegetation planted on vineyard and winery land and in soils**
- **The arrival of frameworks to measure and monitor carbon storage practises and changes to biodiversity and the broader environment**
- **Nature-based reporting amongst businesses, offering the ability for those who manage land to not only capture and sequester carbon but also monetise co-benefits, such as biodiversity.**

Areas of future opportunity will look to maintain and grow relationships with supply chain partners and industries, while shifting our focus to integrating technological improvements and to drive greater emissions reduction performance from high-emitting industries, such as glass manufacturing and transport. Whilst the capital costs for items such as electric tractors and renewable energy battery storage is currently prohibitively high for many smaller business operators, the ongoing emissions and cost savings offered by these technologies are considerable, allowing for a viable medium to long-term return on investment. As equipment evolves and new generations of specialist technology enter the market, it is expected that the capital costs for such items will reduce.

Additionally, we recognise an increasing need to understand and capture the benefits of nature-based solutions. Like other areas of agriculture, the Australian grape and wine sector is well-placed to increase the carbon storage capacity of soils. Planting vegetation around vineyards and wineries is also an opportunity for carbon sequestration and provides multiple additional benefits, such as increased biodiversity, air and water filtration and erosion control. Carbon farming will become increasingly more feasible with improved metrics and a greater understanding of how to maximise carbon sequestration, reduce greenhouse gas emissions and improve the management of other forms of natural capital. In addition, fermentation emissions provide a unique opportunity for carbon dioxide capture and storage in the wine sector.



For grapegrowers and winemakers:
where to start

To help your business reduce emissions, we've developed an Emissions Reduction Guide.

In this document you'll find tools, resources and advice to reduce your emissions, starting today – no matter where you are in your sustainability journey. This includes:

- How you can deliver against the ambition set in Wine Australia's Emissions Reduction Roadmap
- The most impactful methods of reducing emissions in the vineyard and winery
- The potential financial benefit and carbon abatement of key emissions reduction initiatives
- Advice relating to emissions reduction opportunities within the wine supply chain.

As a first step, it is important to calculate emissions arising from your own business operations. A range of freely available tools are available for businesses of all sizes, maturity, understanding and knowledge of emissions reduction opportunities. A review and recommendation of tools to use is included as a supplement to the Emissions Reduction Guide.



Our commitment to continuous improvement

We know the journey is only just starting for a sector-wide, united approach to decarbonisation.

The Roadmap and Guide are just the beginning and the road ahead is complex. Reaching our goals will require action and collaboration across the sector, and beyond.



Wine Australia is committed to continuing to support the sector as we collectively reduce emissions. The targets are not set and forget. We'll promote collective action through investment in regional initiatives, communication and sharing of success, and take a lead role by:

- Rolling out a national program to provide practical support to grapegrowers and winemakers to reduce emissions using the initiatives described in the Roadmap and Guide
- Implementing a targeted communication strategy and amplification plan to raise awareness of key findings in the Roadmap and Guide
- Updating the sector emissions footprint at least every five years (initially in 2025, 2028 and 2030), to track sector progress against targets
- Regularly tracking progress on some of the key initiatives to indicate where changes are occurring
- Reviewing sector emissions reduction targets in line with the latest footprint data, available information and technologies
- Using the sets of data and information which underpin the Roadmap to inform both emissions reduction activities by the sector and communication with governments, markets, consumers and other industries
- Continuing to build sector-wide understanding of our customer drivers and demands and opportunities to align cost savings, productivity, business efficiency and business resilience with emissions reduction
- Continuing to advocate for practices that create co-benefits for winegrape growers and winemakers, including building natural capital, enhancing soil health, carbon capture and storage opportunities and elimination of avoidable emissions
- Investing in new research and technologies that reduce the emissions footprint of the sector
- Considering sector progress and reporting on emissions reduction within wider sustainability and environmental, social and governance (ESG) frameworks
- Supporting a program of review and improvement to ensure that the Wine Carbon Calculator (embedded in Sustainable Winegrowing Australia) continues to meet global sustainability reporting standards, relevant legislation and market expectations and addresses existing and emerging market access risks
- Establishing an information hub for the sector, to house the Roadmap and Guide and supporting resources and to serve as a platform for sharing of knowledge, solutions, emissions reduction pledges and stories of success.

Conclusion

For Wine Australia, the Roadmap is not just a plan for reducing emissions. It is a vision to help transition the grape and wine sector to a lower carbon future, mitigating negative environmental effects while protecting market access and securing the livelihoods of the grape and wine community. It is signal to government, customers, consumers and the community that the Australian grape and wine sector is committed to tackling climate change and that we are collaborative and united in our approach.

Because together, we believe we can safeguard the future of Australian wine.



Part VI

Appendix



Methodology

The methodology and data sources used to calculate the carbon footprint of the Australian wine sector and the emissions reduction opportunities have been captured within an accompanying document, the *‘Australian Wine Sector Emissions Reduction Roadmap Basis of Preparation’*. The information here provides a broad outline of the methodology.

Stakeholder engagement

The Roadmap was developed with collaborative participation from the sector to ensure a sector-wide approach. Over 300 grape and wine sector stakeholders were directly engaged during development of the Roadmap. Stakeholder engagement from across the production and supply chain provided invaluable knowledge of processes, barriers to emissions reduction implementation, feasibility of approaches and opportunities for the future. Stakeholder engagement within the sector was conducted through:



Stakeholder survey

94 responses were received via an online survey related to business ambitions, sustainability progress and plans.



Workshops

7 workshops were hosted with winegrape growers, winemakers, suppliers and farm and winery advisors. Workshops acted as a method of obtaining sector knowledge and a grounds for testing new ideas.



Expert reference group

12 individuals representing different areas of the wine supply chain provided specialised advice relating to sourcing of data, emissions reduction opportunities and key messaging.



Interviews

22 interviews were conducted with key stakeholders to gain in-depth understanding of primary tension points within the sector and the broader grape and wine production and supply chain landscape.



Meetings

Over 30 meetings were conducted with sector stakeholders to access specialised information and to inform emissions reduction opportunities and limitations.



Emissions baseline calculation

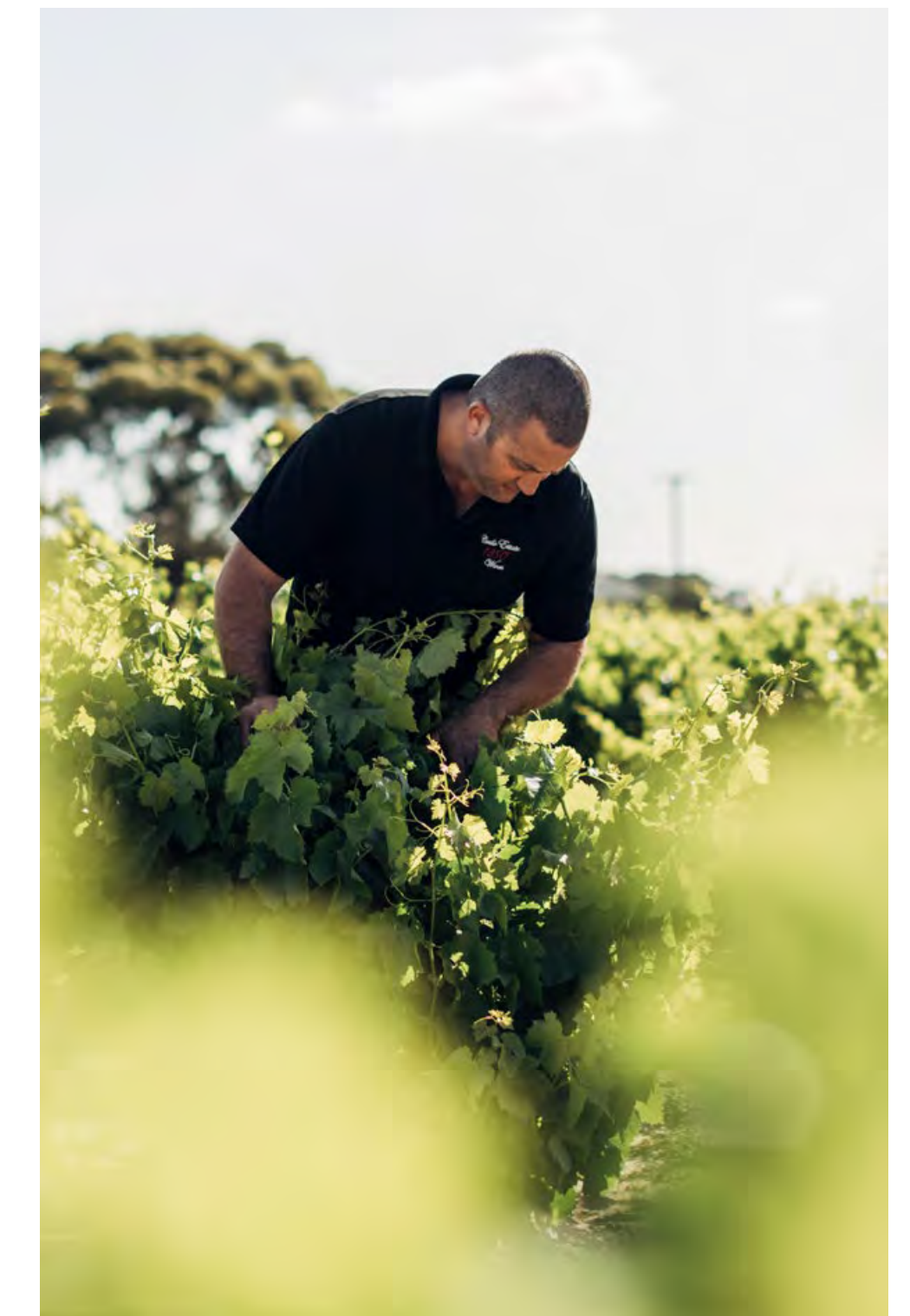
The following list outlines data sources used in calculation of the GHG emissions baseline for the Australian wine sector. Data was from the 2020-21 financial year period.

- Sustainable Winegrowing Australia-supplied sector data
- Wine production company-supplied specific data
- Wine Australia production and export statistics
- Peer-reviewed research and publications
- Life Cycle Assessment of the Australian Wine Industry Report V1.0 (Affinity Labs, 2022)
- Emissions factors sourced from Exiobase version 3, Australian Lifecycle Inventory and Climate Active.

Emissions reduction modelling

The modelling of emissions reduction was conducted utilising a cost-benefit analysis approach, known as a Marginal Abatement Cost Curve (MACC).

Emissions reduction activities for modelling were chosen from a range of options with input from the Expert Reference Panel, key sector personnel and information gained through stakeholder engagement. Calculations and data for the modelling were sourced from information accessed through sector stakeholders, sector information sources, peer-reviewed articles and suppliers.



The emissions reduction initiatives

The table below outlines key modelling details and the emissions reduction potential of the 11 modelled initiatives to 2030. The figures represented in the table below, present the total savings in emissions from the year of implementation to 2030. The initiatives are ranked in order of the greatest emissions reduction potential at the 2030 timeframe. The emissions reduction potential and high-level modelling details of the total 11 modelled initiatives are set out below.

Opportunity #1

Grid decarbonisation

↓ **159,993** In 2030 from 2021 baseline [t CO₂-e]

Details of the initiative: The modelling of the mains supply electricity grid decarbonisation has been conducted on a state-by-state basis, considering each state’s current grid emissions, stated targets and total production per state (vineyards and wineries).

Considerations: Plans and actions resulting in the decarbonisation of the electricity grid are being driven by state governments, citizens and organisations. The wine sector will gain the benefits of the planned ongoing electricity grid decarbonisation. Tasmania’s electricity grid already produces more renewable energy than is consumed within the state over a yearly period⁸. South Australia, which contains half of Australia’s wine production, is projected to achieve 100 per cent net renewable electricity before 2030⁹. The state governments of New South Wales, Victoria and Western Australia have established 2030 renewable electricity and/or emissions reduction targets.

⁸ Tasmanian Government, available at: https://www.stategrowth.tas.gov.au/recfit/renewables/tasmanian_renewable_energy_target
⁹ Government of South Australia, available at: <https://www.safa.sa.gov.au/environmental-s-governance/energy>

Opportunity #2

Increased use of lightweight bottles

↓ **123,081** In 2030 from 2021 baseline [t CO₂-e]

Details of the initiative: The use of lightweight glass has been modelled based on the use of a 380-gram 750 millilitre bottle compared to a 500-gram 750 millilitre bottle. The modelling year commences in 2025, with uptake of the use of lightweight glass bottles increasing over time to 40 per cent of all bottles sold by 2030.

Modelling includes the emissions reduction benefits associated with production, transportation and end-of-life of lightweight glass bottles.

Considerations: The potential emissions reduction associated with a sector-wide move to lighter weight bottles is considerable. Other initiatives that shift wine storage to alternative lower emissions packaging materials, such as bag-in-box and aluminium cans are important alternatives to consider.

Opportunity #3

Reduced emissions road transport

↓ **114,801** In 2030 from 2021 baseline [t CO₂-e]

Details of the initiative: Reduced emissions road transport has been modelled based on stated 2030 and 2050 Australian and international decarbonisation targets. Accordingly, the percentage of reduced emissions trucks transporting vineyard and winery inputs and produce will increase over time.

Considerations: The transition of trucks to electric or hydrogen vehicles is outside the control of the wine sector. However, it is expected that the trucking industry will increase efforts to decarbonise their operations as more options for electric or hydrogen trucks enter the market, and repowering and refuelling infrastructure is installed across Australia.

Opportunity #4

100 per cent renewable electricity purchase

↓ **85,967** In 2030 from 2021 baseline [t CO₂-e]

Details of the initiative: The modelled initiative assumes uptake of renewable electricity in a staged progression from 2023 to 100 per cent in 2028.

Considerations: The purchase of 100 per cent renewable electricity will help all businesses to reduce emissions from operations. The emissions reduction benefits of purchasing 100 per cent renewable electricity is greater for those businesses located within Australian states where the mains supply electricity grid is still largely reliant on fossil fuel electricity generation, such as Western Australia, Victoria and New South Wales.

Opportunity #5

Lower energy glass production

↓ **48,909** In 2030 from 2021 baseline [t CO₂-e]

Details of the initiative: Glass wine bottles produced in Australia come predominantly from two manufacturers. Both are moving to increase the content of recycled glass in their products and to lower the energy used in glass production. This is by either improving energy efficiency or switching from gas to renewable energy sources.

Such measures require upgrades to glass production infrastructure, which are likely to occur over an extended timeframe due to the high cost involved.

Considerations: In order to reduce emissions associated with glass manufacture there is a requirement to increase the availability of recycled glass content and a need to upgrade glass production infrastructure to allow for improved energy efficiency. Such upgrades require significant capital expenditure and are likely to occur over an extended timeframe.

Local manufacturers of glass bottles can support emissions reductions by increasing the availability of lighter weight glass bottles for local use.



Table 2. The emissions reduction potential and high-level modelling details of the total 11 modelled initiatives

Modelled initiative

Total emissions reduction potential to 2030

Modelling details

The emissions reduction initiatives continued

Opportunity #6

Reduced emissions shipping

↓ **21,157** In 2030 from 2022 baseline (t CO₂-e)

Details of the initiative: Reduced emissions shipping is based on the Science Based Targets Initiative decarbonisation targets for the shipping and marine sector, considering the total quantity of Australian wine exported in bulk and in packaging to the key destination markets. The modelling also incorporates the state in which the wine is produced and the distance to key markets.

Considerations: The decarbonisation of the shipping sector has already begun, with several large shipping organisations committing to alternative fuel sources, such as ammonia, methanol and biofuels to power international freight shipping. However, given the useful life of the existing global shipping fleet and the challenges of sourcing cost-effective and readily available alternative fuels, the rate of transition to lower emitting and zero emitting fuels sources is likely to be slower than that of the road and rail transport sectors.

Opportunity #7

Supply chain decarbonisation

↓ **14,384** In 2030 from 2022 baseline (t CO₂-e)

Details of the initiative: Due to the complexity and difficulty in predicting the rate and extent of decarbonisation of the grape and wine supply chain, this initiative has been modelled based on an assumed 20 per cent decarbonisation of the supply chain by 2050. The assumption is supported by peer review literature.

Considerations: There is an increasing trend from markets, banks and insurers to request and require information related to the decarbonisation plans and targets of organisations. The need to supply this information prior to obtaining a loan or accessing insurance will have flow-on effects for all supply chains and will result in more and more organisations reducing their direct emissions. This benefits grapegrowers and winemakers, as the supply chain will likely reduce emissions associated with the production of goods and services.

Opportunity #8

On-site solar generation

↓ **7,782** In 2030 from 2023 baseline (t CO₂-e)

Details of the initiative: The modelled initiative included an assumed uptake of 100 kilowatt on-site solar systems across 100 per cent of wineries across all wine-producing Australian states. State-based generation factors and average pricing were factored into modelling. The start year for this initiative is 2023.

Considerations: The output of the solar array needs to be tailored to the electricity requirements of each business operation. During times of peak electricity demand, i.e., vintage, the outputs of the electricity are unlikely to fully meet the electricity use requirements of the business. However, the use of battery storage systems can assist organisations to better utilise power during peak demand periods. At times of reduced use, electricity will be sold back to the grid, resulting in an increase in supply of renewable electricity to the grid.

Opportunity #9

Electrodialysis units for wine stabilisation

↓ **3,641** In 2030 from 2023 baseline (t CO₂-e)

Details of the initiative: The modelling of electrodialysis, as an alternative to cold stabilisation, incorporated the capital costs of purchasing and installing the units and the operational electricity savings from the use of the units in winemaking. Costs have been sourced from peer-reviewed information and suppliers. The modelling has only considered medium-larger producers of wine.

Considerations: Electrodialysis is just one initiative that can assist wineries to reduce the electricity usage associated with cold stabilisation. This initiative interacts with opportunities one and two, meaning the impact on emissions will be greatest where renewable energy is unavailable or not taken up.

[NSW Government - I am your industrial refrigeration guide \(2017\)](#)

Opportunity #10

Electrification of diesel-powered vineyard irrigation systems

↓ **946** Within the 2030 annual financial year period (t CO₂-e)

Details of the initiative: Electrification of vineyard water pumps is based on Sustainable Winegrowing Australia data, indicating that 12 per cent of all SWA vineyards operate a diesel powered water pumps. Modelling is based on a 50 per cent reduction in diesel pump use by 2030 and elimination of diesel based water pumps by 2050.

Considerations: As well as the reduced impact on emissions, electric pumps are typically more energy-efficient than diesel powered pumps. The benefit of the increased efficiency has been captured through the modelling.

Opportunity #11

Flotation for juice clarification

↓ **687** In 2030 from 2023 baseline (t CO₂-e)

Details of the initiative: The initiative has been modelled to represent a lower energy use juice clarification alternative to traditional methods requiring chilling. The modelling assumes a maximum uptake of 40 per cent of wineries, as it is recognised that juice clarification is not necessarily carried out in all winery operations or for all wine styles.

Considerations: The purpose of modelling juice clarification is to demonstrate the potential of energy-efficient technology to assist wineries to reduce electricity consumption and reduce costs. The above emissions reduction has been modelled assuming renewable electricity uptake.

Table 2. The emissions reduction potential and high-level modelling details of the total 11 modelled initiatives

Modelled initiative

Total emissions reduction potential to 2030

Modelling details

Glossary

Abatement

GHG removals by sinks and/or reduction in GHG emissions by sources of emissions.

Activity data

Quantitative measure of the level of a human activity, taking place during a given time period, that results in GHG emissions or GHG removals. Example: litres of fuel used; tonnes of urea applied; numbers of livestock and their liveweight gain Activity data are multiplied by the relevant emissions factor to quantify the GHG emissions or GHG removals generated by a company or country.

Baseline

A reference that provides the basis for comparison. The baseline can be performance in a specified past year or time period, or a projection of future performance under “business as usual”. The latter is also referred to as a dynamic or forward baseline, or counterfactual. A baseline can be a benchmark, such as industry average or best practice, such as in a baseline-and-credit emissions trading scheme, or the Safeguard Mechanism. Australia has used 2005 as the baseline year for its National Determined Contribution. Under the ERF some methods, such as soil carbon methods, use a historical baseline, determined by the performance prior to project commencement. In contrast, the beef herd management method uses a counterfactual baseline to estimate GHG emissions in the absence of the project activities.

Biogenic emissions / carbon

Carbon released as carbon dioxide or methane from combustion or decomposition of biomass or biobased products. Biogenic carbon emitted as CO₂ from non-woody biomass, and removals by non-woody vegetation, are excluded from national inventory reporting, and are commonly excluded in company-level inventories, emissions trading and carbon neutrality schemes. Biogenic carbon emissions

from woody biomass are included in national inventory reporting, but are sometimes excluded in LCA, such as when supplied from a sustainably managed plantation, on the basis that if forest carbon stocks are stable there is no net A Common Approach to Sector-Level Greenhouse-Gas Accounting for Australian Agriculture | 7 Term Definition Source See also Comments emission. Biogenic carbon emissions may be reported separately, and several standards (ISO 14067, GHG Protocol) require this for woody biomass. In national inventory reporting, emissions from burning peat are classed as fossil fuel emissions due to the slow formation rate of peat compared with other biomass materials.

Carbon

A chemical element with the symbol C. In the context of climate change, carbon often refers to carbon dioxide, or to all greenhouse gases.

Carbon credit

Tradeable certificate representing one tonne of carbon dioxide equivalents (CO₂e) in GHG emission reductions or GHG removals Carbon credits are generated by abatement projects, and quantified relative to a baseline. In Australia, ERF projects generate carbon credits, called ACCUs. Carbon credit schemes commonly apply integrity criteria to ensure that the abatement is genuine, for example, ensuring additionality and permanence, avoiding double-counting and leakage. Carbon credits are commonly purchased to offset GHG emission of the purchasing entity.

Carbon dioxide equivalent (CO₂-e)

Unit for comparing the radiative forcing of a GHG to that of carbon dioxide The carbon dioxide equivalent is calculated as the mass of a given GHG multiplied by its global warming potential.

Carbon footprint

Sum of GHG emissions minus GHG removals of the subject expressed as carbon dioxide equivalents (CO₂e). The subject could be a product or an organisation. Where the subject is an organisation, such as a company, the carbon footprint often includes indirect emissions also known as scope 2 and scope 3 emissions. Where the subject is a product, the carbon footprint includes the emissions and removals across the product life cycle.

Carbon neutrality

IPCC definition: Condition in which anthropogenic carbon dioxide (CO₂) emissions associated with a subject are balanced by anthropogenic CO₂ removals. Common usage e.g. Climate Active, ISO Carbon neutrality standard: Condition in which anthropogenic GHG emissions associated with a subject are balanced by anthropogenic GHG removals. Achieving carbon neutrality commonly involves offsetting residual emissions through the purchase of carbon credits to counterbalance residual emissions. The subject can be an entity such as a country, an organisation, a district or a commodity, or an activity such as a service or an event. For a company: Carbon neutrality assessment includes the emissions and removals, over a specified period, for which the company has direct control, and may also include “scope 3” emissions and other indirect emissions, as specified by the relevant scheme. For a product: Carbon neutrality is assessed over the life cycle of the product, although the use phase and disposal are sometimes excluded. For a country, state or local government: Carbon neutrality is assessed on a territorial basis, including direct emissions and removals occurring within the territory, over a specified period. The term net zero (CO₂ or GHG) is more commonly applied to the territorial perspective.

Carbon sequestration

The process of removing carbon from the atmosphere and transferring it to a carbon pool such as vegetation, soil, ocean or geological formation. Carbon can be sequestered through natural and anthropogenic processes. In national inventory reporting and many other contexts the carbon uptake by annual plants and herbaceous perennial plants, such as grasses, is excluded because it is usually returned to atmosphere within a short period.

Decarbonisation

The process of stopping or reducing carbon gases, especially carbon dioxide, being released into the atmosphere as the result of a process, for example the burning of fossil fuels¹⁰.

Direct emissions

GHG emissions from sources owned or controlled by the reporting entity. Agricultural examples include GHG emissions from burning diesel in farm machinery, the release of N₂O from bacteria breaking down crop residues or N fertilisers. Also called Scope 1 emissions.

Emissions intensity

The quantity of emissions per unit of production. Example: the kg CO₂-e emitted per tonne of grapes at farm gate.

GHG management hierarchy

Priority order of actions to achieve carbon neutrality: 1. Reduce GHG emissions 2. Remove CO₂ by implementing carbon dioxide removal methods 3. Offset residual emissions through purchase of carbon credits.

Global warming potential

An index measuring the radiative forcing following an emission of a unit mass of a GHG, accumulated over a chosen time horizon, relative to that of the reference substance, carbon dioxide (CO₂). The GWP represents the combined effect of the differing times that GHGs remain in the

atmosphere and their different effectiveness in causing radiative forcing, that is, in heating the Earth’s atmosphere. GWP is measured in units of carbon dioxide equivalents (CO₂e). The most common time horizon is 100 years (GWP100). Parties to the UNFCCC have agreed to use GWP100 values from the IPCC’s Fifth Assessment Report (AR5) or GWP100 values from a subsequent IPCC Assessment Report to report aggregate emissions and removals of GHGs under the Paris Agreement. In addition, parties may use other metrics to report supplemental information on aggregate emissions and removals of GHGs.

Greenhouse gas (GHG)

Gaseous constituent of the atmosphere, either natural or anthropogenic, that absorbs and emits radiation at specific wavelengths within the spectrum of radiation emitted by the Earth’s surface, by the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapour (H₂O), carbon dioxide (CO₂), nitrous oxide (N₂O), methane (CH₄) and ozone (O₃) are the primary GHGs in the Earth’s atmosphere. Human-made GHGs include sulphur hexafluoride (SF₆), hydrofluorocarbons (HFCs), chlorofluorocarbons (CFCs) and perfluorocarbons (PFCs). Emissions of CO₂, methane, nitrous oxide, HFCs, nitrogen trifluoride, PFCs and sulphur hexafluoride are reported under the UNFCCC and aggregated into carbon dioxide equivalents (CO₂e) using global warming potentials (GWPs). Water vapour and ozone, which are anthropogenic as well as natural greenhouse gases, are not included in reporting under the UNFCCC. GHGs differ in their radiative efficiency (potency as a GHG) and their atmospheric lifetime.

Greenhouse gas emission

Release of a GHG into the atmosphere. GHG emissions result from a GHG source.

Greenhouse gas Protocol / GHG Protocol

An initiative of the World Resources Institute and the World Business Council on Sustainable Development that provides standards, guidance and tools for quantifying organisation-level GHG inventories.

Indirect emissions

GHG emissions that are a consequence of the organisation’s activities, but that arise from GHG sources that are not owned or controlled by the organisation. Indirect emissions occur upstream and/or downstream of the farm, across the value chain, and include emissions from manufacture of inputs such as fertiliser, and from processing of products, such as abattoir operations or milling. Indirect emissions also include emissions outside the value chain that are induced by change in demand for (or supply of) products produced or sourced by the organisation.

Insetting

Emissions reduction or carbon sequestration through management of GHG sources and GHG sinks within the value chain the reporting entity. Insetting occurs when a company offsets its emissions using abatement occurring within its own value chain. The definition of insetting varies between schemes. Under Climate Active, insetting refers to management of GHG sources and GHG sinks within the emission boundary, that reduce the net GHG emissions of that enterprise.

Inventory boundary

(for reporting or accounting) Boundary specifying which emissions and removals are accounted and reported by the company. GHG accounting and reporting boundaries can have several dimensions, i.e. organizational, operational, geographic, business unit, and target boundaries.

All Glossary terms listed below have been sourced from A Common Approach to Sector-Level GHG Accounting for Australian Agriculture: Common Terminology (April, 2023).

Project details and outputs can be found here: <https://www.aginnovationaustralia.com.au/news/GHG-common-framework/>

¹⁰ Cambridge Dictionary

Glossary

Mitigation

GHG removals by sinks and/or reduction in GHG emissions by sources

Nationally determined contribution (NDC)

(Under the UNFCCC) National plans that specify a party's self-determined target for GHG emissions reduction under the Paris Agreement, and describe how it intends to meet the target, and to assess progress. Australia has committed to reduce emissions by 43 per cent below 2005 levels by 2030, and to reach net zero GHG emissions by 2050.

Net zero GHG emissions

Condition in which GHG emissions are balanced by GHG removals over a specified period. For a company: Net zero GHG assessment includes the GHG emissions and removals, over a specified period, for which the company has direct control, and may also include indirect emissions ("scope 3" emissions), as determined by the relevant scheme. The term GHG neutrality is also applied to the company perspective, with the same meaning. For a country, state or local government: Net zero GHG is assessed on a territorial basis, including GHG emissions and removals occurring within the territory, over a specified period. The quantification of net zero GHG emissions depends on the GHG emission metric chosen to compare emissions and removals of different gases, as well as the time horizon chosen for that metric. GHG neutrality and net zero GHG emissions are overlapping concepts. See GHG neutrality for explanation of the differences.

Offset

The reduction, avoidance or removal of a unit of greenhouse gas (GHG) emissions by one entity, purchased by another entity to counterbalance a unit of GHG emissions by that other entity. Offsets are calculated relative to a baseline. Offsets are commonly

subject to rules and environmental integrity criteria intended to ensure that offsets achieve their stated mitigation outcome. Relevant criteria include the avoidance of double counting and leakage, use of appropriate baselines, additionality, and permanence or measures to address impermanence. Offsets are usually represented by a carbon credit that has been retired or cancelled in a register by or on behalf of the entity that counterbalances unabated GHG emissions or residual GHG emissions ACCUs are sold as offsets on the voluntary emissions trading market.

Paris Agreement

Legally binding international treaty on climate change made under the UNFCCC. It was adopted by 196 Parties at UNFCCC COP 21 in Paris, in 2015 and entered into force in 2016. Its goal is to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels. Under the Paris Agreement (2021-2030), Australia has pledged to cut emissions by 43 per cent compared with 2005 emissions. Based on a 43 per cent reduction by 2030, Australia's emissions budget for this period is 4,381 Mt CO₂-e.

Science-based targets initiative SBTi

Initiative that supports companies to set emission reduction and net zero targets in line with climate science and Paris Agreement goals.

The SBTi is a partnership between CDP, the United Nations Global Compact, World Resources Institute (WRI) and the World Wide Fund for Nature (WWF).

Scope 1, 2, 3 emissions

Terminology developed by the Greenhouse Gas Protocol and now adopted broadly, including in National Greenhouse and Energy Reporting (NGER) documentation.

Scope 1 emissions: direct emissions arising

from sources within the control of the reporting organisation.

Scope 2 emissions: indirect emissions from the generation of purchased or acquired electricity, steam, heating or cooling consumed by the reporting organisation. For farms, this is predominantly electricity use.

Scope 3 emissions: indirect emissions other than scope 2 emissions that occur within the value chain as a consequence of the organisation's activities. For farms, scope 3 emissions are the pre-farm and post-farm emissions, such as from manufacture of urea and herbicides, processing in abattoirs, and refrigerated transport of produce. Scope 3 emissions are not reported under the NGER scheme. Scope 3 emissions that occur outside Australia are not reported in Australia's national inventory report. Scope 3 emissions are included in consumption-based accounting, that seeks to capture the climate impacts of the manufacture of imported goods.

Sink

A process, activity or mechanism that removes a GHG, an aerosol or a precursor to a GHG from the atmosphere. A pool (reservoir) is a sink for atmospheric carbon if, during a given period, more carbon is moving into it than is flowing out. Forests and agricultural lands are reservoirs: they can be either a source or a sink. A forest is a sink if there is net flow of greenhouse gases into the aggregated forest pools (sum of living biomass, litter and soil pools), and it is a source if there is a net flow of GHG to the atmosphere from the aggregated pools.



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