Wine Australia



Identification of investment requirements and opportunities of carbon insetting in vineyards

Final Report

The Growth Drivers™

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CO2 AUSTRALIA

Identification of investment requirements and opportunities regarding carbon insetting in vineyards

Report for Wine Australia

December 2024

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Wine Australia TGD™ CO2 AUSTRALIA

Project Overview

Exploring carbon insetting opportunities and investment requirements for enhancing sustainability in Australian vineyards.

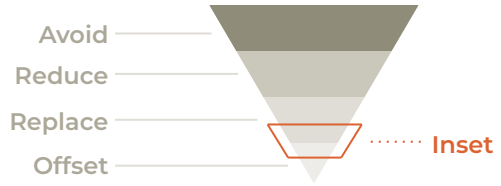
This report, developed by Wine Australia in collaboration with The Growth Drivers and CO2 Australia, provides a comprehensive analysis of the potential for carbon insetting in Australian vineyards. This initiative explores how integrating carbon sequestration within vineyard operations can help achieve carbon neutrality, enhance sustainability, and improve economic viability.

The primary focus is to identify investment requirements and opportunities, outline current industry practices, and propose a roadmap for future initiatives to achieve carbon neutrality.

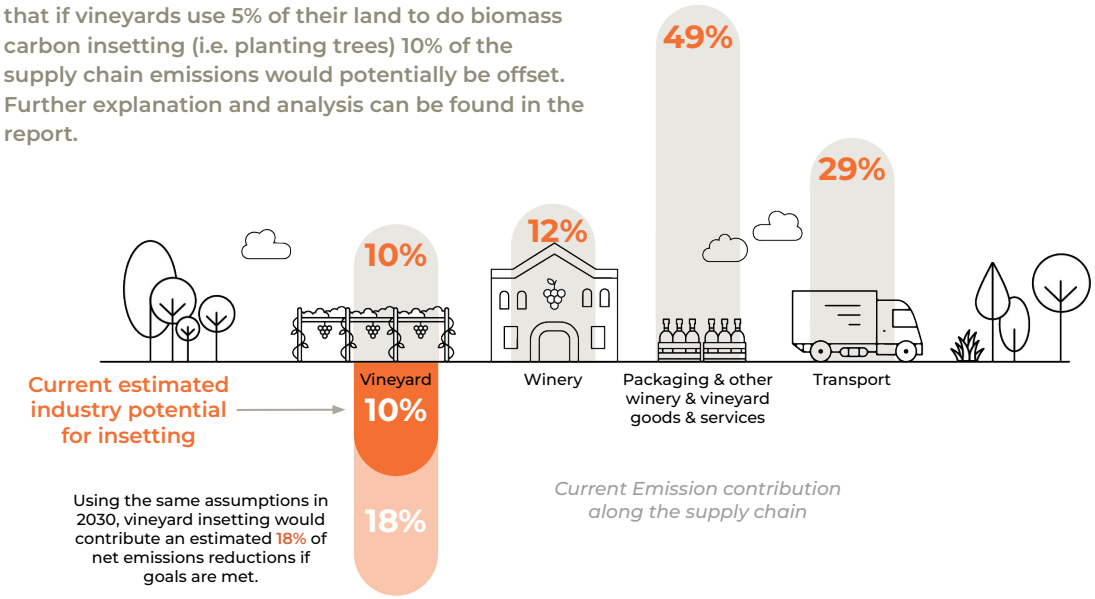
Through extensive research, stakeholder interviews, and technological assessments, the report to provides a clear and actionable path forward for the wine industry.

Insetting Opportunity & Place in the Industry

Carbon insetting's place within the Carbon Management Hierarchy fits after primary efforts in emissions reductions. However, there are still many tangible benefits for carbon insetting for vineyards; economic, environmental, operational and market.



Using some general estimations, it was estimated that if vineyards use 5% of their land to do biomass carbon insetting (i.e. planting trees) 10% of the supply chain emissions would potentially be offset. Further explanation and analysis can be found in the report.



Technologies

Ways in which carbon can be stored.

Biomass
Storing carbon in biomass such as trees.

Soil Carbon
Storing carbon in soil.

Biomass Transformation
Turning biomass into stored carbon for various uses.

Schemes

Ways in which carbon stores can be credited.

- The Australian Carbon Credit Unit Scheme
- The Gold Standard International
- Verra Verified Carbon Standard International
- TOITŪ Envirocare New Zealand

Measurement Methodologies & Tools

Ways in which carbon stores can be measured for accreditation.

Current
Specific methodologies and tools depending on scheme and technology being used.

Development
There is development of proponent-led methodologies under:

| ACCU Scheme
| Gold Standard
| Verra

Innovation

- Fertiliser in irrigated Cotton
- Puro.Earth Biochar
- Downforce Tech.
- LOOC-C
- Unmanned Aerial Vehicle asses.
- FILINTpro

Key Findings

Discussions with key industry stakeholders and experts highlighted the challenges, risks, opportunities, and necessary interventions for adopting carbon insetting practices in vineyards.

Challenges

Carbon Literacy | Understanding carbon insetting practices, implementing them, trusting and accessing standardised emissions tools, and knowing the available options.

Cost & ROI | The high costs of measurement, reporting, and verification (MRV) systems, along with uncertainty about the return on investment (ROI)

Unique Vineyard & Wine Context | The unique/varied settings of vineyards make it challenging to provide standardised advice, while uncertainty and inconsistency around market needs further complicate producers' efforts.

Capability Access | Limited access to qualified experts and unclear roles and responsibilities within vineyard operations.

Risks

System Integrity | Reluctance among vineyard owners to adopt carbon insetting practices stem from a lack of understanding, prevalent misinformation, and the additional financial burden and uncertain returns amid existing operational challenges.

Land Use & Resilience | Locking up land for carbon insetting creates inflexibility and uncertainty about future use, sales, and value, while the risk of losing stored carbon due to natural disasters undermines the reliability and resilience of these efforts.

Opportunities



Education

Comprehensive educational programs can boost adoption rates by increasing carbon literacy and highlighting the long-term benefits of carbon insetting.



Reducing Entry Cost

Forming regional cooperatives and tapping into government grants can enhance the economic feasibility and adoption of carbon insetting practices by reducing entry costs.



Simplifying Practice Through Tech

Leveraging technology for monitoring and reporting can reduce MRV costs and complexity, while investing in baseline data now prepares vineyards for future regulations and market demands.



Understanding the Benefits

Implementing carbon insetting can attract environmentally conscious consumers, secure important markets, and potentially increase production and grape quality through improved soil health and operational efficiencies.

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High Level Roadmap

This report offers a strategic roadmap for integrating carbon insetting into Australian vineyards, enhancing sustainability, resilience, competitiveness, and long-term economic viability while meeting global market demands.

01 Foundation

1.1 Enhanced Carbon Literacy
Vineyard understanding of carbon-related
- Terminologies | Governance | Practices | Opportunities

1.2 Financial Modelling
Analyse the cost-benefit, investment, operational costs, market access, and financial viability of carbon insetting technologies.

1.3 Unified Supply Chain
To ensure low-cost, consistent planning, measurement, reporting, and verification.

1.4 Clarity & Monitor MRV Requirements
Track evolving policies to ensure future market access.

02 Scale up

2.1 Collective Resource Utilisation
Regional hubs will reduce costs and complexity by providing shared access to equipment, infrastructure, and project establishment for carbon insetting technologies.

2.2 Continuous Blue Sky Innovation Monitoring
Keep vineyards updated on the latest technological and financial advancements to leverage new carbon insetting opportunities and support market entrants.

03 Integration

3.1 Pilot Projects for Best Practices
Pilot projects will demonstrate effective carbon insetting practices, providing data and case studies to guide broader implementation.

3.2 Supportive Policy Environment
Advocacy efforts will result in supportive policies and incentives, making it easier for vineyards to adopt and benefit from carbon insetting practices.

01 Introduction

The project encompasses a comprehensive analysis of carbon insetting potentials within vineyards, focusing on investment needs, technological advancements, and practical implementation strategies. This involves conducting both quantitative and qualitative data collection activities to establish the current state of the industry, identifying opportunities, risks, and gaps. Findings will be validated with stakeholders, and a final roadmap will be developed, inclusive of investment opportunities. The project will be executed through a sprint methodology facilitated by The Growth Drivers and CO2 Australia, ensuring inclusive participation of key stakeholders across the value chain.

This report aims to bring together the quantitative and qualitative data collection to provide a snapshot of industry's current state and particularly, understand:

1. Potential size of the opportunity and where does insetting fit in the carbon management hierarchy?
2. How does industry feel about insetting and what are their drivers for change?
3. Current technologies vineyards can use to sequester carbon.
   Ways to sequester carbon are referred to as 'technologies' in this report.
4. What certifications and schemes are available for vineyards.
   Ways to get the value of the carbon stored these are referred to as 'schemes'.
5. Current methods vineyards can use to measure carbon storage.
   There are verified ways to measure the carbon stored from technologies under the schemes, these are called 'methodologies'.
6. Opportunities and investment roadmap

The information provided in this report is intended for general guidance and informational purposes only. While every effort has been made to ensure the accuracy and reliability of the data presented, it should not be considered as definitive or relied upon for making business decisions. Readers are advised to conduct their own research and consult with qualified professionals before making any decisions based on the information contained in this report. The authors and publishers of this report do not assume any liability for any losses or damages resulting from the use of the information provided herein.

Research Activities

14 | In-depth Interviews

The team conducted in-depth interviews (1 hour) to gather diverse insights directly from the supply chain. These interviews predominantly involved growers and include discussions with technology experts, researchers and other stakeholders to ensure a comprehensive understanding across key parts of the supply chain. Each interview was tailored depending on the stakeholder, as a whole the interview process aimed to understand these 4 objectives:

1. **Awareness of carbon insetting practices and technologies among vineyards**
2. **Challenges in integrating sustainable carbon insetting practices into the industry**
3. **Opportunities between wineries, technology providers, and sustainability experts**
4. **Investment opportunities for innovative and impactful carbon insetting technologies**

6 | Short form Interviews

In our research protocol, we also included a series of short-form interviews that are adapted from the COM-B framework. These interviews were designed to be concise, lasting around 30 minutes, enabling us to engage with a broader range of stakeholders efficiently. This approach utilises the COM-B model (Capability, Opportunity, Motivation, and Behavior) to guide the structure of the interviews, ensuring that each session probes into how these components influence the adoption and integration of carbon insetting practices. While these interviews were in less depth than the 1 hour format, they were designed to gather quick perceptions and insights from various participants across the supply chain.

Desktop Research

The desktop research played a key role in providing a foundational understanding of the current landscape of carbon insetting technologies and practices. The desktop research involved an extensive review of existing literature, industry reports, and policy documents to map current technologies and identify emerging trends in both technologies and methodologies. Our desktop research also included a thorough technology assessment, where we evaluated various carbon insetting technologies based on different scenarios and their adoption readiness (ARL) and technology readiness levels (TRL). This systematic review helped us understand the practical implications of current policies on adopting these technologies. It guided our analysis of the technological maturity and feasibility for widespread integration within the industry. By combining current data and forecasts, our desktop research established a solid baseline to explore the potential pathways and barriers to implementing effective carbon insetting strategies in vineyards.

Our Carbon Estimation Approach

Based on Extensive Industry Experience

- Methodology developed by CO2 Australia, drawing on 15+ years delivering carbon projects, including work with major Australian vineyards and wine brands.
- Analysis incorporating data from over 100 carbon farming projects across diverse Australian regions
- Track record includes successful delivery of carbon credit projects under the Emissions Reduction Fund (ERF)
- CO2 Australia team has managed the establishment of 26,000+ hectares of carbon plantings
- Experience spans multiple methodologies including environmental plantings, soil carbon, and avoided deforestation

Rigorous Methodology

- Relies on in-depth knowledge of FullCAM and modelling results - the Australian Government's approved model for carbon credit development and national carbon accounts
- Rainfall-based modeling calibrated against actual measurement data from completed projects
- Conservative estimates that account for project risks and variability
- Validated through comparison with real vineyard carbon measurement data

Industry-Scale Estimates

Detail on the basis of sequestration estimates is provided on pages 13-15. The core values are provided below.

High Rainfall Areas:

Total potential: ~11 tonnes CO_2-e per hectare/year
Includes ~10 tonnes from biomass + ~1 tonne from soil carbon

Low Rainfall Areas:

Total potential: ~5.5 tonnes CO_2-e per hectare/year
Includes ~5 tonnes from biomass + ~0.5 tonnes from soil carbon

Seek advice for vineyard scale decision making

These estimates are designed for industry-level planning and cannot be relied on for financial and investment decision-making for specific vineyards.
Site-specific assessments are recommended for individual projects, as local conditions can significantly impact outcomes.

Specifically, while rainfall has been used here to provide a useful indicator at large scale, it is not necessarily the most critical driver of carbon sequestration potential. Individual assessments are recommended to capture the full range of factors influencing carbon insetting opportunities at a specific site.

Such factors include:

- Vegetation type
- Land management practices
- Soil characteristics
- Local climate conditions

Stakeholder Ecosystem Map

This stakeholder map shows the range of stakeholders engaged part of the discover phase of the project. A breakdown of who was engaged can be found in appendix 1. The stakeholders were separated into the '4 voices of design' (defined below) and given different weights for contribution. I.e. voice of experience stakeholders was aimed to make up 50% of our interviews.

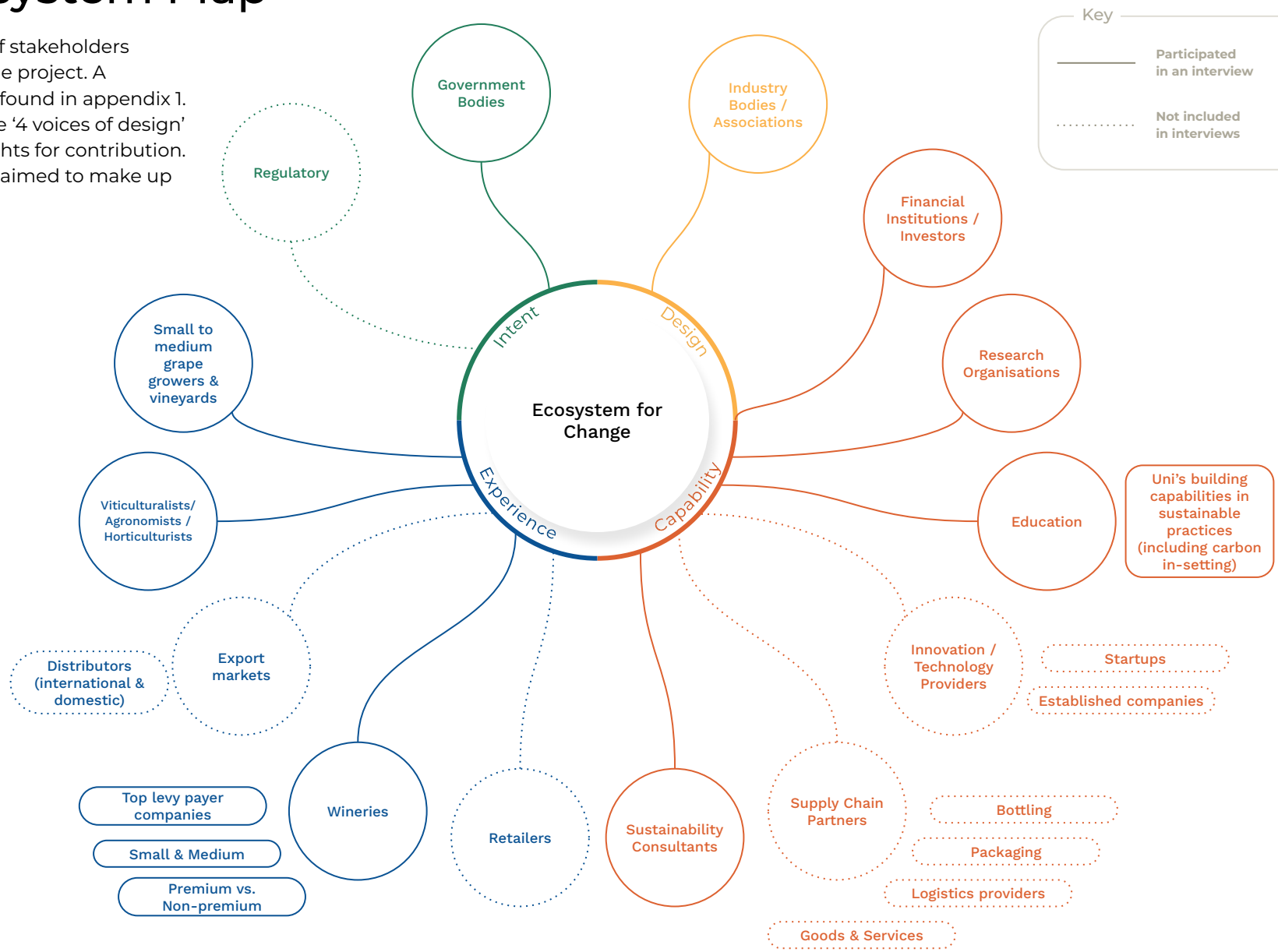
Voice of Intent (10%)
People with:
- **Passion** or **motivation** to take action.
- **Authority** or **mandate** to drive change.

Voice of Design (10%)
People who can:
- **Broker, facilitate and coordinate change.**
- **Connect** diverse communities.
- **Represent and document progress** and make it accessible to industry.

Voice of Capability (30%)
People with:
- **Resources** to contribute (money, labour).
- **Specialist knowledge, skills and tools.**
- **Access** to problem space (e.g. worksites).

Voice of Experience (50%)
People with:
- **Lived experience** of the issue and ground level context.

People who:
- Will be a user of, or affected by the **intervention.**



02 Context & Drivers for Change

The Australian wine industry has already begun progress in emission reduction and carbon offsetting. However, carbon insetting remains a relatively new and less understood concept within the industry. While the primary focus of this project is on insetting, the following section will outline why it is important for the industry to inset, the size of the opportunity, as well as how insetting fits in driving the industry toward net zero - working together with emissions reductions and offsetting.



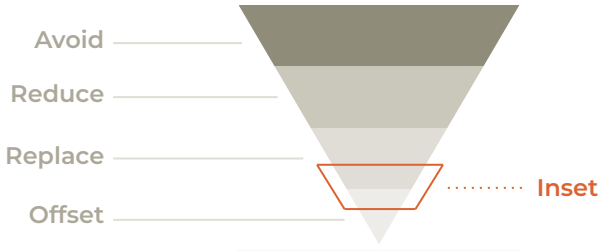
Context Defining Insetting

Wine Australia's emissions reduction guidelines outline the carbon management hierarchy, however, it did not include insetting. The diagram on the right demonstrates how insetting integrates into this framework, complementing existing priorities.

While the primary focus of this project is on insetting, the following diagram explains emission reduction and offsetting to provide clarity on the overall carbon management landscape and scope of this report.



The Carbon Management Hierarchy



Carbon Insetting

Carbon insetting refers to the proactive measures taken within an organisation's own network or logistical supply chain to reduce carbon emissions. In the wine industry, this could involve implementing practices that directly sequester carbon within the vineyard itself. For example, a winery might undertake a soil carbon program, where carbon is captured and stored in the soil through sustainable agricultural practices. This approach integrates carbon reduction efforts directly into the winery's operations, ensuring that emissions are mitigated as part of the production process. It is important to note that the definition of insetting may vary between schemes.

Carbon Offsetting

Carbon offsetting involves compensating for emissions that have already been produced by investing in external projects designed to reduce or sequester carbon. This is typically done retrospectively after the emissions have been quantified. For instance, a winery might purchase carbon credits from a forestry project or establish a separate carbon sequestration project on land outside their primary operations. This approach helps balance out the carbon footprint by supporting projects that reduce emissions elsewhere.

Reducing Emissions

Reducing emissions encompasses all efforts to decrease the amount of greenhouse gases produced in the first place. This can include upgrading equipment to more energy-efficient models, using renewable energy sources, optimising logistics to minimise transportation emissions, and implementing sustainable farming practices that lower overall carbon output. This is outlined as *'avoid, reduce, replace'* in the carbon management hierarchy. Reducing emissions is the priority pathway towards sustainability, as it directly tackles the source of emissions.

Context Size of Opportunity Industry

With the industry focusing on achieving a 42% reduction in emissions by 2030, emissions reduction strategies in direct sources such as electricity use, transport, and supply chain material are the primary focus. However, there will always be unavoidable emissions inherent in the winemaking process that emissions reductions alone cannot address, such as biogenic emissions (soil emissions, crop residue, fermentation emissions). Although there are carbon capture process being done to combat this, industry will still require offsetting and insetting to achieve net zero.

We've made assumptions to assess the total potential carbon inset opportunity for vineyards. Based on this we believe vineyard insetting can contribute approximately *182,855t CO2-e* (~10% of supply chain emissions). The remaining will need to be reduced or offset in an ongoing way.

Estimation calculation for insetting opportunity
Estimated carbon storage for biomass (Approx. 5t CO2-e for 5% of land area of vineyards) + soil carbon potential at 1t CO2-e for all vineyard land area, divided by total supply chain emissions in 2021 baseline.

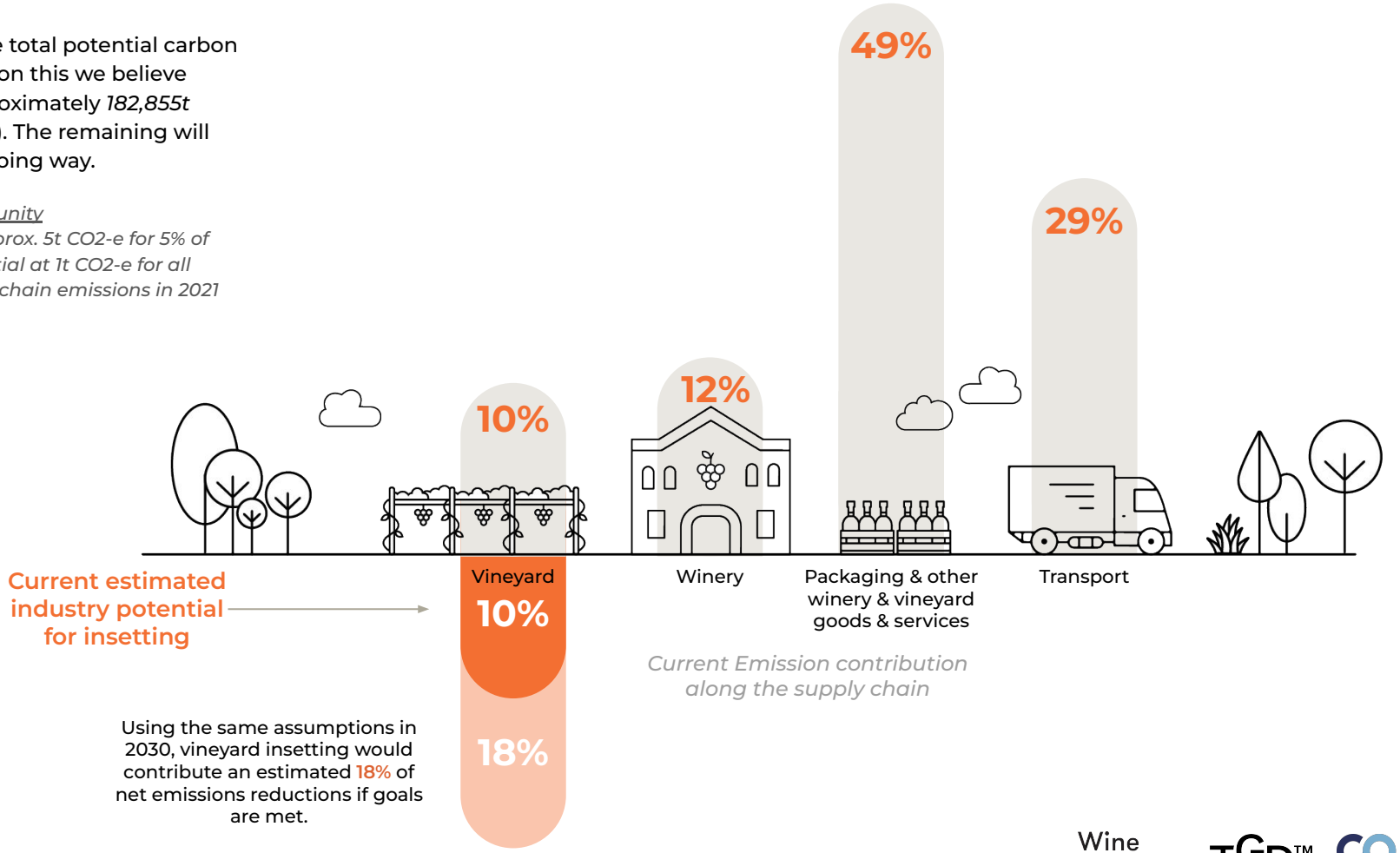
Statistics collected from Wine Australia Emissions Reduction Roadmap.



GHG Emissions Baseline

1,770,997

t CO2-e
2020-2021 Australian Wine Sector



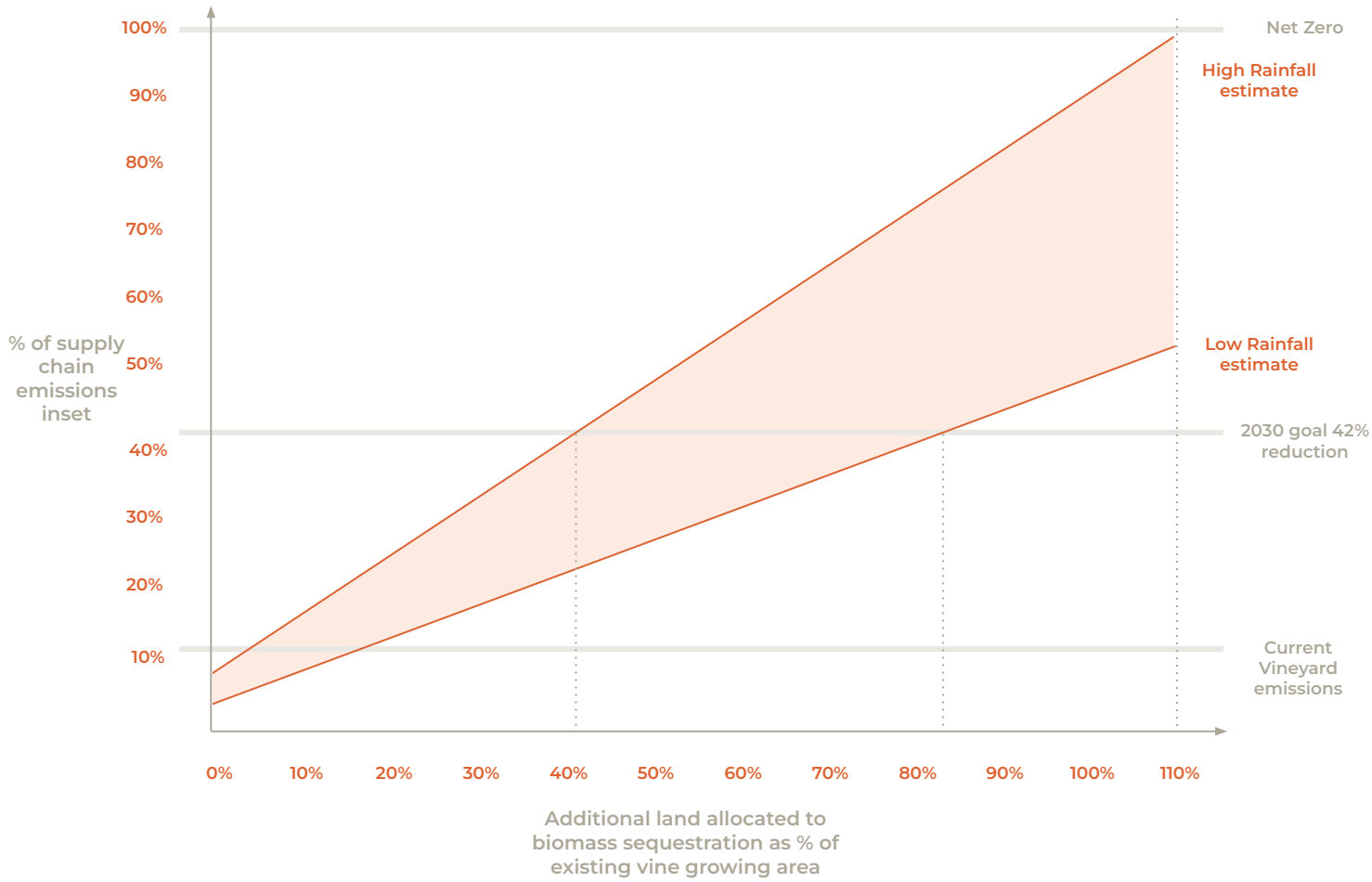
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Context Size of Opportunity Vineyard

Assuming that emissions across the supply chain are proportionate, we can begin to estimate the potential size of the opportunity for vineyards based on the percentage of additional land allocated to biomass sequestration. The graph illustrates how different allocation percentages correlate to the amount of supply chain emissions that can be inset. These calculations are based on various assumptions and provide an approximate indicator of potential outcomes. For example, if a vineyard owner allocates an additional 5% of land to planting trees (e.g. 20 Ha vineyard adds 1 Ha of tree plantings), they will be able to offset their general on farm emissions, any more land allocation will begin to inset carbon further down their supply chain.

Extensive work is needed to determine precise results for both the industry and individual vineyard operations. Therefore, this graph serves as a general guide to what might be achievable.

We use industry averages for a general understanding. As detailed on page 9, this is not appropriate for individual vineyard or supply chain planning. Due to site and customer specific contexts, actual results may vary significantly.



Estimation calculation for insetting opportunity

$$\frac{(\text{Additional land allocated to tree planting} \times \text{Assumed biomass sequestration rate}) + (\text{Vine growing area} \times \text{Assumed Soil Carbon sequestration rate})}{\text{GHG Emissions Baseline 2020-2021}}$$

Assumptions

The size of the opportunity has been split into general sequestration rates:

Biomass Sequestration (i.e. tree planting)

~10 tonnes of CO_2-e per hectare *high rainfall*

~5 tonnes of CO_2-e per hectare *low rainfall*

Soil carbon

~1 tonne of CO_2-e per hectare high rainfall

~0.5 tonne of CO_2-e per hectare low rainfall

It is also assumed the soil carbon covers the entire vine growing area. It is assumed that supply chain emissions are all proportional to each other - in reality this is not the case.

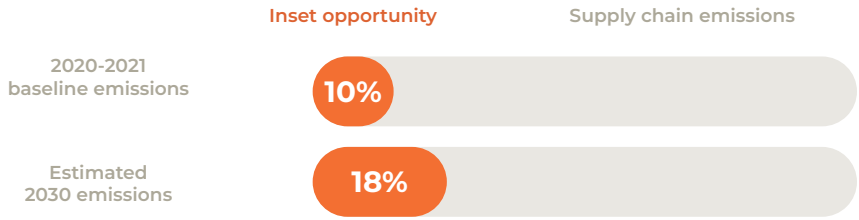
Statistics collected from Wine Australia Emissions Reduction Roadmap.

Context Size of Opportunity Vineyard Example Scenarios

To further explain the opportunity, 3 scenarios have been selected to show the potential scale of insetting and its impact now and estimated impact in 2030. It is using the assumptions around high rainfall regions.

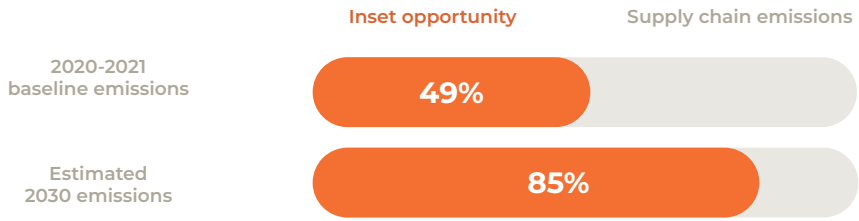
Vine growing area

5%
Additional land allocated to planting trees



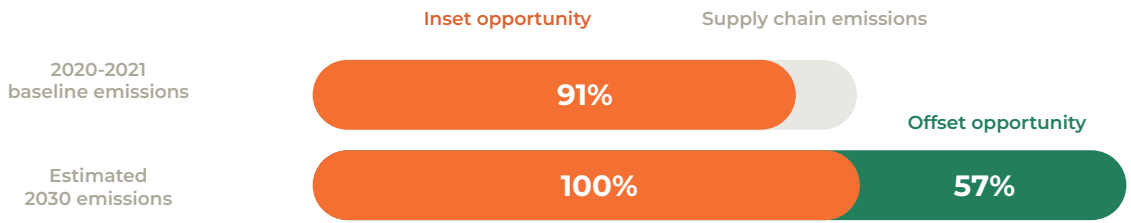
Vine growing area

50%
Additional land allocated to planting trees



Vine growing area

100%
Additional land allocated to planting trees

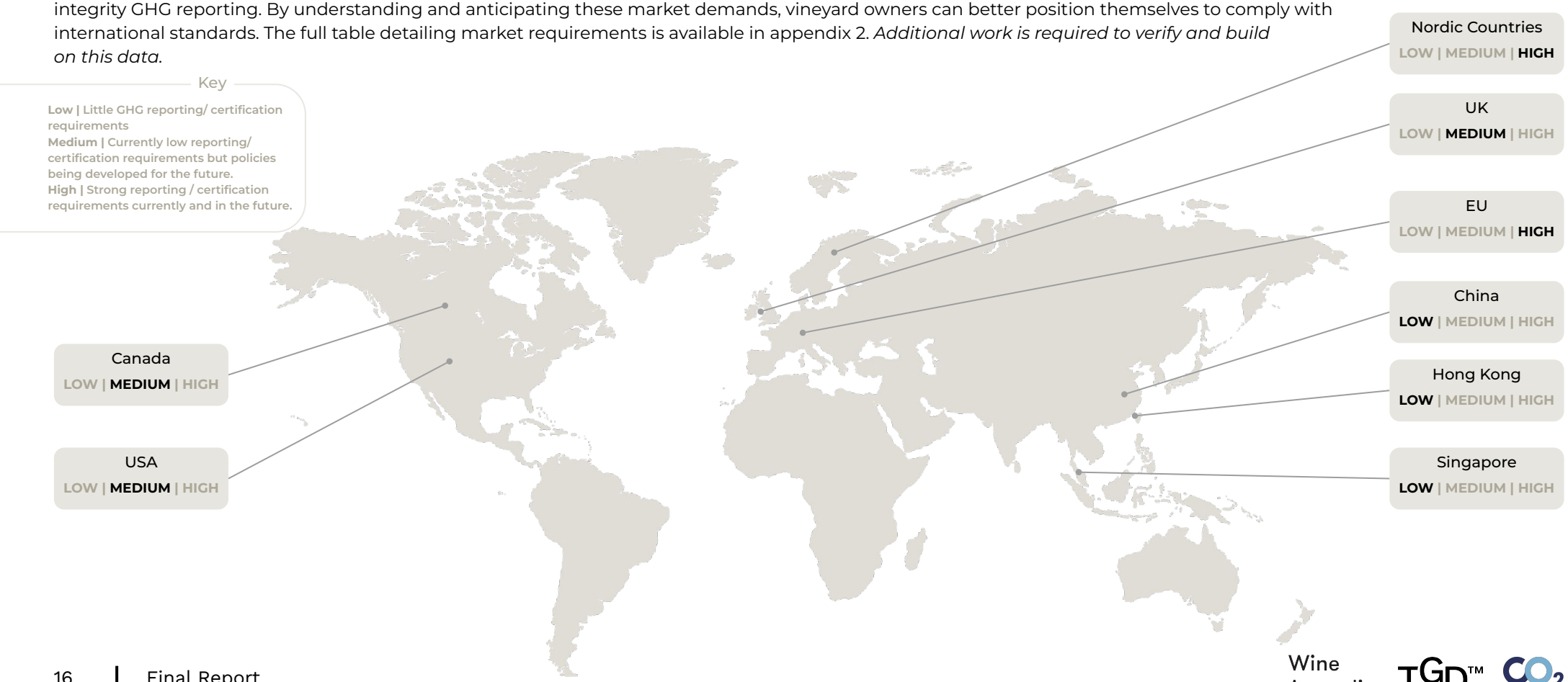


Context What is Happening in the Market

To ensure the project's success and encourage participation in insetting, it is essential to establish a clear connection between the requirements of international export markets and the methods detailed in this report. Exporting Australian wine to these key markets involves adhering to various carbon emissions reporting standards and regulations. The level of integrity required is moving in a direction to be generally quite high, with a strong emphasis on third-party verification and adherence to international standards. Companies must provide detailed and accurate reports, undergo regular audits, and ensure their practices align with the regulatory requirements of each market. This alignment will help vineyard owners understand the minimum standards they need to meet or are already being asked to adhere to regarding their carbon claims.

In addition, the shifting nature of international markets and the increase in regulations means that Australian producers must stay proactive to avoid being caught off guard by new policies and regulations emerging overseas. Insetting can be viewed as a strategic measure to protect against the potential loss of international markets. The decision to pursue carbon insetting should be made after careful consideration of market requirements and business needs. This document does not provide specific financial advice regarding insetting, and we recommend seeking professional guidance before making any investment.

Below shows a map of the requirements of key export markets and provide an analysis of whether these requirements demand high, medium or low integrity GHG reporting. By understanding and anticipating these market demands, vineyard owners can better position themselves to comply with international standards. The full table detailing market requirements is available in appendix 2. *Additional work is required to verify and build on this data.*



03 Current State

In our discussions with industry stakeholders and experts, we focused on the challenges, risks, and opportunities associated with carbon insetting in the vineyard context. We also explored the necessary interventions required to facilitate the adoption of insetting practices. The following section will provide high-level insights gathered from these conversations and will further detail them in the subsequent pages.



Voice from Industry Challenges & Risks Overview

After 20+ interviews with industry, the findings around challenges, risks and opportunities for the industry are synthesised in this section. Below are the four high level challenges and two risks uncovered.

CHALLENGE 1

Carbon Literacy

Challenges in understanding carbon insetting practices, dealing with the complexity of implementation, trusting and accessing standardised emissions calculation tools, and knowing the available options and pathways forward. The complex nature of the space is turning people away.

CHALLENGE 2

Cost & ROI

High costs of measurement, reporting, and verification (MRV) systems, which make it challenging to justify the financial investment in carbon insetting practices. Additionally, the uncertainty surrounding the return on investment (ROI) for these practices creates further deterrence for producers, as the financial benefits and long-term viability remain unclear.

RISK 1

System Integrity

The lack of understanding of carbon insetting schemes, methodologies, and prevalent misinformation has led to skepticism and reluctance among vineyard owners to adopt these practices. Additionally, vineyard owners are already grappling with significant operational challenges, and the additional financial burden and uncertain returns of carbon insetting make it a low priority, deterring investment.

CHALLENGE 3

Unique Vineyard & Wine Context

The unique and varied settings of vineyards pose significant challenges in providing standardised knowledge and communication, making it difficult to offer tailored advice that addresses the specific needs and conditions of each vineyard. Additionally, the uncertainty and inconsistency around market needs and wants create further challenges, as producers struggle to keep up with evolving market requirements.

CHALLENGE 4

Capability Access

The limited access to qualified experts creates a challenge on the implementation of effective carbon insetting practices. In addition, the challenge of defining roles and responsibilities of insetting within vineyard operations, creates confusion over who is best placed to lead insetting efforts.

RISK 2

Land Use & Resilience

Locking up land for carbon insetting purposes creates an inflexibility problem, as vineyard owners are uncertain about future land use, potential sales, or changes in land value. Additionally, there is a risk of losing stored carbon due to natural disasters or conditions, as highlighted by carbon experts and researchers, which undermines the resilience and reliability of carbon storage efforts.

Voice from Industry Challenges

CHALLENGE 1

Carbon Literacy



Challenges in understanding carbon insetting practices, dealing with the complexity implementation, trusting and accessing standardised emissions calculation tools, and knowing the available options and pathways forward. The complex nature of the space is turning people away.

Understanding Carbon Insetting
There is a general lack of understanding and awareness among producers about insetting practices and their potential benefits.

Complexity in Implementation
Implementing carbon insetting requires sophisticated methods and tools that can be expensive and technically challenging. The complexity was found to be off putting to those that look into it.

Lack of knowledge/trust for Standardised Tools for Emissions Calculation
While many producers have completed the SWA certification, which includes a baseline, producers reported struggling to baseline their emissions due to the absence of accessible, standardised tools specifically tailored for small producers in the wine industry.

Unclear pathways
Industry have unclear pathways forward and options making it hard for decision making amongst growers and wineries.

CHALLENGE 2

Cost & ROI



High costs of measurement, reporting, and verification (MRV) systems, which make it challenging to justify the financial investment in carbon insetting practices. Additionally, the uncertainty surrounding the return on investment (ROI) for these practices creates further deterrence for producers, as the financial benefits and long-term viability remain unclear.

High MRV Costs
The high cost of measurement, reporting, and verification (MRV) systems poses a significant challenge for producers, making it difficult for them to justify the financial investment required to implement and maintain effective carbon insetting practices.

High cost for an unknown ROI
The unknown ROI for carbon insetting practices creates uncertainty for producers, deterring them from committing to these initiatives without clear financial benefits and long-term viability.

Voice from Industry Challenges

CHALLENGE 3

Unique Vineyard & Wine Contexts



The unique and varied settings of vineyards pose significant challenges in providing standardised knowledge and communication, making it difficult to offer tailored advice that addresses the specific needs and conditions of each vineyard. Additionally, the uncertainty and inconsistency around market needs and wants create further challenges, as producers struggle to keep up with carrying market requirements..

Uniqueness of the Vineyard Context
The unique and varied settings of vineyards (rainfall region, soils, business structure, supply chain, capabilities, capital availability, infrastructure lifecycle etc.) make it challenging to provide standardised knowledge and communication, leading to difficulties in offering tailored advice that addresses the specific needs and conditions of each vineyard.

Market Variability
Market variability, uncertainty, and inconsistency around market needs and policy/regulation pose challenges to vineyard owners. Understanding the end consumer objective is challenging, as it is unclear what the market truly demands now and in the future, particularly regarding international and domestic policies and recognised certifications.

CHALLENGE 4

Capability Access



The limited access to qualified experts creates a challenge on the implementation of effective carbon insetting practices. In addition, the challenge of defining roles and responsibilities of insetting within vineyard operations, creates confusion over who is best placed to lead insetting efforts.

Consultant Capability & Access
It can be hard to identify the appropriate consultant for business needs, as many carbon advisory companies do not have expertise in the wine sector. It is important to confirm project examples and understand the scientific rigour applied to the work by consultants before engagement. Clarify the scope of work to be provided by the consultant and what will be expected by the business.

Unclear Role Responsibility
Wineries and vineyards face a challenge in appointing the person responsible for carbon insetting practices. During our discussions, we talked to people with various backgrounds, including accountants, viticulturists, soil scientists, and general managers, all tasked with this responsibility. These individuals approached the challenge with different priorities, leading to confusion and inconsistency in implementing insetting practices.

Voice from Industry Risks

RISK 1

System Integrity



The lack of understanding of carbon insetting schemes, methodologies, and prevalent misinformation has led to skepticism and reluctance among vineyard owners to adopt these practices. Additionally, vineyard owners are already grappling with significant operational challenges, and the additional financial burden and uncertain returns of carbon insetting make it a low priority, deterring investment.

Market Integrity and Trust
The lack of understanding of carbon insetting schemes, methodologies, and prevalent contradictory information has led to skepticism and reluctance among vineyard owners to adopt these practices.

Economic Viability
Vineyard owners are already grappling with significant operational challenges, the additional financial burden and uncertain returns of carbon insetting make it a low priority, deterring investment.

RISK 2

Land Use & Resilience



Locking up land for carbon insetting purposes creates an inflexibility problem, as vineyard owners are uncertain about future land use, potential sales, or changes in land value. Additionally, there is a risk of losing stored carbon due to natural disasters or conditions, as highlighted by carbon experts and researchers, which undermines the resilience and reliability of carbon storage efforts.

Locking land use
Locking up land for carbon insetting poses an inflexibility problem, as vineyard owners may be uncertain about future uses of their farm or potential sales, making long-term commitments challenging.

Resilience of storage
There is a risk of losing stored carbon due to natural disasters, as highlighted by carbon experts and researchers.

Operational Uncertainty
Perceived potential risks to operations from implementation of carbon project via pest animal increases, introduction of disease, extra water requirements, agricultural/productivity challenges.

Voice from Industry Opportunities Overview

Below are the four high level opportunities identified during the stakeholder engagements.



OPPORTUNITY 1

Education

Developing comprehensive educational programs to inform vineyard owners starting from a basic general increase in carbon literacy through to the understanding of the long-term economic and environmental benefits of carbon insetting can increase adoption rates. Implementing widespread education programs and workshops would serve as an effective starting point for enhancing understanding and engagement in these practices.



OPPORTUNITY 2

Reducing Entry Cost

Forming regional cooperatives to share resources (labour, funds, space etc.) and machinery (pyrolysis biochar equipment or any other infrastructure required for methods) can enhance the economic feasibility and adoption of carbon insetting practices among vineyard owners, including cross-industry collaboration, as a way of reducing entry costs. Additionally, tapping into available government grants and incentives can help offset initial costs, making carbon insetting projects more financially viable by further reducing entry costs.



OPPORTUNITY 3

Simplifying Practice Through Tech

Leveraging technology to simplify the practice of monitoring and reporting can significantly reduce the costs and complexity associated with MRV. Additionally, investing in baseline data collection now can prepare vineyards for future regulatory requirements and market demands, ensuring they are ahead of the curve when carbon insetting becomes more mainstream.



OPPORTUNITY 4

Understanding the Benefits

Implementing carbon insetting initiatives can provide vineyards with a unique selling proposition, appealing to environmentally conscious consumers and markets, securing important markets. Currently, there is no price advantage for sustainable wines, but with increasing social and environmental pressure, increasing demand from buyers of grapes for sustainability credentials (e.g. requiring membership of Sustainable Winegrowing Australia), vineyards will be expected to address their emissions footprint. Additionally, carbon insetting has the potential in some circumstances to increase production and improve grape quality through enhanced soil health and other operational efficiencies, as demonstrated by Tahbilk.

Voice from Industry Opportunities

OPPORTUNITY 1

Education



Developing comprehensive educational programs to inform vineyard owners starting from a basic general increase in carbon literacy through to the understanding of the long-term economic and environmental benefits of carbon insetting can increase adoption rates. Implementing widespread education programs and workshops would serve as an effective starting point for enhancing understanding and engagement in these practices.

Education Programs & Resources
Developing comprehensive educational programs to inform vineyard owners.These education pieces should start with basic carbon literacy, covering the principles of carbon management, then progressing to carbon insetting best practices, offering detailed information on technologies and methodologies, along with implementation strategies and monitoring and reporting guidelines. To ensure a thorough understanding, the programs should also delve into the broader carbon management hierarchy, explaining how insetting integrates with avoiding, reducing, and replacing emissions. Additionally, they should highlight the economic and environmental benefits, provide case studies from successful vineyards, and offer insights into relevant policies and market incentives. This holistic approach equips vineyard owners with the knowledge and skills to effectively integrate carbon insetting into their operations, aligning with their overall carbon management strategies and contributing to sustainable vineyard practices.

OPPORTUNITY 2

Reducing Entry Cost



Forming regional cooperatives to share resources and machinery can enhance the economic feasibility and adoption of carbon insetting practices among vineyard owners, including cross-industry collaboration, as a way of reducing entry costs. Additionally, tapping into available government grants and incentives can help offset initial costs, making carbon insetting projects more financially viable by further reducing entry costs.

Collaborative Models
Forming regional cooperatives to share resources and machinery can enhance the economic feasibility and adoption of carbon insetting practices among vineyard owners. This includes cross industry collaboration.

Maximising Funding Sources
Tapping into available government grants and incentives can help offset initial costs, making carbon insetting projects more financially viable.

Clear ROI Streams

Voice from Industry Opportunities

OPPORTUNITY 3

Simplifying Practice Through Tech



Leveraging technology to simplify the practice of monitoring and reporting can significantly reduce the costs and complexity associated with MRV. Additionally, investing in baseline data collection now can prepare vineyards for future regulatory requirements and market demands, ensuring they are ahead of the curve when carbon insetting becomes more mainstream.

Leveraging Technology to simplify the practice
Developing innovative technology for monitoring and reporting can significantly reduce the costs and complexity associated with MRV. It should be noted that new technologies would have to be certified.

Baseline Data Collection
Investing in baseline data collection now can prepare vineyards for future regulatory requirements and market demands, ensuring they are ahead of the curve when carbon insetting becomes more mainstream.

OPPORTUNITY 4

Understanding the Benefits



Implementing carbon insetting initiatives can provide vineyards with a unique selling proposition, appealing to environmentally conscious consumers and markets, securing important markets. Currently, there is no price advantage for sustainable wines, but with increasing social and environmental pressure, vineyards may eventually be pushed out of the market if they do not follow sustainable standards. Additionally, carbon insetting has the potential in some circumstances to increase production and improve grape quality through enhanced soil health and other operational efficiencies, as demonstrated by Tahbilk.

Market Differentiation
Implementing carbon insetting initiatives can provide vineyards with a unique selling proposition, appealing to environmentally conscious consumers and markets.

There is currently no price advantage for sustainable wines but with increasing social/environmental pressure they may eventually get pushed out of the market if not following sustainable standards.

On Farm Benefits & Co-benefits
Potential to increase production/produce better grapes with improved soil health/other operational efficiencies as per Tahbilk case study.

04 Technologies

With the current state of play being understood, this section will delve into the options available to vineyards to sequester carbon. It will break down and assess the current ways vineyard owners can sequester carbon and assess them based on different configurations and challenges for vineyards.

To put simply, there are 3 categories in which you can store carbon in the vineyard.

Biomass
Storing carbon in biomass such as trees.

Soil Carbon
Storing carbon in soil.

Biomass Transformation
Turning biomass into stored carbon for various uses.

Reforestation

Cover Crops

The largest determinant of opportunity is the scale of unvegetated land available for adoption of biomass sequestration via revegetation activities. For example, tree planting activities provide an average of 10 tonnes of CO2e storage per hectare, while soil carbon typically provides one tonne.

Mulching

Composting

Fertilisers

Reduced Tillage

Enhanced Mineral Weathering

Livestock integration

Carbon storage in soil can be improved by many approaches already being implemented on farm as best practice land management. The challenge is that there is high variability in the reliability of the data collection processes, and in the soil conditions themselves which affects data collection and the soil's ability to store carbon. The amount of carbon that can be stored in soil overall is also limited compared to biomass. It is important to note that there are ERF methods for soil carbon that can be followed to provide the most confidence. During the investigation it was found that some of the soil carbon technologies are out of scope, either due to it not being a practice in vineyards or there is currently more emissions used to carry out that practice (such as transportation costs of mulch etc.). Mulching, composting, fertilisers were still assessed and can be found in appendix 3.

Pyrolysis Biochar

Assessment Criteria for Available Technologies

Assessment criteria details

A brief description of the technology.

Adoption Readiness Level (ARL) | This measures how ready the industry or stakeholders are to adopt a particular practice. Factors include ease of implementation, cost, and industry familiarity.

Technology Readiness Level (TRL) | This measures the maturity of a particular technology. It ranges from Low (basic principles observed) to High (proven in operational environment).

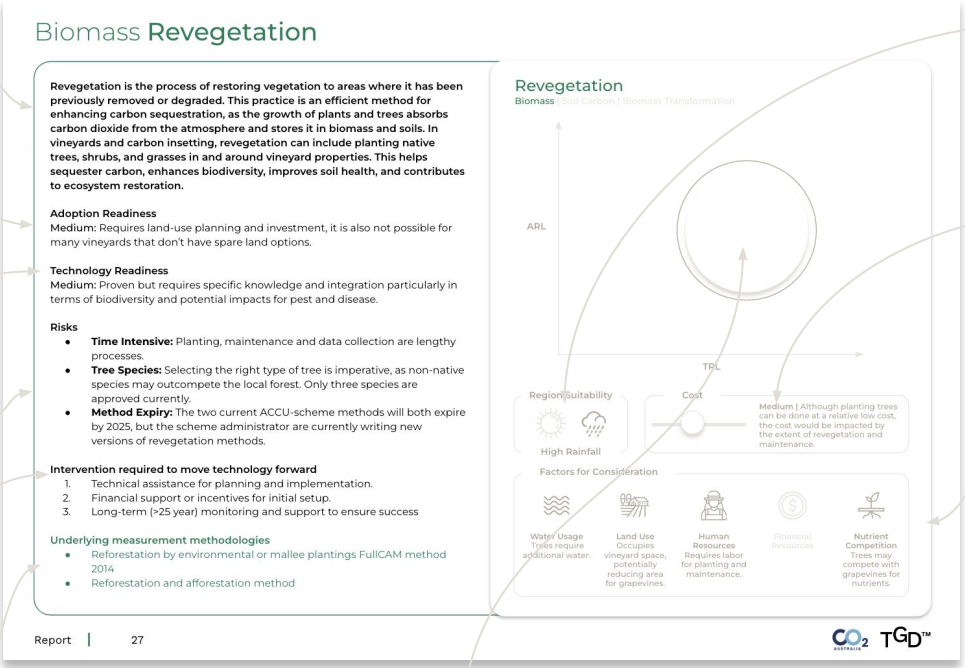
Risks | Risks associated with implementing the technology to vineyards.

Interventions | Interventions and considerations required to move the technology forward.

Underlying measurement methodologies | These are the measurement methodologies and schemes available for the technology. Information on what these are will be provided in the following sections of the report.

ARL vs TRL vs Size of Opportunity Graph

Our desktop research included a thorough technology assessment, where we evaluated various carbon insetting technologies based on different scenarios and their adoption readiness (ARL) and technology readiness levels (TRL). This systematic review helped us understand the practical implications of current policies on adopting these technologies. It guided our analysis of the technological maturity and feasibility for widespread integration within the industry.



The size of the circle is an *indication* of the size of the opportunity. A lack of validated research, testing and varied results make it difficult to provide definitive numbers around the size of the opportunity. The size of the opportunity being how much carbon can be stored per hectare (note that this is just an estimation and further research needs to be done and validated to understand the size).

In general terms, the size of the opportunity has been split into general sequestration rates
Biomass: 5-10 tonnes of CO2-e per hectare
Soil carbon: <1 tonne of CO2-e per hectare

Vineyards present challenges and unique characteristics which mean each piece of land has several dimensions of complexity. These variations cause differences in the most effective way to sequester carbon. The assessment cards outline the key characteristics of vineyards that will help growers choose the best insetting technologies for them. The vineyard characteristics assessed are outlined below.

Region Suitability |

- High Rainfall (>500 mm per year)
- Low Rainfall (<500 mm per year)

Implementation Cost |
The cost of purchasing and/or adoption of an insetting practice (including operational cost) is labelled from low to high. A proper cost assessment has not be conducted making this just a general indication.

Factors for consideration |
These are competing resources that should be considered when implementing that technology. They are:

- Water Usage
- Land Use
- Human Resources
- Financial Resources
- Nutrient Competition

Biomass **Revegetation**

Revegetation is the process of restoring vegetation to areas where it has been previously removed or degraded. This practice is an efficient method for enhancing carbon sequestration, as the growth of plants and trees absorbs carbon dioxide from the atmosphere and stores it in biomass and soils. In vineyards and carbon insetting, revegetation can include planting native trees, shrubs, and grasses in and around vineyard properties. This helps sequester carbon, enhances biodiversity, improves soil health, and contributes to ecosystem restoration.

Adoption Readiness

Medium: Requires land-use planning and investment, it is also not possible for many vineyards that don't have spare land options. *Eligibility considerations include: Planting within the operational control or supply chain, planting post 1990, area must have FullCAM data available, free of forest cover before planting, ability to maintain 20% cover of trees >2m, not registered as part of other carbon credit generation scheme and no forestry (clearing).*

Technology Readiness

Medium: Proven but requires specific knowledge and integration particularly in terms of biodiversity and potential impacts for pest and disease.

Risks

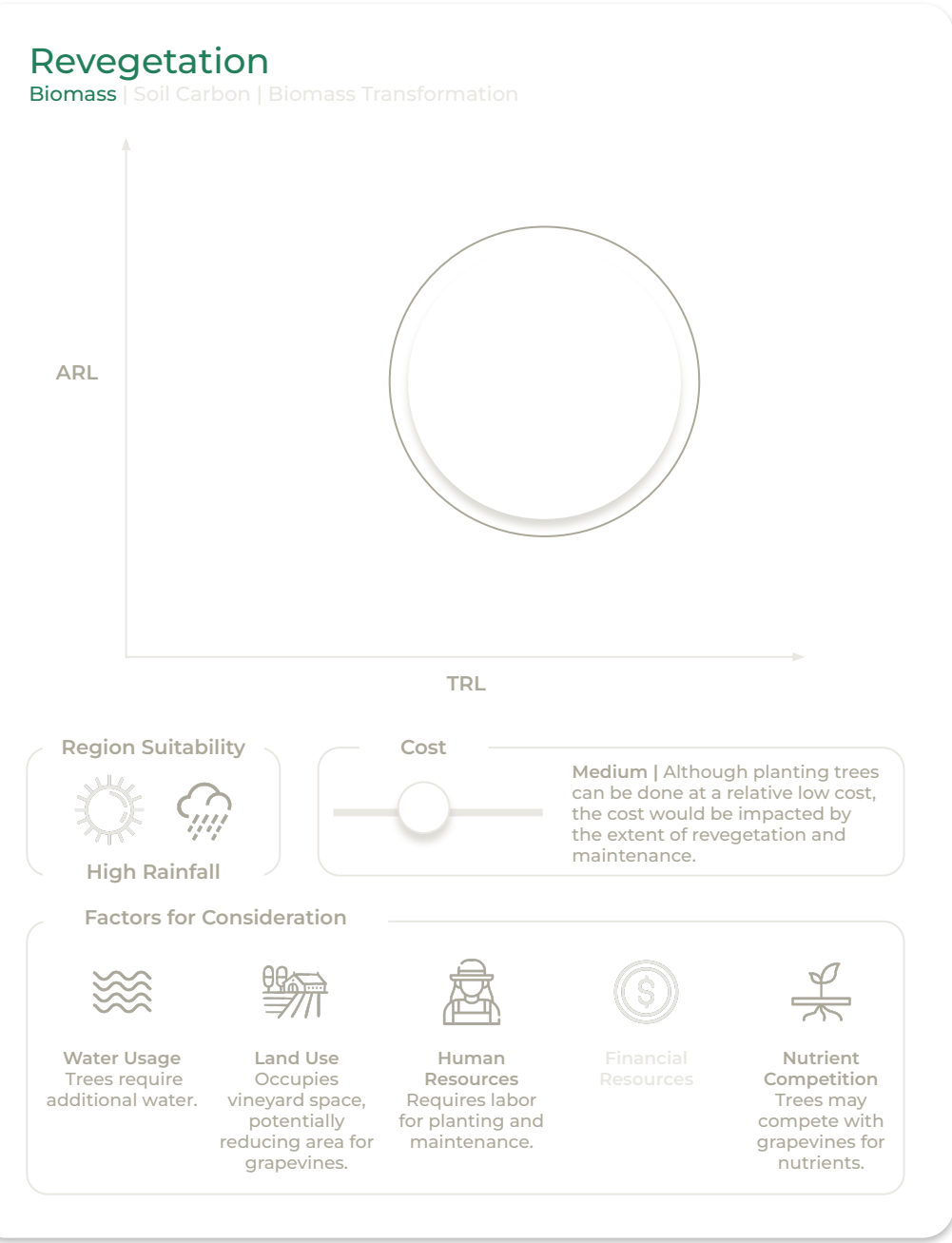
- **Time Intensive:** Planting, maintenance and data collection are lengthy processes.
- **Tree Species:** Selecting the right type of tree is imperative, as non-native species may outcompete the local forest. Only three species are approved currently.
- **Method Expiry:** The two current ACCU-scheme methods will both expire by 2025, but the scheme administrators are currently writing new versions of revegetation methods.

Interventions

1. Technical assistance for planning and implementation.
2. Financial support or incentives for initial setup.
3. Long-term (>25 year) monitoring and support to ensure success

Underlying measurement methodologies

- Reforestation by environmental or mallee plantings FullCAM method 2014
- Reforestation and afforestation method



Biomass **Cover Crops**

Cover cropping involves planting specific types of plants (such as commercial pasture species or native grasses or forbs) between the rows of grapevines and/or in the under vine area. These plants increase biodiversity and assist in mitigating soil erosion, recycling nutrients and water, controlling weed growth, and add soil organic matter. Cover crops are an important soil carbon sequestration strategy

Adoption Readiness
High: Widely known and practiced, easy to implement, low cost.

Technology Readiness
High: Mature practice, well-documented benefits.

Risks

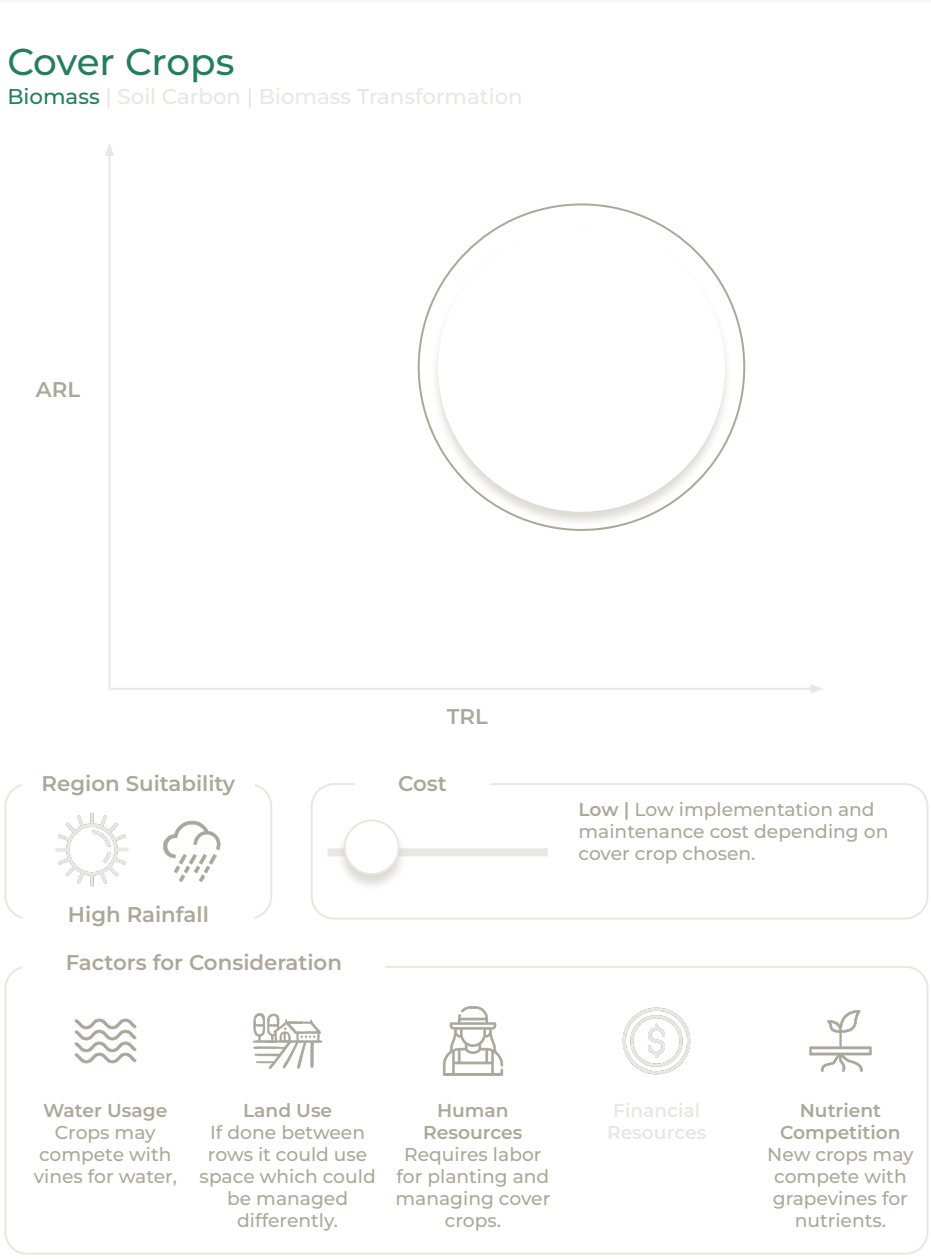
- **Soil:** Soil characteristics can affect cover crop performance, for example, poor drainage can restrict growth and potential benefits.
- **Pests:** Cover crops can attract both beneficial insects and pest species.
- **Resource competition:** Wrong species selection can result in competition with the vine when resources such as soil moisture are limited.

Interventions

1. Education and awareness programs on benefits.
2. Financial incentives or subsidies for cover crop seeds.
3. Demonstration projects showcasing successful implementation.

Underlying measurement methodologies

- Estimating soil organic carbon sequestration using measurement and models method (2021)



Soil Carbon **Enhanced Mineral Weathering**

Enhanced weathering is a carbon capture technology that accelerates natural weathering processes, involving the chemical and physical breakdown of rocks, to extract CO2 from the atmosphere. During this process, silicate rock weathering interacts CO2, converting it into bicarbonate ions, leading to carbon sequestration.

Adoption Readiness
Low: Emerging technique, limited awareness, and higher costs.

Technology Readiness
Low: Promising technology but requires more research and field trials.

Risks

- **Energy and Pollution:** High energy demands of are required for pulverising rocks. A potential downside of enhanced mineral weathering is that the extracting, grinding, and transporting of suitable rock requires significant energy, much of which comes from fossil fuels that contribute to climate pollution.
- **Safety:** Silicates contain elements such as chromium and nickel, which can surpass safe levels when applied to an agricultural field in large quantities.
- **Quantity:** Large amounts of minerals will require in order to draw down meaningful amounts of carbon.

Interventions

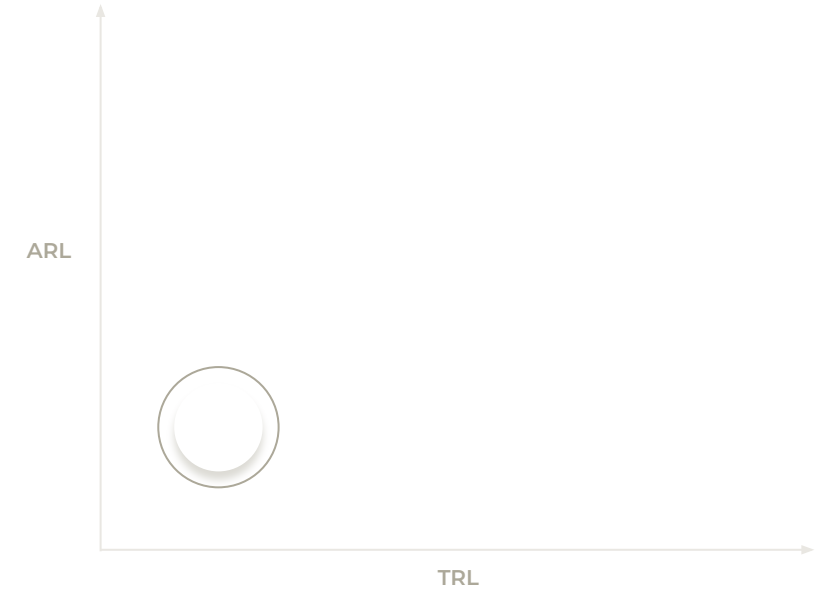
1. Research and field trials to validate effectiveness.
2. Financial incentives or subsidies for initial trials.
3. Education on benefits and application methods.

Underlying measurement methodologies

- No ACCU Scheme methods

Enhanced Mineral Weathering

Biomass | Soil Carbon | Biomass Transformation



Region Suitability

Any region

Cost

High | Current high costs to run as the technology, benefits and best practice are still under development.

Factors for Consideration

Water Usage

Land Use

Human Resources
Labor for application as well as sourcing and transporting silicate rocks.

Financial Resources
High initial cost for minerals and application.

Nutrient Competition

Biomass Transformation **Pyrolysis Biochar**

Biochar is a stable carbon-rich form of charcoal that can be applied to many practices to reduce net greenhouse gas emissions. It is produced by pyrolysis, a method involving the heating biomass (Biomass: plant or animal waste) at temperatures exceeding 250°C in a low or oxygen-free environment. Although a primary use case for biochar is returning it to the soil, it was not included in 'soil carbon' as it has many use cases around the vineyard. Ways biochar can be used include water filtration, animal feed, composting, construction materials, pollution remediation, energy production and has the potential to reduce fertiliser requirements while maintaining crop productivity, or increase crop yields at lower rates of fertiliser use.
One ton of biochar sequesters carbon equivalent to 3.6 tons of carbon dioxide that would otherwise be emitted through natural degradation processes. Biochar, as a thermochemical conversion product, not only repurposes waste but also effectively captures carbon, storing it in a stable solid form that can remain intact for centuries.

Adoption Readiness
Medium: Growing interest, but less widespread use and higher costs.

Technology Readiness
Medium: Proven benefits but still under research for optimal use.

Risks

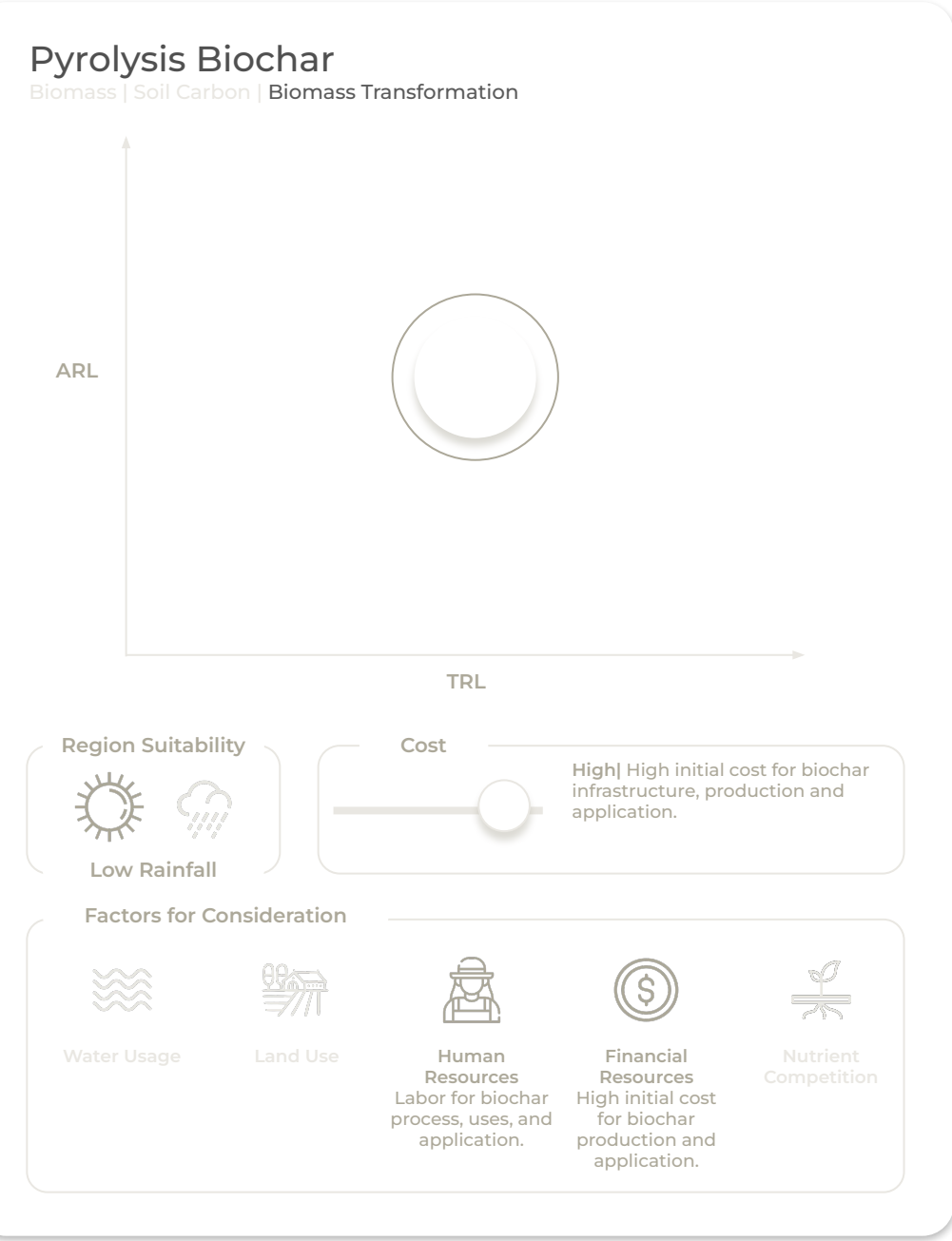
- **Biochar combination:** Not all soil and biochar combinations will provide a positive result.
- **Soil microbial:** Biochar can cause changes to soil microbial communities and their abundance.

Interventions

1. Research and trials to refine biochar application methods.
2. Subsidies or cost-sharing for biochar production.
3. Training on biochar benefits and usage.

Underlying measurement methodologies

- No ACCU Scheme methods
- Some developments in other measurement methodologies such as Puro.Earth



Blue sky carbon sequestration technologies

Below is a table including additional technologies that are emerging in the market that may be worth monitoring for the wine industry as the technologies progress.

Technology	TRL	ARL	Description
Bioenergy with Carbon Capture and Storage (BECCS)	6-7	Medium	BECCS involves capturing CO_2 from bioenergy processes and storing it. It is at the demonstration stage with several projects in operation.
Agro-Sequestration	5-6	Medium	Growing biomass crops for carbon capture and burying them in biolandfills. Still in the early stages of demonstration and requires further development.
Enhanced Rock Weathering (ERW)	4-5	Medium	Spreading crushed silicate minerals on soils to capture CO_2. Early-stage technology with ongoing research and small-scale trials.
Direct Air Capture (DAC)	6-7	Medium	Captures CO_2 directly from the atmosphere. Several pilot projects are operational, but large-scale deployment is limited by high costs.
Carbon Capture and Utilisation (CCU)	6-8	Medium	Captures CO_2 for conversion into useful products. Various applications are in the demonstration and early adoption stages. Potential source of CO2 from within the supply chain is fermentation CO2 produced during winemaking.
Microbial-Based Carbon Sequestration	4-5	Medium	Uses microbes to sequester carbon in soils. Early-stage technology with promising research but limited large-scale application.
Chemical Looping	6-7	Medium	Uses metal-based particles to capture CO_2 during combustion. Demonstrated at pilot scale but not yet widely adopted.
Cryogenic Carbon Capture (CCC)	5-6	Medium	Uses cryogenic cooling to capture CO_2. Early-stage technology with ongoing research and pilot projects.
AI-Powered Satellite Data Analytics	7-8	Medium	Uses AI and satellite data to monitor and manage soil carbon. Widely used in precision agriculture with increasing adoption.
Carbon Capture Infrastructure	8-9	Medium	Infrastructure for CO_2 transport, storage, and utilisation. Mature technology with several large-scale projects in operation.

05 Schemes

Now that we understand how to capture carbon in the vineyard, the next step for vineyard owners is to measure, report, and verify the carbon stored to capture value from it. This next section discusses the various schemes and certifications available to Australian vineyards.



System Integrity

There are two MRV (Measurement, Reporting, and Verification) streams a vineyard owner can follow:

High Integrity MRV Stream (Regulatory): This stream involves more rigid and costly processes but allows carbon offsets to be monetised by meeting the requirements of recognised schemes and certifications. It requires thorough research and compliance but will safeguard access to international markets and reduce long-term risks for organisations in a rapidly evolving sustainability policy landscape.

Low Integrity MRV Stream (Voluntary): This stream offers lower measurement, reporting, and verification costs and greater flexibility but does not allow for the direct monetisation of offsets. It is targeted at values-driven branding and marketing.

This section will outline the schemes and certifications available in the high integrity MRV stream to Australian vineyards. Below are the options available, and the following pages will detail what they are. This framework sets the stage for the next section, which will cover methodologies for measuring stored carbon on farms to meet the criteria for these schemes and certifications.

Carbon Sequestration Schemes for Participation by Vineyards

- **The Australian Carbon Credit Unit Scheme**
- **The Gold Standard**
  International
- **Verra Verified Carbon Standard**
  International
- **TOITŪ Envirocare**
  New Zealand

Emissions Accounting Certifications for Participation by Vineyards

While the focus of this report is participation in emissions reduction by increasing carbon sequestration within vineyards, we have summarised some important emissions accounting frameworks that Australian vineyards should consider participating in.

- International Wineries for Climate Action (IWCA) Membership
- Climate Active
- Sustainable Winegrowing Australia (SWA)

Carbon Sequestration Schemes for Participation by Vineyards

The Australian Carbon Credit Unit Scheme

The Australian Carbon Credit Unit (ACCU) Scheme is a Commonwealth Government-backed scheme that incentivises emissions reduction practices by individuals and businesses. The ACCU Scheme is enacted through the Carbon Credits (Carbon Farming Initiative) Act 2011, the Carbon Credits (Carbon Farming Initiative) Regulations 2011 and the Carbon Credits (Carbon Farming Initiative) Rule 2015. Under the ACCU Scheme, there are a variety of eligible methodologies from which scheme participants can generate ACCUs for reducing, sequestering or avoiding greenhouse gas emissions. CO2 Australia has delivered and managed vegetation method projects, including reforestation, revegetation and protection of native forests, under the various Australian Government carbon schemes since the first registered project in 2007. Each methodology has a set of eligibility requirements that must be met in order for a land parcel to become a registered carbon project under that set method.

Benefits
Robust and regulatory
Bespoke to Australian ecosystems
10+ years of administration
Innovation from leading scientists and practitioners

Disadvantages
Entry barriers (cost, expertise)

The Gold Standard
International

The Gold Standard (GS) is a non-government organisation certification body that aims to establish an international standard for emissions reduction programs which are not affiliated with a country's governmental legislation (e.g. the Australian Clean Energy Regulator). The GS ensures validity of carbon credits and is globally recognised as the prime example of voluntary carbon credit verification, in part due to the frequent and extensive audit processes. The GS is typically applied in situations where carbon credits can be utilised as a financial tool for sustainable development in lower socioeconomic settings and has been used by over 500 project developers to design more than 3,400 projects in over 100 countries. Projects certified under the GS are to create measurable impacts in alignment with the United Nation's Sustainable Development Goal priorities. There is currently only one listed project in Australia that has been certified by the GS.

Benefits
International credibility
Connected to World Wildlife Fund
Connected to UN Sustainable Development Goals

Verra Verified Carbon Standard
International

Verra is the administrator for the Verified Carbon Standard (VCS), a global offset scheme allowing the crediting of greenhouse gas abatement. Verra offers an international voluntary carbon crediting program that helps finance international reduction and removal of emissions, along with supporting livelihoods and benefiting nature. Verra offers a wide range of methodologies, which are frequently added to and can be applied to various carbon offsetting schemes. It should be mentioned that the global attitude towards Verra and its VCS has soured due to alleged flaws in the standard and significant over-estimations of carbon sequestration rates. However, due to its versatility in methodologies, a project accredited by the VCS may be viable in both terrestrial and blue carbon sequestration scenarios.

Benefits
International credibility
Good marketing

Disadvantages
Recent stories around exposing lack of genuine sequestration.

Readers are advised to consult a licensed carbon market expert or financial advisor to determine the suitability of participating in this scheme based on their specific situation.

Carbon Sequestration Schemes for Participation by Vineyards

TOITŪ Envirocare
New Zealand

Toitū Envirocare's Carbon Programmes and Certification schemes support organisations to measure their greenhouse gas emissions, and put in place strategies to manage, reduce and offset impacts. Toitū Envirocare offer three levels of certification including:

- **Toitū carbonreduce certification;**
- **Toitū net carbonzero certification; and**
- **Toitū climate positive certification.**

Toitū offer tools to measure an organisation's emissions and set realistic goals to reduce future emissions. To verify results are accurate and complete, an independent audit is arranged by Toitū and verified annually to maintain certification. Any remaining emissions may be offset through carbon credits.

Toitū Carbonreduce Certification
This certification involves quantifying greenhouse gas emissions and implementing strategies to manage and reduce their impacts. Toitū provides tools designed to support the organisation undertaking the project. Certification is in accordance with ISO 14064-1 or ISO 14067, allowing the organisation to make carbon claims with confidence in any market. Compliance with the program is independently verified annually.

Toitū Carbonzero Certification
The Toitū Net Carbonzero Certification offers evidence that an organisation is actively contributing to the environment through measuring, reducing, and offsetting their carbon footprint. To attain this certification, an organisation measures all operational greenhouse gas emissions in accordance with the international standard for carbon footprints (ISO 14064-1). This certification is similar to the Toitū Carbonreduce Certification. The key difference is that all emissions are offset through verified carbon credits to achieve carbon neutrality. The organisation would also be certified in accordance with ISO 14064-1 or ISO 14067, and the organisation must reduce emissions on a six-year cycle.
Toitū uses carbon credits from varying projects, of which have been audited extensively to ensure for high integrity behind the credits. All projects are endorsed by the International Carbon Reduction and Offset Alliance. Verified carbon credits are purchased by Toitū from registered projects who have satisfied the conditions to become Carbonzero certified.

A carbon credit (equal to 1 tonne of CO2e) is awarded to projects that store or avoid greenhouse gas (GHG) emissions in the atmosphere. Retiring one carbon credit, on a reputable registry, balances the atmospheric impact of emitting one tonne of greenhouse gases (in CO2e).2

Toitū Climate Positive Certification
This certification involves following Toitū's framework for action, which facilitates organisations to take science-led and ambitious climate action, aligned with international standards. Toitū accurately measures companies' emission, and implement strategies to manage, reduce and offset impacts. Certification is in accordance with ISO 14064-1 or ISO 14067, allowing the organisation to make climate positive claims with confidence in any market.

Benefits
Permits insetting
Selection of own, rigorous, calculation scheme

Emissions Accounting Certifications for Participation by Vineyards

International Wineries for Climate Action (IWCA) Membership

International Wineries for Climate Action (IWCA) is a non-profit collaborative working group of environmentally committed wineries taking a science-based approach to reducing carbon emissions across the wine industry. The membership program features a three-tier approach, including gold, silver and applicant levels, of which works in accordance with the Greenhouse gas (GHG) Protocol. This protocol serves as a globally renowned benchmark for tracking and overseeing greenhouse gas emissions for businesses and organisations. The protocol provides a structured approach to gauge, disclose, and control emissions. The protocol was developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD).

Climate Active

Climate Active is Australia's only government accredited carbon neutral certification scheme. It supports the national climate policy through encouraging voluntary climate action by Australian businesses. The Climate Active certification is granted to organisations that have credibly achieved carbon neutrality in accordance with the criteria outlined in the Climate Active Carbon Neutral Standard.

To become carbon neutral, businesses and organisations calculate the greenhouse gas emissions generated by their activity, such as fuel or electricity use and travel. They reduce these emissions where possible by investing in new technology or changing the way they operate. Wine Australia can claim carbon neutral certification from Climate Active if all emissions are offset/abated.

Sustainable Winegrowing Australia (SWA)

Sustainable Winegrowing Australia (SWA) is a sustainability program for the Australian wine industry, focusing on environmental, social, and economic practices. It supports vineyards and wineries in reducing their environmental impact and enhancing sustainability through measurable and transparent actions. The SWA certification is awarded to organisations that meet specific sustainability criteria, including the management of resources, reduction of greenhouse gas emissions, and improvement of biodiversity.

To achieve SWA certification, vineyards and wineries must assess their greenhouse gas emissions from activities like fuel or electricity use and implement strategies to mitigate these emissions. This includes adopting sustainable practices such as carbon insetting, energy efficiency, and waste management. By achieving SWA certification, Australian wine producers demonstrate their commitment to sustainability, aligning with both national and international market expectations and enhancing their competitive advantage.

06 Methodologies

Methodologies are the way that carbon sequestration (typically measured in tonnes of CO2 equivalent) is calculated. They are developed by a variety of proponents, but always technical experts.

For the wine industry, selecting a methodology means choosing a way to calculate the carbon sequestered on the vineyard. A method explains what the eligibility requirements are, and what activities and measurements are in and out of scope for the calculations.

The prior sections discussed technologies to sequester carbon and schemes available to australian vineyards, this section will outline the verified methods measure the carbon stored under the schemes as well as emerging methodologies.

Methodologies Overview

Under the schemes outlined before, there are various methodologies that are verified in measuring the amount of carbon sequestered on the vineyard. A high level map of this can be found below and in depth descriptions of each will be detailed out in the following pages.

The Australian Carbon Credit Unit Scheme

| The ‘Environmental Planting’ method

| The ‘Reforestation and Afforestation’ method

| The ‘Plantation Forestry’ method

| The proposed ‘Integrated Farm and Land Management’ method

| The ‘Soil Carbon’ method

Verra Verified Carbon Standard
International

| VM0007 REDD+ Methodology Framework (REDD+MF), v1.7

The Gold Standard
International

| Methodology for Afforestation/Reforestation (A/R) GHGs Emission Reduction & Sequestration

Methodology Review of Carbon Sequestration Opportunities for Vineyards

The Australian Carbon Credit Unit Scheme
Australian Government Clean Energy Regulator

The 'Environmental Planting' method

Projects registered under the Reforestation by Environmental or Mallee Plantings FullCAM method 2014 store carbon through the planting of native tree species to establish forest cover. The species of tree and arrangement of trees (e.g., groups or multiple lines) within the project area determine how much carbon is stored in the established forest. The trees must be planted at a density that allows them to reach Kyoto Protocol defined forest cover, which is 20 percent cover of trees at least 2 metres in height.

The FullCAM is a calculation tool for modelling Australia's greenhouse gas emissions from the land sector. Inputs to the FullCAM modelling for the Environmental Planting methodology include the size of the areas where trees are planted, management actions and confirmation that the trees are not being disturbed. Under the method, monitoring is conducted at least annually to confirm effective storage of the carbon, lack of disturbance and to collect evidence of tree growth overtime. If tree survival is reduced in an area, replanting of tube stock can occur or these areas can be removed from the carbon estimation areas. Careful tracking of management actions is required, as management such as weed control can provide a boost in ACCU during a crediting period. There are specific requirements for these plantings, which are relevant depending on the selection of block or belt (linear) planting. These specifications include spacing between plants and the size of the planting areas.

To be eligible for this method:

- FullCAM data must be available in the area,
- Planting areas must have been clear of forest for at least five years before project registration, and
- There must be no woody or invasive shrub species that need to be cleared prior to planting.

This method is due to expire in October 2024. It is currently under review by the Commonwealth Government and is most likely to be re-established as a very similar Environmental Planting method 2.0.

The 'Reforestation and Afforestation' method

Projects under the Carbon Credits (Carbon Farming Initiative) (Reforestation and Afforestation) Methodology Determination 2013 (Reforestation and Afforestation method) can generate ACCUs by planting trees of specific species to establish a permanent forest. Reforestation is the restoration of previously forested land back to forest whereas afforestation is the establishment of new forest in an area that was not forested. The method may be suitable for areas where seeds/seedlings can be planted to establish a permanent forest on grazed, cropped or fallow land. The difference between these two methods can be found in appendix 4.

To be eligible, land must have been grazed, cropped or fallow for the past five years and be able to support the growth of new forest. The plantings cannot be harvested or planted as a landscape planting. Exceptions to harvesting include:

- Thinning for ecological purposes;
- Removing debris for fire management;
- Removing firewood, fruits, nuts, seeds or material for fencing or craft, as long as items aren't removed for sale; and/or
- Removing material in accordance with traditional First Nations practices or native title rights.

Methodology Review of Carbon Sequestration Opportunities for Vineyards

The Australian Carbon Credit Unit Scheme *Continued*

Australian Government Clean Energy Regulator

The 'Plantation Forestry' method

The Carbon Credits (Carbon Farming Initiative—Plantation Forestry) Methodology Determination 2022 (Plantation Forestry method) provides opportunities for the plantation forestry industry to participate in the ACCU Scheme. A project under the 2022 Plantation Forestry Method will accumulate or sequester carbon as the trees grow. Carbon stored in debris and harvested wood products (where relevant) will also be accounted for.

The abatement calculations under the method also account for carbon stock changes and emissions due to management activities such as thinning, pruning, harvesting, fertilising and controlled burning, and material emissions from fossil fuel use.

Two activities have been retained from Carbon Credits (Carbon Farming Initiative—Plantation Forestry) Methodology Determination 2017 (the 2017 Plantation Forestry method) establishing a new plantation and conversion from short rotation to long rotation. There are also two new activities that can generate ACCUs for retaining forest where the land would have otherwise been converted to non-forested land. These activities maintain permanent not-for-harvest plantings or continue plantation activities, where the avoided conversion of plantation land is demonstrated to be additional and go beyond business-as-usual activity.

It should be noted that this method may require approval by some councils as it could be classed as a change in land use.

This method is more suited toward the timber industry rather than vineyards.

The proposed 'Integrated Farm and Land Management' method

The Integrated Farm and Land Management Methodology is holistic agricultural production and land management method that considers vegetation and soil methods. This integration of 'whole-of-landscape' management practices allows land managers to receive carbon credits for multiple carbon farming activities on a single property. The aim of this method is to realise an increase in carbon abatement on a single property and enable participation of smaller land managers under the ACCU Scheme.

The method has been in development for a number of years and holds substantial capacity to the grow the carbon market. It is an active point of focus for the current Department of Climate Change, Energy, the Environment and Water. As the Integrated Farm and Land Management method is yet to be released, its final details such as calculation methods and carbon abatement estimates cannot be known. CO2 Australia is part of a taskforce developing and finalising the method and remain up to date on any changes to the method's construction and release date.

Additional information:

- Not enough information on the proposed method. Important for WA to track opportunities.
- Best opportunity would be to utilize 'stacking' of vineyard emissions reduction with soil carbon through this method in a few years time

Methodology Review of Carbon Sequestration Opportunities for Vineyards

The Australian Carbon Credit Unit Scheme *Continued*

Australian Government Clean Energy Regulator

The 'Soil Carbon' method

The Carbon Credits (Carbon Farming Initiative – Estimation of Soil Organic Carbon Sequestration using Measurement and Models) Methodology Determination 2021 allows generation of carbon credits from projects that store carbon in agricultural soils. Carbon sequestration estimates are made through soil sampling, sometimes with additional models to enhance predictions. There are specific requirements for the soil sampling method, including for contractors to conduct the soil sampling and to write the land management plans, and for accredited laboratories to calculate the stored carbon.

Reporting periods are between one and five years and require an intensive data collection period to determine the amount of organic carbon in the soil.

The list of eligible management activities that can be used in isolation or together include:

- Synthetic or non-synthetic fertiliser to address a material deficiency;
- Applying lime to remediate acidic soils;
- Applying gypsum to remediate sodic or magnesic soils;
- Applying new or additional irrigation obtained through improving efficiency of existing on-farm infrastructure and/or management practices;
- Re-establishing a pasture by seeding or pasture cropping;
- Establishing a pasture where there was no, or limited, pasture previously;
- Altering stocking rate, duration or intensity of grazing to promote soil vegetation cover and soil health;
- Retaining stubble after crop harvesting;
- Converting to reduced or no tillage practices;
- Modifying landscapes for remediation;
- Using mechanical means to add or redistribute soil through the soil profile;
- Using legume species; and/or
- Using cover crops to promote soil vegetation cover and soil health.

Land must meet eligibility requirements to run a soil project on it. Land is eligible if:

- It is used for pasture, cropping, perennial horticulture (such as grapevines) or is a bare fallow during the baseline period
- Soil carbon can be increased through new land management activities
- The area can be accessed to sample the soil
- There is at least 30 cm of soil

Eligible land can be included in carbon estimation areas (CEA) when project mapping is undertaken.

Land is ineligible if it:

- Is forest land, or has forest potential, and participates in another ACCU Scheme sequestration method that is not a spoil method
- Has buildings
- Contains organosols (peat soils)
- Was subject to clearing of native forest cover or draining of a wetland within 7 years prior to registration application. This exclusion period is reduced to 5 years for properties that have changed ownership since the cleaning or draining.

This method is best suited for change in management practices which benefit increased soil health and most advantageous for those who have not yet started changing to "green" practices.

Methodology Review of Carbon Sequestration Opportunities for Vineyards

The Gold Standard
International

Methodology for Afforestation/Reforestation (A/R) GHGs Emission Reduction & Sequestration

This methodology aims to enable A/R activities to quantify and certify emissions sequestration impacts. In turn this allows the Project to access Gold Standard Voluntary Emissions Reductions (VERs) as per the Gold Standard Emissions Reduction and Sequestration Product Requirements. VERs operate independently of government obligations under the Kyoto Protocol and enable individuals to voluntarily offset their emissions.

Verra Verified Carbon Standard
International

VM0007 REDD+ Methodology Framework (REDD+MF), v1.7

This method intends to reduce emissions from deforestation and forest degradation (REDD). The modules, when used together, quantify greenhouse gas emission reductions and removals from avoiding unplanned and planned deforestation and forest degradation. This methodology is applicable to forest lands, forested wetlands, forested peatlands and tidal wetlands that would be deforested or degraded in the absence of the project activity.

Emerging Methodologies **Development**

Development of a proponent-led methodology under the ACCU Scheme

Wine Australia may choose to invest in developing a carbon insetting methodology tailored to the grape and wine businesses that can be relatively easily replicated across locations. This can be done in accordance with the Department of Climate Change, Energy, the Environment and Water 'Method Development Interim Framework'. This framework provides interim guidance for proponents to follow when proposing and developing methods and modifications until the new Carbon Abatement Integrity Committee replaces the Emissions Reduction Assurance Committee.

The first stage would involve an expression of interest (EOI) that outlines the method or module concept. The Carbon Abatement Integrity Committee would then triage EOIs to assess the method or module proposals that can be progressed for development. Although this may be time-consuming initially, having a proponent-led method that has been developed in collaboration with involved wineries may enhance not only participation/willingness, but also replicability and efficiency later on.

Development of a proponent-led methodology through Gold Standard

The Gold Standard Scheme offers a platform for a proponent to develop their own methodology, however it seems that the procedure is currently open for public consultation. This can be revisited once finalised if the Gold Standard is of interest to Wine Australia.

Development of a proponent-led methodology through Verra

New ideas/methodologies can be developed through Verra's Methodology development and review process. As outline in the process, steps to apply are as follows:

1. Stakeholder submits a methodology idea note;
2. Verra reviews the methodology idea note to determine priority and the appropriate development pathway;
3. Methodology developer submits methodology concept note;
4. Verra reviews methodology concept and determines if it can proceed to the next stage;
5. Methodology developer prepares and submits the draft methodology, methodology revision, module, or tool and draft project description (if applicable);
6. Verra reviews the draft methodology, module, or tool;
7. Verra conducts public consultation;
8. Methodology developer contracts validation/verification body (VVB);
9. VVB assesses the new or revised methodology, module, or tool and produces an assessment report; and
10. Verra reviews updated methodology, module, or tool and VVB assessment report and determines if it can be approved.

Emerging Methodologies **Innovation in the Wider Agriculture Sector**

The 'Fertiliser in Irrigated Cotton' method

Established in 2014, a methodology focusing on fertiliser efficiency in irrigated cotton was implemented, with the objective of supporting the agricultural sector. This method is recognised within the framework of the Australian Carbon Credit Unit Scheme. Through the irrigated cotton method, projects can accrue ACCUs by using a nitrogen fertiliser in cotton irrigation.

Livestock

The Australian Red Meat Industry developed their "Carbon Neutral by 2030 Roadmap (CN30)" to promote sustainable food production regarding greenhouse gas emissions. The roadmap presents industry stakeholders with the chance to access and apply relevant information on how to reduce emissions, shaping both current decisions and future actions. According to analysis undertaken by CSIRO, the Australian red meat industry's proportion of national GHG emissions has reduced from 21% in 2005 to 10% in 2017. This continued reduction in emissions is primarily due to changes in land management practices such as planting shrubs, pastures and legumes that lower enteric methane emissions, as well as establishing plantings that not only build feedbase and carbon stocks, but also store carbon in woody biomass – similar to what would happen in the case of the Environmental Plantings methodology.

Puro.Earth | Biochar

In 2019, Puro.Earth introduced the first carbon removal crediting methodology for biochar to the market. Aligned with the IPCC's carbon removal definition, the Puro Standard grants CO_2 Removal Certificates (CORCs) to carbon removal suppliers via the Puro Registry. Climate-conscious companies can purchase CORCs to offset their emissions and support their sustainability assertions.

LOOC-C

The Landscape Options and Opportunities for Carbon Abatement Calculator (LOOC-C) is an online tool that allows landowners to assess what Emission Reduction Fund might be suitable and offers reliable estimates of potential carbon abatement. It estimates greenhouse gas (GHG) abatement via an emission factor database and GHG emission models such as FullCam. The output includes eligible carbon project types and estimates of Australian Carbon Credit Units that each project may generate.

Methods available through LOOC-C include:

- Measurement of soil carbon sequestration
- Estimating sequestration of carbon in soil using default values method (model-based soil carbon)
- Reforestation by environmental or mallee plantings – FULLCAM
- Human-induced regeneration of a permanent even-aged native forest
- Native forest from managed re-growth
- Avoid clearing of native regrowth

Downforce Technologies

Downforce Technologies provides a remote and cost-effective process to measure soil health, carbon stocks, biodiversity health, water holding capacity and erosion rates in as small as 10 metre plots. Services by Downforce Technologies may include:

- Comprehensive, high quality metrics including soil health, carbon, water, erosion, biodiversity and landscape health.
- Planning and implementing projects at scale with comparable data and consistency across different geographies.
- A rapidly deployable remote process.
- Potential to aggregate multiple smaller, distributed sites as well as tackle large scale areas around infrastructure assets.
- Can support any type of land regeneration or carbon project.
- Essential land behaviour analytics to maximise return on investment and minimise implementation risks.

Emerging Methodologies **Innovation in the Wider Agriculture Sector**

Unmanned Aerial Vehicle assessment tools

Within the agricultural sector, Unmanned Aerial Vehicles (UAV) (UAVs) are becoming highly sought after as a cost-effective, remote monitoring tool for properties. There is an untapped potential to utilise datasets gathered through UAV, to derive very high spatial resolution digital soil carbon maps at farm scales. These UAV-borne systems are less impacted by cloud cover and additional radiometric calibration steps generally required by passive remote sensing satellite systems such as Sentinel 2/Landsat.

Studies have suggested that soil organic matter – a critical indicator of soil nutrient levels, which can be used to estimate soil organic carbon, can be incorporated via machine learning through UAV imagery to generate outputs of soil carbon estimations. Further exploration into using UAVs for property monitoring in the context of carbon insetting may present a viable option so as not to impede on the operations of wineries or demand too much physical labour for the necessary data collection.

CO2 Australia has experience in operating drones; however, this experience currently does not extend to measuring soil carbon. Should Wine Australia be interested in pursuing the use of UAVs as an assessment tool, it may be ideal to partner with a drone flying service provider that specialises in agricultural settings and in the measurement of environmental conditions. Further investigation by CO2 Australia can be undertaken, should this be of interest.

FLINTpro

FLINTpro is a commercial online platform that provides critical information on nature-based metrics. In the Australian context, FLINTpro has been developed to reflect the forest growth models that underpin FullCAM. This allows for replication of FullCAM's growth of environmental plantings (EP), human induced regeneration (HIR), native forest and mallee species, as well as plantation species based on the anticipated updates.

The FLINTpro approach allows for efficient modelling of:

- Impacts of disturbance events that result in forest cover loss;
- Changes in management activities that result in forest cover gains; and fire event impacts.

The results are suitable for abatement potential assessments, due diligence for carbon projects, as well as forest carbon baseline assessments. While FLINTpro replicates the growth curves of FullCAM, it is not considered as 'FullCAM' by the Clean Energy Regulator, and as such cannot be used for reporting under the ACCU Scheme.'

Emerging Funds **Investment Groups**

Below are four emerging investment groups looking to supporting and promoting insetting methodologies and technologies.

Pollination

Climate change/net zero investment and advisory firm

Pollination Foundation is a not-for-profit partnering with Indigenous and community groups

“Connecting practitioners creating landscape scale nature-based initiatives for peer-to-peer learning and leadership support”

Projects

Main Sequence Ventures (co-founded by CSIRO)

Founded to bridge research with commercialisation

“Decarbonise the Planet”: carbon sequestration, renewable energy-powered industrial processes, low carbon footprint food tech

Portfolio examples:

- Loam Bio: microbial tech capturing carbon in agricultural soils
- number8bio: ag sector decarbonisation with synthetic biology
- Varden: sustainable packaging
- Regrow: regenerative agriculture

Clean Energy Finance Corp

“Australia’s ‘green bank’, investing Towards ZERO to capture the benefits of the net zero future”

Primarily energy sector - decarbonisation, energy tech, renewable/clean energy (ARENA)

Case studies

Virescent Ventures (part of CEFC)

- investment focus areas: clean energy transition, smart cities, food and agriculture (“enrich and build resilient soils”), circular economy/industry

- manage the Clean Energy Innovation Fund on behalf of CEFC which aligns companies with climate tech investors

Wollemi Capital

Global climate specialist investment firm investing in food and agriculture, energy transition, climate services

Work includes soil carbon (Loam Bio), nature-based climate solutions and carbon credits, carbon-fixing microbes

Summary Table

Capture Type	Method	Potential	Land conditions for suitable projects	Length of storage	Required paid resources	Primary benefit	co-benefit	Risks
Soil Carbon	Soil carbon method - ACCU Scheme	Approved method	Ability to change management actions, any land	25 or 100 years	Consultant, Contractors, Measurement tools (e.g. data)	Generation of carbon credits through sequestration of carbon in agricultural soils	Soil health	Rigour of method; validity of data collection methods
	Soil Carbon method - International	Approved methodologies exist dependent on chosen verification body	Ability to change management actions, any land	Varies based on Verification Body	Consultant, Contractors, Measurement tools (e.g. data)	Carbon sequestration and carbon credit generation	Utilisation of UN's SDG's, Increased biodiversity	Reputation of body issuing credits; validity of data collection methods
	Cool Farm Tool	Technology accepted amongst agricultural sector	Understanding of harvested yield, total growing area, fertiliser applications, crop protection active ingredient and rate of application, energy use, and transport use	NA	Consultant, Contractors, Measurement tools (e.g. data)	Relatively easy method of calculating ideal agricultural practices to reduce carbon emissions.	Minimised sampling costs	Accuracy
Biomass	The 'Environmental Planting' method	Method will sunset on 30 September 2024. New determination date release unknown	Large, unvegetated site, high rainfall	25 or 100 years	Consultant, Contractors, Measurement tools (e.g. data)	Store carbon through the planting of native tree species to establish forest cover.	Increased biodiversity	Potential increase in water usage, pests and disease, weeds
	The ACCU-scheme proposed 'Integrated Farm and Land Management' method	Method is under development; economic potential for similar project activities (e.g. Human-Induced Regeneration is well vetted)	Large, unvegetated site, high rainfall	25 or 100 years	Consultant, Contractors, Measurement tools (e.g. data)	Allows land managers to receive carbon credits for multiple carbon farming activities on a single property.	Increased biodiversity	Potential increase in water usage, pests and disease, weeds
	The 'Reforestation and Afforestation' method		Large, unvegetated site, high rainfall	25 or 100 years	Consultant, Contractors, Measurement tools (e.g. data)	Generate ACCUs by planting trees of specific species to establish a permanent forest	Increased biodiversity	Potential increase in water usage, pests and disease, weeds

Credibility vs Cost Considerations

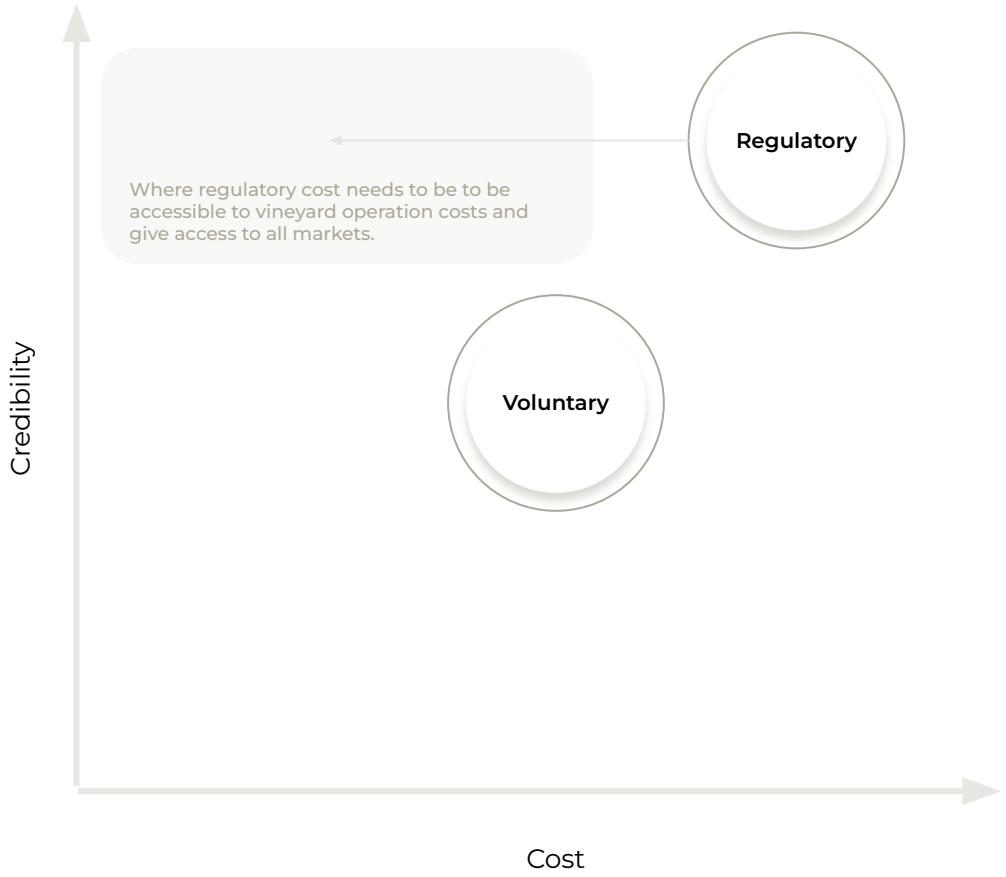
A business seeking to validate their carbon insetting activities needs to consider the tradeoff between external credibility and the cost you are willing to pay for that credibility.

Key considerations for choosing a scheme (certifier) and method (calculation tool):

1. Understand how and where the carbon is being stored.
2. Gain a basic understanding of the science behind the calculations.
3. Confirm that calculations are verified by a third party before credits are issued.
4. What evidence is there that the sequestration is occurring?

We used these criteria to evaluate the credibility of annual costs to administer certification under some of the most well-known schemes. It was found that prices and information on credibility is tightly protected, so the results were unable to be validated.

It is highly recommended more work to be done to uncover scheme cost vs credibility, and which ones will meet certain international market requirements.



07 Opportunity & Investment Roadmap

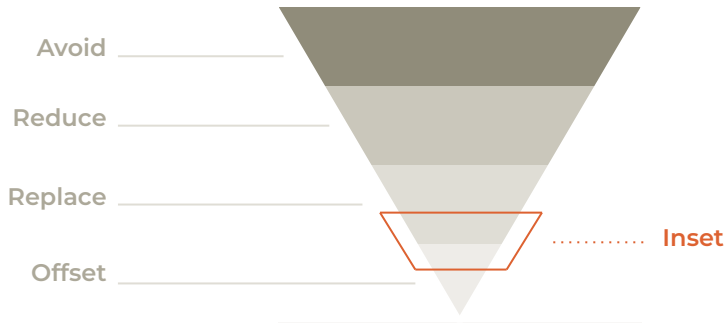
This section introduces the roadmap, which outlines key stages of progression for carbon insetting and identifies investment opportunities for Wine Australia as an industry enabler. Before the roadmap, it will outline the tangible benefits of insetting as well as how the industry can create an environment to increase the opportunity size.



Value of Insetting

The current value of carbon insetting to the wine industry is closely tied to the scale of emissions reductions achieved. As supply chain emissions decrease, the potential for impactful insetting increases. Therefore, the primary focus should remain on emissions reduction, as illustrated in the carbon management diagram below, which highlights the role of insetting within the overall strategy. Insetting, while secondary to direct emissions reductions, offers numerous tangible benefits, such as enhanced soil health, improved biodiversity, and resilience to climate change, which are detailed on the right. The roadmap ensures that immediate emissions reductions are prioritised, while also leveraging the long-term benefits of carbon insetting.

The Carbon Management Hierarchy



Tangibility of Insetting

Environmental

Reduction of net emissions

Biodiversity enhancements such as:

- Increased water retention and microbiota from revegetation.
- Recruitment of native flora and fauna, increasing biodiversity.

Soil health improvement

Operational

Resilience to climate change

Resource efficiency

Effective land management.

Market & Reputation

Compliance and Risk Management

Market Access

Competitive advantage & brand image

Advocacy options for the wine sector to increase opportunity for uptake

Economic

Potential for Revenue Generation
Provides opportunities to sell carbon credits in regulated or voluntary markets.

Access to Funding
Will open opportunities to access to government grants, subsidies, aimed at supporting sustainable practices.

Opportunity & Investment Roadmap

01 Foundation

1.1 Enhanced Carbon Literacy
Vineyards will have a deep understanding of carbon-related terminologies, governance, practices, and opportunities through targeted education and resources.
Wine Australia's Role | Coordinating the design and delivering these educational resources and programs, leveraging partnerships with universities, industry bodies, and sustainability experts.

1.2 Financial Modelling
Conduct various financial modelling scenarios to understand the cost-benefit analysis of carbon insetting technologies and methodologies. This will include assessing the initial investment, ongoing operational costs, potential market access benefits, and overall financial viability.
Wine Australia's Role | Develop financial modelling tools, conduct research, facilitate access to financial expertise.

1.3 Unified Supply Chain
The supply chain will be aligned on carbon insetting standards, data and modelling standards including interoperability and access, ensuring low cost consistent planning, measurement, reporting, and verification practices. Further research is also required outlining unit cost abatement and the cost implication for the supply chain.
Wine Australia's Role | Coordinate the development of unified frameworks, engaging stakeholders across the supply chain to ensure buy-in and compliance.

1.4 Clarify and Monitor International Measurement, Reporting and Verification (MRV) Requirements
It is essential to clarify and monitor international MRV requirements to ensure that investments in schemes will grant access to future market requirements, with continuous tracking of the evolving policy landscape being critical.
Wine Australia's Role | Act as the central repository of information on international MRV requirements, offering regular briefings, reports, and advisory services to vineyards. By staying ahead of policy changes and market demands, Wine Australia will help ensure that investments in carbon insetting schemes remain relevant and advantageous.

02 Scale up

2.1 Collective Resource Utilisation
Regional hubs will enable shared access to equipment, infrastructure and project establishment, reducing costs and complexity for adopting carbon insetting technologies.
Wine Australia's Role | Facilitate the creation and management of these regional hubs, working with local governments and industry partners to provide the necessary infrastructure and resources.

2.2 Continuous Blue Sky Innovation Monitoring
Keep vineyards informed of the latest blue sky technological and financial advancements, leveraging new opportunities for carbon insetting as well as providing a helping hand for those entering the market.
Wine Australia's Role | Establish an innovation monitoring system / platform, providing regular updates.

03 Integration

3.1 Pilot Projects for Best Practices
Pilot projects will demonstrate effective carbon insetting practices, providing data and case studies to guide broader implementation.
Wine Australia's Role | Identify, fund, and oversee these pilot projects, collaborating with vineyards, researchers, technology providers, and alternative sources of finance (e.g. blended government, philanthropy and private funding)

3.2 Supportive Policy & Funding Environment
Advocacy efforts will result in supportive policies and incentives, making it easier for vineyards to adopt, fund and benefit from carbon insetting practices.
Wine Australia's Role | Lead advocacy initiatives, explore blended finance opportunities, work with policymakers, industry groups, and stakeholders to shape a supportive policy environment.



Wine Australia

TGD™

CO_2 AUSTRALIA

Appendix 1 | Who we Engaged

4 voices of Design | We've used the 4 voices of design to ensure we have good representation of stakeholders across the ecosystem. Below show a list of stakeholder engaged throughout this phase of the project. The names of the individuals have been de-identified.

Voice of Intent (10%)

People with:

- **Passion** or **motivation** to take action.
- **Authority** or **mandate** to drive change.

Stakeholders Engaged

| Wine Australia
| Wine Victoria

Voice of Design (10%)

People who can:

- **Broker, facilitate and coordinate change.**
- **Connect** diverse communities. **Represent and document progress** accessible.

Stakeholders Engaged

| Wine Australia
| Wine Victoria

Voice of Capability (30%)

People with:

- **Resources** to contribute (money, labour).
- **Specialist knowledge, skills and tools.**
- **Access** to problem space (e.g. worksites).

Stakeholders Engaged

| CSIRO
  - Towards Net Zero Mission Lead
  - Research scientist Agriculture & Food with specialist focus on sustainability from a soil science perspective

| University of Adelaide
  - Research Lead in Carbon Valorisation

| University of Tasmania
  - Professor in improving the sustainability of agricultural and land-use systems

| Charles Sturt University
  - Associate Director of Academic and Education Partnerships for the Wine Industry

| Consultants/advisors
  - DJs/Elders
  - AHA Viticulture
  - Vitibit

Voice of Experience (50%)

People with:

- **Lived experience** of the issue and ground level context.

People who:

- Will be a user of, or affected by the **intervention.**

Stakeholders Engaged

| Small Growers/wineries
  - Maclaren Vale
  - *A range of individuals we talked to were also representing small growers such as AHA viticulture and vitibit.*

| Medium Growers/wineries
  - Australian Vintage
  - De Bortoli
  - Tahbilk
  - Jim Barry Wines
  - Chalmers Wines
  - Hill Smith Family Estates

| Large Wineries
  - Treasury Wine Estates
  - Duxton Vineyards

Appendix 2 | What is Happening in the Market

Country	Regulations & Standards	Thresholds	CBAMs	Certifications & Processes	System Integrity level
United States	The U.S. Environmental Protection Agency (EPA) requires annual reporting of greenhouse gas (GHG) data under the Greenhouse Gas Reporting Program (GHGRP). This includes specific subparts for different types of emissions, such as petroleum products (Subpart MM) and industrial gases (Subpart OO).	Reporting is required if the quantity of imported/exported products results in 25,000 metric tons of CO2 or more annually.	The US is also considering implementing a CBAM. Multiple bills in the US Senate propose CBAMs, including the Fair, Affordable, Innovative, and Resilient Transition and Competition Act (FAIR Act) and the Clean Competition Act (CCA). These proposals reflect different approaches to crediting climate change policies in exporting countries, with the US favoring a broader set of climate change mitigation policies beyond explicit carbon pricing	Companies must comply with Title 27 CFR for alcoholic beverages and Title 21 CFR for food and drugs. The Alcohol and Tobacco Tax and Trade Bureau (TTB) and the Food and Drug Administration (FDA) regulate these standards.	**Medium**
European Union	The European Green Deal, Corporate Sustainability Due Diligence Directive (CSDDD), Carbon Border Adjustment Mechanism (CBAM), VI-1 Certificates, Life Cycle Assessment (LCA), Multi-Regional Input-Output (MRIO) Model, ISO Standards, Third-Party Verification, Detailed documentation and record-keeping.	Facilities emitting 10,000 tonnes or more of CO2e annually must report their emissions under the EU's GHG reporting program.	The EU is at the forefront of implementing a CBAM. The EU's CBAM will begin its transitional phase on October 1, 2023, and will become fully operational in 2026. During the transitional phase, importers will report greenhouse gas emissions embedded in their imports without making financial payments. From 2026, importers will need to purchase CBAM certificates corresponding to the carbon emissions of the imported goods.	Compliance with international standards such as ISO 14067 (carbon footprint of products) and ISO 14064 (GHG accounting and verification) is often required. Exporters must maintain detailed records of all emissions data and undergo regular audits to ensure compliance with EU standards.	**High**
China	China requires all wine imports to comply with the General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) regulations. Labels must comply with Chinese legislation, and products must meet China's Compulsory Mark (CCC) standards and currently has little information on GHG reporting requirements.	Not specified.	Currently, China does not have a specific CBAM mechanism in place for wine imports, but there are stringent requirements for quality, safety, and labeling that indirectly impact the market	Importers must register with the AQSIQ, and wine must be accompanied by certificates of origin, health/sanitation, and authenticity/free sale. On-site inspections and possible sampling are conducted by CIQ officials at entry ports.	**Low**
United Kingdom	The UK follows the Brand Reputation through Compliance Global Standard (BRCGS) and requires compliance with the European Union (Withdrawal) Act 2018 and the Agricultural Products, Food and Drink (Amendment etc.) (EU Exit) Regulations 2020.	No specific CO2e thresholds mentioned, but compliance with EU regulations is mandatory.	The UK is considering introducing a CBAM similar to the EU's mechanism. This move aligns with the UK's broader climate goals and its commitment to reducing greenhouse gas emissions. The UK aims to ensure that its industries remain competitive while adhering to stringent climate policies.	Exporters must complete a self-certificate confirming compliance with EU regulations. The Department for the Environment, Food and Rural Affairs (DEFRA) and the Food Standards Agency (FSA) oversee these regulations.	**Medium**
Hong Kong	Hong Kong does not have specific carbon emissions reporting requirements for wine imports. However, companies often adhere to international standards such as ISO 14067 for carbon footprint quantification.	Not specified.	Hong Kong does not have its own Carbon Border Adjustment Mechanism (CBAM). However, it is influenced by international trade practices and regulations, particularly those from the European Union (EU).	Compliance with the Public Health and Municipal Services Ordinance (Cap. 132) and the Food Safety Ordinance (Cap. 612) is required. The Centre for Food Safety (CFS) and the Customs and Excise Department enforce these regulations.	**Low**
Canada	Canada follows international standards such as ISO 14064 for GHG accounting and verification. The Canadian Food Inspection Agency (CFIA) and provincial liquor control boards regulate these standards.	Not specified.	Canada is also considering the introduction of CBAMs, looking to align their climate policies with those of the EU and other major trading partners to ensure that their industries are not disadvantaged by differing carbon pricing mechanisms/	Compliance with the Federal Importation of Intoxicating Liquors Act 1985 and the Safe Food for Canadians Act 2018 is required. Provincial regulations may also apply.	**Medium**
Singapore	Singapore adheres to international standards for carbon emissions reporting and is part of global agreements requiring detailed reporting and verification of GHG emissions.	Not specified.	Singapore is developing CBAMs and investing in renewable energy to mitigate the impact of CBAM. These efforts are crucial for maintaining competitiveness in the EU market	Companies exporting to Singapore often follow ISO standards and may undergo third-party verification to ensure compliance.	**Low**

Appendix 2 | What is Happening in the Market

Country	Regulations & Standards	Thresholds	CBAMs	Certifications & Processes	System Integrity level
Nordic Countries	The Nordic countries, particularly Sweden, Norway, Denmark, and Finland, are setting the de facto ESG standards. Swedish retailer Systembolaget leads in establishing rigorous ESG criteria.	Not specified.	Nordic countries do not have a specific CBAM mechanism in place yet but are heavily influenced by EU regulations and are developing policies to align with international carbon pricing mechanisms.	Compliance with international standards such as ISO 14067 (carbon footprint of products) and ISO 14064 (GHG accounting and verification) is often required. Systembolaget, in particular, requires detailed documentation and verification of sustainable practices.	**High**

Appendix 3 | Soil Carbon Mulching

Mulching improves the soil water content, promoting the leaching of soil nutrients into the deeper soil layer and the movement of organic carbon from the topsoil to the subsoil increasing the sequestration rate of carbon.

Adoption Readiness
High: Simple, cost-effective, and widely practiced.

Technology Readiness
High: Established practice with clear benefits.

Risks

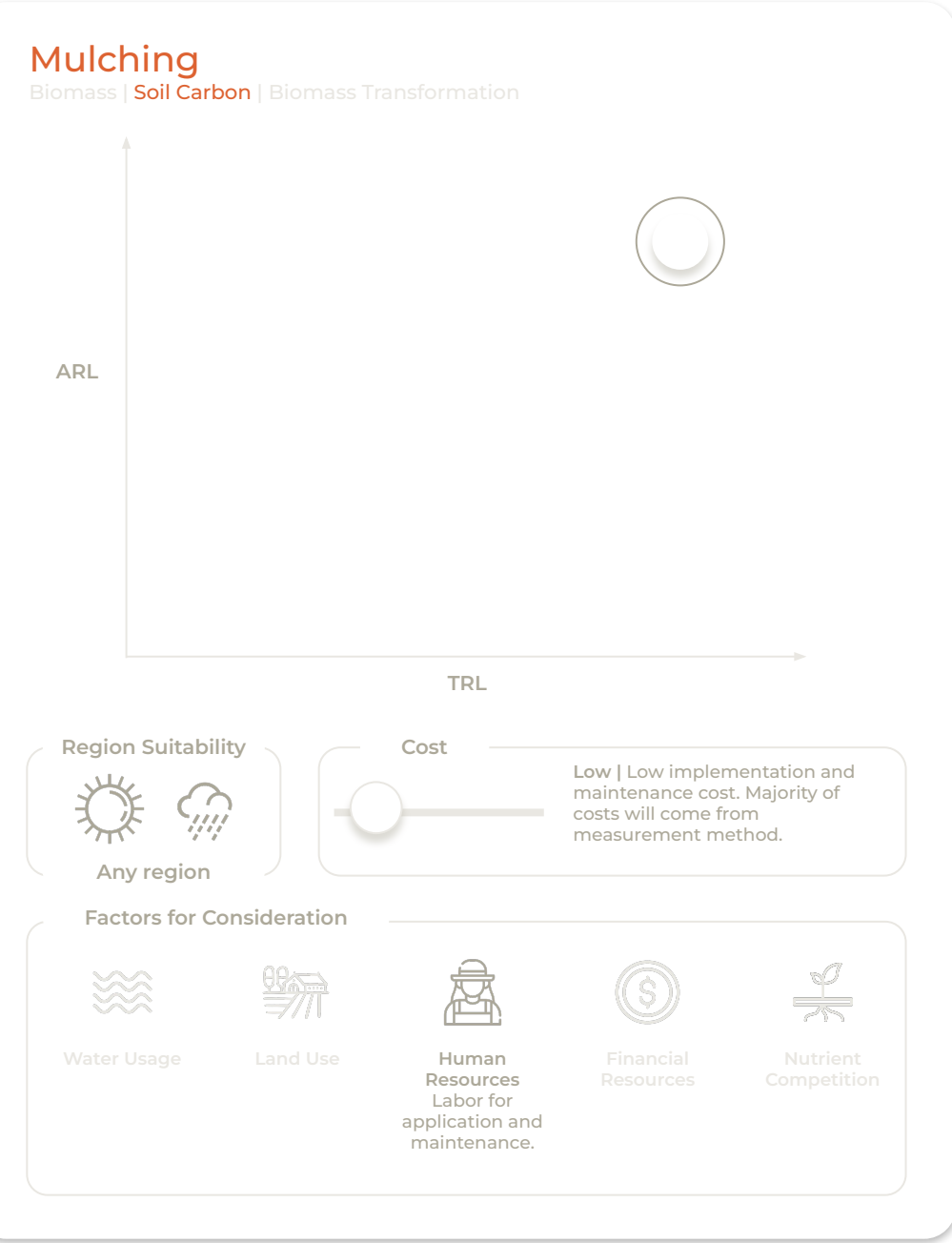
- **Pests:** Mulching has the potential to harbour pests, although combining with other beneficial organic practices can help mitigate this issue.
- **Timing:** Organic mulch needs to be applied during the first stages of decomposition, otherwise nitrogen may be extracted from the soil.

Interventions

1. More robust ways of measuring.
2. Demonstration projects to show effectiveness in carbon insetting.

Underlying measurement methodologies

- The Carbon Credits (Carbon Farming Initiative - Estimation of Soil Organic Carbon Sequestration using Measurement and Models) Methodology Determination 2021 allows generation of carbon credits from projects that store carbon in agricultural soils. Carbon sequestration estimates are made through soil sampling, sometimes with additional models to enhance predictions.
- No ACCU Scheme method



Appendix 3 | Soil Carbon **Composting**

Composting for carbon insetting involves converting organic waste from vineyards into compost, which enhances soil health and sequesters carbon. While effective, this method is limited by its scalability and can result in some carbon re-releasing into the atmosphere during decomposition. To improve carbon storage stability, attaching carbon to substrates like clay may be necessary for more consistent results but this needs further development.

Adoption Readiness
High: Simple, cost-effective, and widely practiced.

Technology Readiness
High: Established practice with clear benefits.

Risks

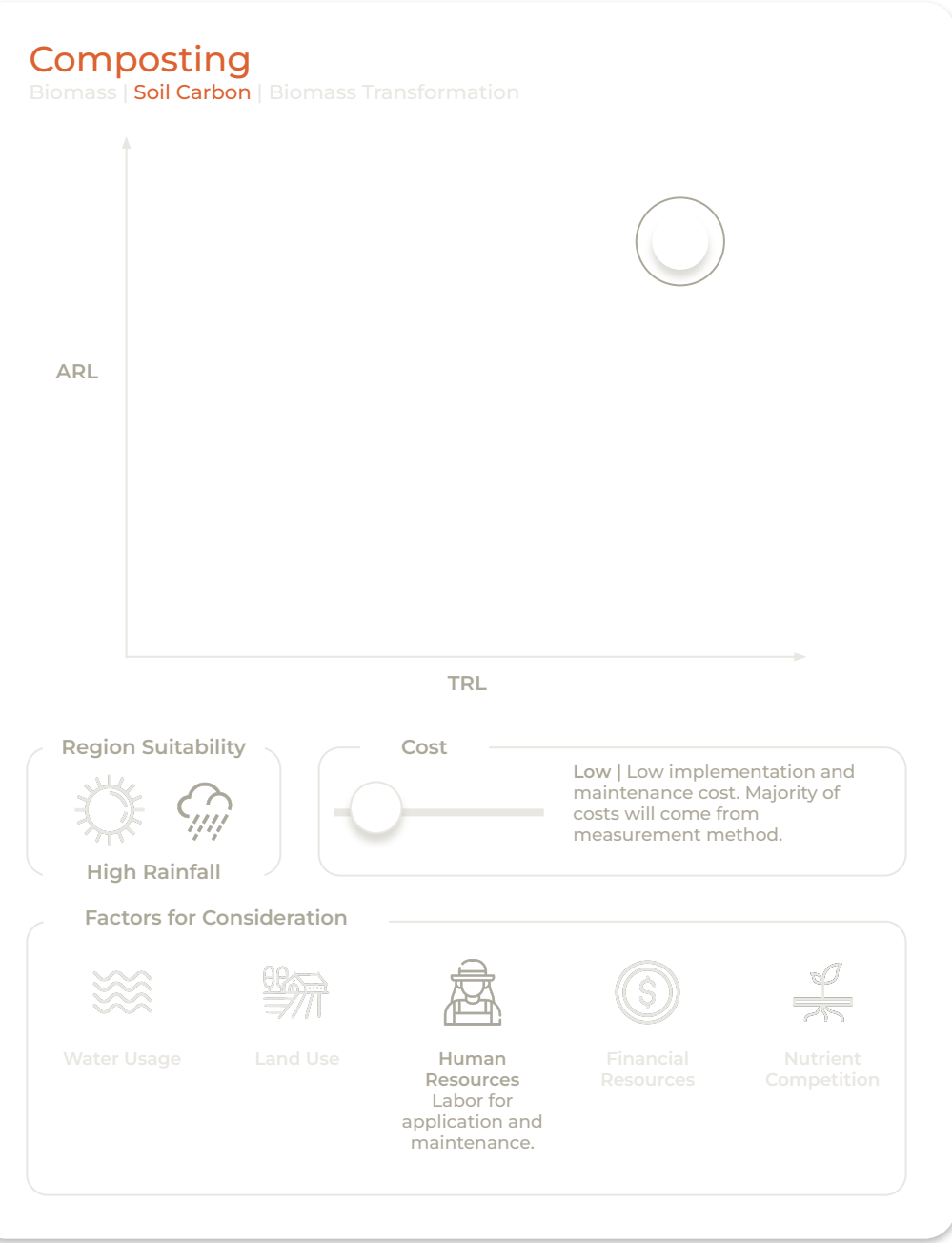
- **Carbon Re-release:** During decomposition, some carbon may be re-released into the atmosphere, reducing the overall effectiveness of sequestration.
- **Consistency and Quality:** Ensuring consistent and high-quality compost production can be challenging, impacting the effectiveness of carbon insetting.

Interventions

1. More robust ways of measuring.
2. Demonstration projects to show effectiveness in carbon insetting and or scalability.

Underlying measurement methodologies

- The Carbon Credits (Carbon Farming Initiative - Estimation of Soil Organic Carbon Sequestration using Measurement and Models) Methodology Determination 2021 allows generation of carbon credits from projects that store carbon in agricultural soils. Carbon sequestration estimates are made through soil sampling, sometimes with additional models to enhance predictions.
- No ACCU Scheme method



Appendix 3 | Soil Carbon **Fertilisers**

Through the use of synthetic or non-synthetic fertiliser, crop yields can be increased, which can lead to an increase in the availability of organic residue. There can also be an improvement of carbon-to-nitrogen ratio, increasing the rate at which soil organic carbon forms.

Adoption Readiness
Medium: Many vineyards already have the necessary infrastructure and knowledge to apply fertilisers, although the specific practice of optimising fertilisers for carbon sequestration may require additional training and incentives.

Technology Readiness
High: well-established products and methods available for enhancing soil carbon storage, though ongoing advancements aim to further improve their efficiency and environmental impact.

Risks

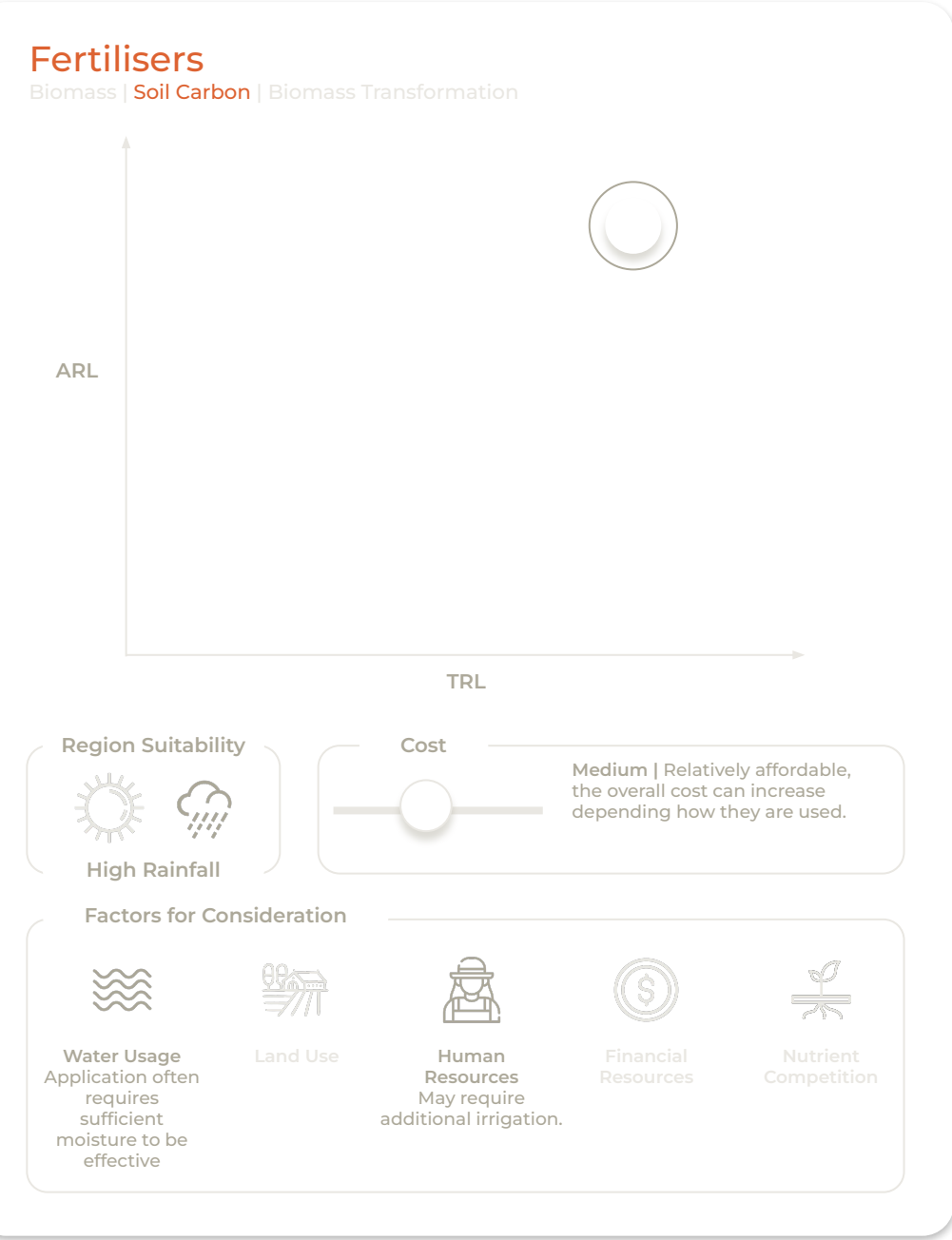
- **Impact on soil:** Synthetic fertiliser may decrease soil fertility due to chemical nitrogen stimulating excessive microorganism growth, overall depleting organic matter in the soil.
- **Slow results:** Fertilisers have to break down the soil before results can be seen. This can typically take a few months after the first application.

Interventions

1. A major risk for soil carbon is the accuracy of data collection and calculations - this applies here too.
2. Important to ensure no leakage of fertiliser from the property into nearby water sources.

Underlying measurement methodologies

- Estimating soil organic carbon sequestration using measurement and models method (2021)



Appendix 4 | Method differentiation

Method	**Environmental Planting*** Reforestation by Environmental or Mallee Plantings FullCAM Methodology Determination 2014	**Reforestation and Afforestation** Carbon Credits (Carbon Farming Initiative) (Reforestation and Afforestation) Methodology Determination 2013
When to use this method	Planting mixed native trees or mallee eucalypt Have land clear of forest cover for the last 5 years	Can plant seeds or seedlings to establish a permanent forest on grazed, cropped or fallow land Prepared to undertake field measurements of your planted trees
Eligibility	Land is in an area of Australia where FullCAM modelling data exists Project area must be clear of forest cover, for at last the last 5 years before application For Mallee plantings the project area receives 600mm or less of rainfall (unless the planting meets the exemption requirements for a specific calibration) Trees are established on project land with the potential to attain: • Height of 2 metres or more • Crown cover of at least 20% over the total area of the strata where project trees are located	Land must have been grazed, cropped or fallow for the past 5 years. It must be able to support the growth of new forest The project area must be located within Australia It must involve establishing a permanent planting on land that's been: • Grazed • Cropped • Fallow The above must have happened in the 5 years before project application
Requirements	Subject to performance obligations – maintain the carbon stored or sequestered for either 25 or 100 years Must meet the general eligibility requirements for the Australian Carbon Credit Unit (ACCU) Scheme	Must meet the general eligibility requirements for the Australian Carbon Credit Unit (ACCU) Scheme Collection or provision of allometric data on tree growth

** The Reforestation by Environmental or Mallee Plantings 2014 method expires on 30 September 2024*

** R&A method expires in 2025.*

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