Benefit Cost Analysis of Wine Australia's R&I investments 2024/25

Final Report

Wine Australia

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Acronyms

BCA	Benefit Cost Analysis
BCR	Benefit Cost Ratio
BOM	Bureau of Meteorology
CRRDC	Council of Rural Research and Development Corporations
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEECA	Department of Energy Environment and Climate (Victoria Government)
DO	Dissolved Oxygen
E&I	Extension and Innovation
ERP	Expert Reference Panel
GHD	GHD Pty Ltd
GHG	Greenhouse Gas
GDP	Gross Domestic Product
IRR	Internal Rate of Return
MIRR	Modified Internal Rate of Return
NOLO	No- and Low-Alcohol Wine
NPMP	National Phylloxera Management Protocol
NPV	Net Present Value
PIZs	Phylloxera Infested Zones
PRZs	Phylloxera Risk Zones
PV	Present Value
R&D	Research and Development
R&I	Research and Innovation
RDC	Rural Research and Development Corporation
RI&A	Research, Innovation and Adoption
SLO	Social License to Operate
TRL	Technology Readiness Level

1. Introduction

Wine Australia is the wine and grape industry's rural research and development corporation (RDC). It invests into research, innovation and adoption (RI&A) to better the knowledge, opportunities and excellence of the sector. GHD Pty Ltd (GHD) was engaged by Wine Australia to complete its annual research and innovation investment impact assessment for the 2024/25 financial year.

This report presents the results of six ex-post impact assessments completed on a representative sample of Wine Australia projects finalised during the 2024/25 financial year.

Evaluations were completed in line with the Council of Rural Research and Development Corporations (CRRDC) *Impact Assessment Program: Guidelines* (2018). They were informed by a desktop review of project outputs, consultation with researchers, Wine Australia project managers and other relevant stakeholders, as well as review of relevant literature and data where available.

The results provide an objective and independent assessment of the qualitative and quantitative outcomes likely to be realised from the evaluated projects. Where necessary, the evaluations rely on informed estimates of unknown parameters, such as economic benefits from practice change, potential rates of adoption and attribution of benefits.

2. Objectives

Specific objectives of this impact assessment were to:

1. Evaluate a random sample of Wine Australia investments in projects completed in the 2024/25 financial year for triple bottom line benefits
2. Perform a cost-benefit analysis including present value of benefits, present value of costs, net present value, benefit-cost ratio, and internal rate of return on each of the randomly selected projects.

3. Wine Australia Background

Wine Australia is a statutory authority established under the *Wine Australia Act 2013*, dedicated to supporting the success and sustainability of the Australian grape and wine sector. As the industry's RDC, it is funded by grape growers and winemakers through levies and user-pays charges, and by the Australian Government, which provides matching funding for RI&A investments.

Wine Australia operates across three core functions: research and innovation, market development, and regulatory services. Through strategic investment in research and innovation, Wine Australia helps grape and wine businesses adapt to emerging challenges and improve global competitiveness, as set out by its 2050 Vision: *Australian wine: enjoyed and respected globally*. Together with its vision and goal of *profitable, resilient and sustainable winegrape and wine businesses,* Wine Australia establishes its long-term aims and strategies.

Wine Australia promotes Australian wine domestically and internationally, aiming to increase demand and premium value. As the industry's regulatory body, Wine Australia safeguards product integrity and ensures compliance with export standards. By collaborating with growers, winemakers, and government, Wine Australia works toward building a resilient, profitable and globally respected wine industry (Wine Australia, 2024).

Grape growing, winemaking and wine-related tourism contributes $51.3 billion to the Australian economy and supports more than 200,000 jobs (Wine Australia, 2025a). Spanning 65 winegrowing regions, the industry constitutes over 2,100 wineries and 6,000 grape growers (Wine Australia, 2025b). In 2024/25, Australian winegrape crush was 1.57 million tonnes, with reds being the most prominent. In the same year, Australian wine production was estimated to be 1.13 billion litres, with white wine's share at 48 per cent, and red wine's share at

52 per cent. The country exported 638 million litres, valued at $2.5 billion, with China as the top destination (Wine Australia, 2025c).

As the industry's RDC, one of Wine Australia's core functions is to invest in grape and wine Research and Innovation (R&I). As these investments are funded by levy payers and government, evaluating investment impact and effectiveness is important to demonstrate value to the industry, government and the broader Australian community. This forms part of the broader CRRDC impact assessment process, which aims to demonstrate the economic, environmental and social benefits from investments made by all Australian Rural RDCs.

Wine Australia's Strategic Plan for the period 2020-25 highlights the importance of R&I investment, which accounts for around 45% of its total budget. Together with its vision and goal, Wine Australia's strategies inform how it invests for the sector's success.

Wine Australia's strategies are developed and informed by the Australian Government's Science and Research Priorities (Australian Government Department of Industry, Science and Resources, 2024), the National Agricultural Innovation Priorities, as well as by stakeholder consultation.

For Wine Australia's Strategic Plan 2020-25, which is most relevant for this investment period, the strategies were to:

1. Market Australian wine
2. Protect the reputation of Australian wine
3. Enhance grape and wine excellence
4. Grow sustainable environments
5. Build business sustainability, excellence and leadership.

This benefit-cost analyses helps to ensure that Wine Australia's investments are transparent, accountable, and aligned with sector needs, providing a strong foundation for demonstrating the economic, social and environmental returns of its initiatives. Section 5 demonstrates how each project assessed aligns with these strategies, as well as with broader Australian Government priorities.

4. Methodology

4.1 Economic Impact Evaluation

As per the CRRDC *Impact Assessment Program: Guidelines* (2018) GHD considered and modelled the project case (with project scenario) against the counterfactual (without project scenario) to determine the likely change in net economic benefit and, therefore, return on investment.

GHD reviewed project reports and outputs and consulted with key stakeholders to determine reasonable assumptions for the following:

- Potential impact if/when project outputs and findings are utilised by industry
- Likely rates of adoption over the coming years (adoption profile)
- Attribution of benefits, i.e. the extent realised benefits are attributable to the project investment, as separate from previous related research, future implementation costs and other factors.

Where available, industry data was used to inform assumptions: e.g., yield, profitability, global and domestic consumption, exports, regional/historical annual rainfall, costs and emissions reduction proxies.

Impacts were modelled over a 30-year timeline and discounted to present day amounts (applying a 5% discount rate) to determine the:

- Net Present Value of Benefits (NPV): Present value benefits minus present value costs
- Benefit Cost Ratio (BCR): Present value benefits divided by present value costs
- Internal Rate of Return (IRR): Interest rate at which the NPV of all the impacts from a project (both costs and benefits) from a project or investment equal zero

- Modified Internal Rate of Return (MIRR): Similar to the above IRR, but assuming more realistic returns from reinvested benefits and financing of initial outlays (5% applied for both, as per CRRDC guidelines).

All past costs and benefits were expressed in 2025/26 dollar terms using the Implicit Price Deflator for Gross Domestic Product (GDP). The Wine Australia components of project investment costs were all multiplied by a factor of 1.12 to accommodate program management costs. All costs and benefits after 2025/26 were discounted to present dollars using a discount rate of 5%. A reinvestment rate of 5% was used for estimating the MIRR. The base analysis used the best available estimates for each variable, notwithstanding a high level of uncertainty for many of the estimates. All analyses ran for the length of the investment period plus 30 years into the future.

Sensitivity analysis was used to test results against changes to key assumptions and discount rates, for both individual projects and aggregate results. For each evaluation, confidence ratings in terms of coverage of benefits and accuracy of assumptions were also specified.

It is noted that all results are subject to rounding error. All assumptions, results and sensitivity analysis are referenced in the individual project evaluations (see Section 9 Appendices).

4.2 Project Selection

Projects were independently selected by GHD to ensure a balanced representation across Wine Australia's investment portfolio in the 2024/25 financial year. To ensure a diverse and representative sample, projects were first grouped using categorical variables aligned to high-level program areas. Random numbers were then generated to select projects for evaluation across each program area grouping, whilst ensuring at least 10% of Wine Australia's investment finalised in 2024/25 would be assessed. The required 10% of investment coverage was reached once five projects were selected. The selected sample was reviewed by the Wine Australia team to ensure satisfaction that an appropriate coverage of their investment was being evaluated. Wine Australia also requested that GHD assess a sixth project from its People Development program area – Future Leaders (WAC 2419), an ongoing, biennial investment.

During early consultation, it became evident that one of the selected projects (AWR 2202-3.1.2) was closely linked to another project completed in 2024/25 (AWR 2202-3.1.3). Wine Australia and GHD subsequently agreed that it was best to include this project in the analysis and cluster the two projects.

The six assessments (including one cluster) were:

1. **DJP 2001:** Integrated management of grapevine phylloxera: Phase II
2. **CSU 1702-9:** Drought resilience
3. **EDG 2201:** Emissions Reduction Roadmap
4. **AWR 1701-3.1.5:** Influencing wine style and efficiency through management of oxygen during wine production
5. **AWR 2202-3.1.2 and AWR 2202-3.1.3:** NOLO Mouthfeel and NOLO Flavour Stability
6. **WAC 2419:** Future Leaders 2025

Together, the projects selected for evaluation had a combined investment by Wine Australia of $3.72 million, approximately 19% of its total investment finalised in the 2024/25 financial year.

5. Alignment with Australian Government Research Priorities

Australia's RDC system recognises innovation as crucial for building a profitable and competitive agricultural sector. To support research and development (R&D) and extension and innovation (E&I) investment that is strategic, collaborative and targeted, the Australian Government sets national Science and Research Priorities and Agricultural Innovation Priorities. Priorities are established to ensure that RDCs appropriately target R&D and E&I investment to benefit industry and the broader Australian community. By aligning with these priorities, RDCs empower industries to adopt innovative practices. Reflecting this, Wine Australia's investments are aligned with both the strategic research priorities of the Australian Government and the Australian wine and grape community.

*Table 1 Alignment of projects with Wine Australia strategies (**Strategic Plan (2020-25)***) and Australian Government Priorities.*

			No. Projects Aligned	Project Codes
Wine Australia Strategies	**1**	Market Australian wine	**0**	N/A
	2	Protect the reputation of Australian wine	**0**	N/A
	3	Enhance grape and wine excellence	**3**	DJP 2001; EDG 2201; AWR 2202-3.1.2 and AWR 2202-3.1.3
	4	Grow sustainable environments	**2**	CSU 1702-9; EDG 2201
	5	Build business sustainability, excellence and leadership.	**1**	WAC 2419
Science and Research Priorities	**1**	Transitioning to a net zero future	**1**	EDG 2201
	2	Supporting healthy and thriving communities	**2**	AWR 1701-3.1.5; AWR 2202-3.1.2 and AWR 2202-3.1.3
	3	Elevating Aboriginal and Torres Strait Islander knowledge systems	**0**	N/A
	4	Protecting and restoring Australia's environment	**0**	N/A
	5	Building a secure and resilient nation.	**3**	DJP 2001; CSU 1702-9; WAC 2419

			No. Projects Aligned	Project Codes
National Agricultural Innovation Priorities	**1**	Australia is a trusted exporter of premium food and agricultural products by 2030	**3**	AWR 1701-3.1.5; AWR 2202-3.1.2 and AWR 2202-3.1.3; WAC 2419
	2	Australia will champion climate resilience to increase the productivity, profitability and sustainability of the agricultural sector by 2030	**2**	CSU 1702-9; EDG 2201
	3	Australia is a world leader in preventing and rapidly responding to significant incursions of pests and diseases through futureproofing our biosecurity system by 2030	**1**	DJP 2001
	4	Australia is a mature adopter, developer and exporter of digital agriculture by 2030	**0**	N/A

* As this analysis focused on projects completed in 2024–25, alignment was assessed against Wine Australia's Strategic Plan 2020–25.

Table 2 shows how each project aligns with Wine Australia's Strategic Plan 2020–25 and Australian Government priorities.

*Table 2 Alignment of projects with Wine Australia strategies (**Strategic Plan (2020-25)***) and Australian Government Priorities (expanded)*

Project Code	Project Name	Wine Australia	Australian Government	
		Strategic Plan 2020-25 Strategies	Science and Research Priorities	National Agricultural Innovation Priorities
DJP 2001	Integrated management of grapevine phylloxera: Phase II	3	5	3
CSU 1702-9	Drought resilience	4	5	2
EDG 2201	Emissions Reduction Roadmap	4	1	2
AWR 1701-3.1.5	Influencing wine style and efficiency through management of oxygen during wine production	3	2	1
AWR 2202-3.1.2 and AWR 2202-3.1.3	NOLO Mouthfeel and NOLO Flavour Stability	3	2	1
WAC 2419	Future Leaders 2025	5	5	1

* As this analysis focused on projects completed in 2024–25, alignment was assessed against Wine Australia's Strategic Plan 2020–25.

6. Results

6.1 Economic Impact by Project

Results for the 6 impact assessments are presented in Table 3.

Table 3 Results from impact evaluation (Total Project Investment, 30 years)

Project Code	Project Name	Present Value (PV) Benefits ($M)	Present Value (PV) Costs ($M)	Net Present Value (NPV) ($M)	Benefit Cost Ratio (BCR)
DJP 2001	Integrated management of grapevine phylloxera: Phase II	$11.63	$1.90	$9.73	6.1
CSU 1702-9	Drought resilience	$3.27	$1.01	$2.27	3.2
EDG 2201	Emissions Reduction Roadmap	$1.66	$0.37	$1.29	4.5
AWR 1701-3.1.5	Influencing wine style and efficiency through management of oxygen during wine production	$5.54	$1.66	$3.88	3.3
AWR 2202-3.1.2 and AWR 2202-3.1.3	NOLO Mouthfeel and NOLO Flavour Stability	$0.84	$0.78	$0.06	1.1
WAC 2419	Future Leaders 2025	$1.67	$0.58	$1.09	2.9

Note: Figures are rounded.

6.2 Overall Economic Impact

The aggregated results from the individual assessments where benefits were able to be quantified are presented in Table 4. The aggregated results are shown over the 30 years from the year of assessment (in 2025/26 dollars).

Table 4 Summary of overall results from the six projects where benefits were quantified

Years from project assessment	0	5	10	15	20	25	30
Present value (PV) of benefits ($M)	$0.70	$9.52	$17.89	$21.06	$22.89	$23.87	$24.61
Present value (PV) of costs ($M)	$6.30	$6.30	$6.30	$6.30	$6.30	$6.30	$6.30
Net present value (NPV) ($M)	-$5.60	$3.23	$11.59	$14.76	$16.59	$17.58	$18.31
Benefit Cost Ratio (BCR) (weighted average)	0.1	1.5	2.8	3.3	3.6	3.8	3.9

Note: Figures are rounded.

6.3 Sensitivity Analysis

Table 5 shows how the overall economic impact results would change based on changes in the discount rate. The results show that, even applying a discount rate of 10%, the projects would still deliver a positive NPV ($11.09M) and favourable BCR (2.8).

Additional sensitivity analysis was also undertaken for individual assessments, adjusting both discount rates and assumed benefits once innovations are adopted. These results are detailed in the individual analyses for each project, provided as appendices to this report.

Table 5 ***Aggregated economic impact (total project investment, after 30 years) applying different discount rates.***

Discount rate	NPV ($M)	BCR
0%	$32.77	6.2
3%	$22.81	4.6
5%	$18.31	3.9
7%	$14.89	3.4
10%	$11.09	2.8

6.4 Comparison to Assessments in Previous Years

Figure 1 presents the weighted average BCR for 2024/25 (3.9) along with the results from assessments conducted over the previous five years (Wine Australia, 2020; 2021, 2022, 2023, 2024). The analysis indicates that across the six-year period, Wine Australia's project investments have delivered an estimated weighted average BCR of 3.0.

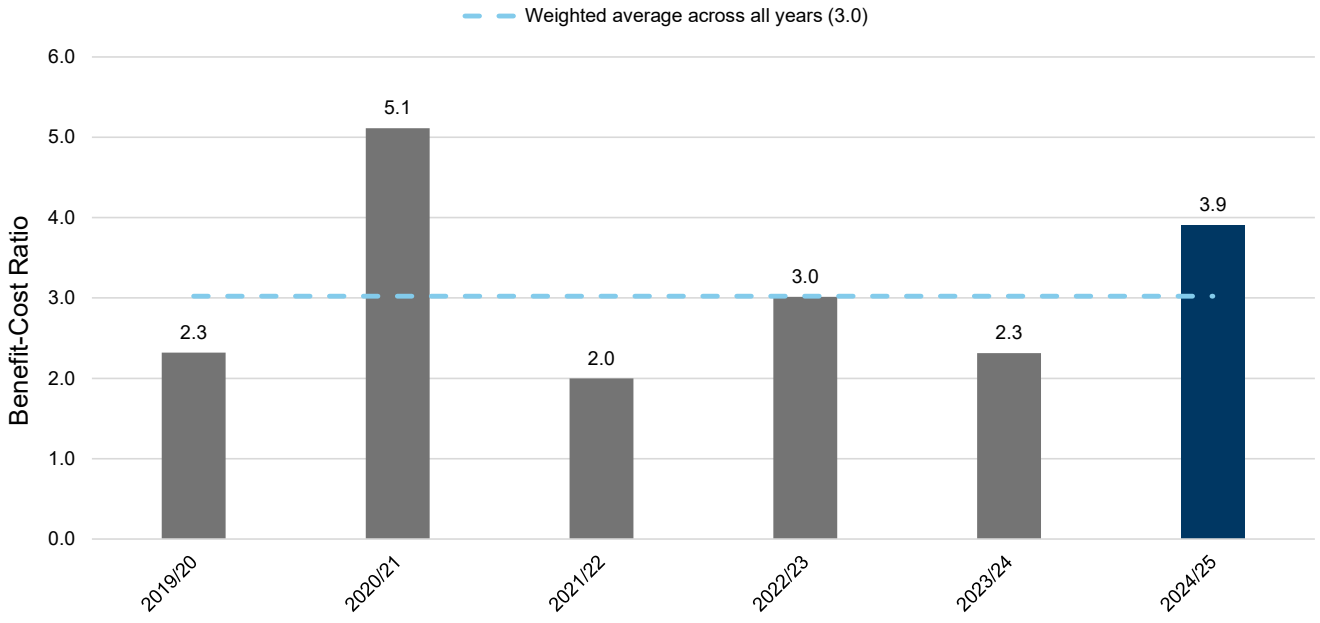


Figure 1 ***Weighted average BCRs from Wine Australia impact assessments, 2019/20 to 2024/25, with results from the present analysis shown in dark blue.***

7. Conclusions

All six projects (including one cluster) evaluated as part of Wine Australia's 2024/25 impact assessment process yielded a positive BCR. The aggregated economic return across all analyses is 3.9 using a weighted average BCR over the 30-year period from the year of assessment. This is a positive outcome, suggesting that the sample of Wine Australia R&I projects analysed for 2024/25 are likely to yield substantial benefits to the grape and wine industry, along with its larger supply chain and the broader public over the coming years. It is also noted that there were several identified benefits, in particular social and environmental impacts, that were unable to be quantified as part of the analysis and therefore the results for some projects may be considered conservative.

The 2024/25 results have been compared to the results from impact assessments commissioned by Wine Australia over the previous five years. Across the period from 2019/20 to 2024/25, annual weighted average BCRs ranged from 2.0 to 5.1. Taken together, the results provide an overall weighted average BCR of 3.0 for the six-year period indicating that Wine Australia's ongoing investment in research and innovation continues to enhance and support the industry, generating economic, social and environmental benefits for levy payers and the broader Australian community.

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9. Appendices

Appendix	Project Code	Project Name
A	DJP 2001	Integrated management of grapevine phylloxera: Phase II
B	CSU 1702-9	Drought resilience
C	EDG 2201	Emissions Reduction Roadmap
D	AWR 1701-3.1.5	Influencing wine style and efficiency through management of oxygen during wine production
E	AWR 2202-3.1.2 and AWR 2202-3.1.3	NOLO Mouthfeel and NOLO Flavour Stability
F	WAC 2419	Future Leaders 2025

Appendix A: Integrated management of grapevine phylloxera: Phase II (DJP 2001)

Background

Grapevine phylloxera (*Daktulosphaira vitifoliae*) is one of Australia's most damaging viticulture pests. The aphid-like insects feed on either the roots or the leaves of the vine, typically resulting in vine death. Currently, there is no treatment that can remove phylloxera from the soil once it has been established in a vineyard, and therefore providing sustainable improvements to this species' management is a key priority for the wine industry. Management practices aimed at preventing the spread of phylloxera outside defined quarantine boundaries incorporate a suite of management tools and strategies. These include effective surveillance and diagnostics, availability of resistant rootstocks, validated disinfestation protocols, comprehensive understanding of the insect's ecology, and sustainable management options for growers. By building on previous research (see *Phylloxera Integrated Pest Management (IPM)* project (DED1701)), this project investigated management practices of grapevine phylloxera across these five research themes, conducted via seven distinct studies:

Research Theme 1: Effective Surveillance and Diagnostics

1. Improved Surveillance and Detectability of Grapevine Phylloxera

Research Theme 2: Improved Selection of Resilient Rootstock

2. Improved Selection of Resilient Rootstocks M5512 and M5489

Research Theme 3: Improved disinfestation procedures

3. Improved Disinfestation Procedures Under Different Hygiene Conditions

Research Theme 4: Improved Knowledge of Phylloxera Ecology

4. Phylloxera Population Dynamics and Survival Over Winter
5. Increased Prevalence of Leaf Galling Phylloxera in the North-East Phylloxera Infested Zone
6. Genetic Diversity of Leaf Gall Grapevine Phylloxera in the King Valley, North-Eastern Victoria

Research Theme 5: A Conservation Biocontrol Approach

7. A Conservation Biocontrol Approach

Taken together, these studies aim to continue to improve the industry's ability to sustainably manage grapevine phylloxera, leading to more resilient vineyards, reduced labour costs in the prevention of a significantly damaging pest, and improved biosecurity management measures and practices.

Description of the project

Project code	**DJP 2001**
Title	Integrated management of grapevine phylloxera: Phase II
Research organisation	Department of Energy Environment and Climate (DEECA) (VIC)
Principal investigator	Jessica Henneken
Wine Australia project manager	Robyn Dixon
Project duration	03/05/2021 – 30/06/2024
Wine Australia investment	$795,000

Rationale	Grapevine phylloxera (*Daktulosphaira vitifoliae*) is one of Australia's most damaging viticulture pests. Currently, there is no treatment that can remove phylloxera from the soil once it has been established in a vineyard. Providing sustainable improvements to this species' management is therefore a key priority for the wine industry.
Objectives	This project aimed to improve the industry's ability to sustainably manage grapevine phylloxera across five key areas by delivering: • more effective surveillance and diagnostics • improved selection of resilient rootstocks • improved disinfestation procedures • improved knowledge of Australian phylloxera ecology • a conservation biological control approach.
Activities and outputs	**Study 1** • Developed simulation models to establish a level of confidence in detecting a phylloxera infestation at different levels of prevalence • Conducted a large-scale side-by-side comparison of the different detection methods specifically: visual inspection, LAMP analysis of emergence traps, and LAMP analysis of root samples • Reviewed prior and within-project data for any relationship between rootstock, genotype, and environmental factors on phylloxera detection • Assessed the relative effectiveness of using different surveillance methods outside of peak phylloxera activity. **Study 2** • Screened two novel rootstocks M5512 and M5489 for their susceptivity to phylloxera genotypes G4 and G38 using updated screening methodology • Determined susceptibility ratings for M5512 and M5489 rootstocks against G4 and G38 phylloxera genotypes. **Study 3** • Evaluated the effectiveness of the then-current dry heat disinfestation protocols under different hygiene conditions • Trialled a new disinfestation protocol involving higher temperatures in the laboratory • Evaluated the new dry heat disinfestation protocol in a commercial dry heat shed under different hygiene conditions across diverse phylloxera genotypes. **Study 4** • Assessed the risk of human-assisted dispersal of phylloxera during winter by: Part A – assessing phylloxera development under field conditions; and Part B – assessing phylloxera survival at overwintering temperatures in the laboratory across at least two diverse strains • Investigated soil characteristics that may contribute to variation in the population dynamics of phylloxera in the field. **Study 5** • Investigated environmental- and rootstock-related factors that may account for the increased prevalence of leaf galling phylloxera in vineyards and the associated risks to industry • Genotype mapping of leaf galling phylloxera in the North-East Phylloxera Infested Zone (PIZ) was conducted.

	Study 6 • Survey and genotype leaf galling grape phylloxera from the King Valley to compare with a previous root phylloxera study and complement the root samples obtained previously • Examined the genetic diversity in the same region and use these results to update the known distribution of genetic variation of grape phylloxera in the King Valley, the Alpine Valley and North-East PIZ vineyards. **Study 7** • Conducted field surveys to identify potential phylloxera predators in Victorian vineyards • Assessed the efficacy of commercial aphid predators in laboratory settings for potential use in Inundation Biological Control.
Outcomes	• Improved efficacy and efficiency of detection and surveillance of phylloxera leading to improved confidence in declarations of phylloxera absence • New options for resistant rootstocks improving the ability of growers to make informed replanting decisions • Improved dry-heat disinfestation protocols for the movement of machinery between quarantine zones leading to increased efficacy and therefore confidence in protocols • Improved information on the risk of phylloxera dispersal during winter operations leading to improved management and decision making • Improved knowledge of the genetic diversity of Australian phylloxera informing future research needs • Improved information on predators of phylloxera, including confirming the predation capacity of commercially available aphid predators, leading to improved opportunities for biological control.
Potential impacts	• Reduced probability of spread and damage to Australian grapevines from phylloxera outbreaks and thus impacts to grower livelihoods through more effective surveillance and management • Increased phylloxera surveillance and management options, and thus the potential for reduced costs to growers and regulatory bodies • Increased capacity of researchers, agency staff and grape growers in the understanding, detection and management of phylloxera • Increased efficiency in future research through more targeted research activities as a result of improved knowledge and understanding of the ecology of phylloxera • Improved mental health outcomes for growers through increased options and greater confidence in phylloxera detection and management.

Project investment

A breakdown of Wine Australia's investment in the project and contribution by others is shown by financial year and in aggregate in Table 6.

Table 6 Total investment in DJP 2001 (nominal)

Year ending June 30th	Wine Australia ($)	Others ($)	Total contributions
2020/21	$61,576	$57,237	$118,813
2021/22	$264,084	$263,094	$527,178
2022/23	$251,085	$261,863	$512,948
2023/24	$218,255	$212,806	$431,061
Total	**$795,000**	**$795,000**	**$1,590,000**

Source: Information provided by Wine Australia.

For the BCA, the cost of managing the Wine Australia funding was added to the Wine Australia contribution for the project using a multiplier of 1.12, i.e. consistent with past year assessments, overhead costs are assumed to be 12%. In undertaking the impact assessment, all past costs were expressed in 2025/26-dollar terms using the Implicit Price Deflator for GDP.

Summary of impacts

Table 7 below provides a breakdown of the expected impacts across the triple bottom line (economic, environmental, and social).

Table 7 Triple bottom line impacts, including those valued as part of this evaluation (in bold) for Project DJP 2001

Economic	• **Contributes to a reduction in the likelihood and cost of spread of grapevine phylloxera through more effective surveillance and management** • Potential reduction in costs to growers and regulatory bodies through increased surveillance and management options • **Increase in the efficiency of future research through more targeted research activities as a result of improved knowledge and understanding of the ecology of phylloxera.**
Environmental	• Improved understanding and surveillance and management capabilities of phylloxera, an invasive pest in Australia.
Social	• Increased capacity of researchers, agency staff and grape growers in the understanding, detection and management of phylloxera • Improved mental health outcomes for growers through increased options and greater confidence in phylloxera detection and management.

Public versus private impacts

This project is expected to generate both public and private impacts. Improved protocols and new simulation models will deliver public benefits to regional communities and biosecurity agencies by enabling identification and better management of high-risk zones. Private benefits will be delivered to viticulture growers resulting from increased profitability of their enterprise due to more informed management and decision making, and a reduction in the risk of the spread of grapevine phylloxera.

Distribution of private impacts

Private impacts will be distributed along the supply chain but will be concentrated for individual grape growers in all regions. The findings highlight the importance of a suite of detection and management strategies, which provide improved options and confidence for growers in infected and high-risk zones, as well as reduce the risk of spread to areas currently free from grapevine phylloxera.

Impacts on other Australian industries

Improvements in strategies to aid the detection and management of grapevine phylloxera will also benefit other grape growing industries, such as table and dried grapes. Of note, since the project's completion Vinehealth Australia has undertaken a phylloxera simulation exercise between the wine, table and dried fruit industries.

Impacts overseas

Learnings from this project have been made public and are available to other countries dealing with the pest.

Quantification of impacts

For the BCA, the quantification of impacts has focused on 1) the contribution to the reduction in the likelihood and spread of grapevine phylloxera and 2) an increase in efficiency of RD&E investment as a result of the increase in knowledge about phylloxera arising from the project.

While it is recognised that conducting regular surveillance and employing advanced methods like LAMP testing, choosing phylloxera-resistant rootstocks appropriate to local genotypes and adhering to stringent biosecurity protocols, particularly for machinery and plant materials, provide additional options to growers and regulatory bodies, the primary benefit is increased confidence in the efficacy of tools, technologies and protocols in minimising further incursions and spread of the pest.

Quantification of the contribution to the reduction in the likelihood and cost of further spread of phylloxera has relied on publicly available information on the cost of past outbreaks, such as that in the Yarra Valley (Vinehealth Australia, 2024), as well as credible estimates of the economic impact of potential outbreaks, such as that determined by Cook et al. (2025) for Western Australia. While it is recognised that the actual risk of incursion and spread varies widely depending on local conditions, the analysis considers the incremental improvement that new surveillance and management approaches will have to reducing the risk of incursion and spread across Phylloxera Risk Zones (PRZs) and Phylloxera Exclusion Zones (PEZs) more broadly. It is also noted that it is reasonable to assume that the impact is likely to be greater in PRZs than PEZs due to higher baseline risk and proximity to PIZs.

The benefit that the learnings from DJP 2001 has had on future research has been quantified by applying an efficiency dividend to investment made in subsequent project AVR 2401 *Development and adoption of new tools for the surveillance and management of grapevine phylloxera,* which will run for the three-year period from July 2024 to June 2027. This is based on consultation indicating that DJP 2001, in particular studies 5 and 6 on the genetic diversity of phylloxera has provided evidence that has strongly influenced the themes in the new project. It is also noted that the National Phylloxera Management Protocol (NPMP) will be updated as part of the new project, as will extension resources that will assist with pathways toward industry adoption of research findings.

Estimated benefits

An outline of the assumptions supporting the quantification of impacts are reported in Table 8 below.

Table 8 Benefit assumptions for Project DJP 2001

Variable	Assumption	Source/ Explanation
Impact 1: Reduction in spread of phylloxera		
a) Area of PRZs	4,655 ha	Estimated from Wine Australia, Agriculture Victoria, and Vinehealth Australia phylloxera zone maps
b) Area of PEZs	141,040 ha	Estimated from Wine Australia, Agriculture Victoria, and Vinehealth Australia phylloxera zone maps
c) Cost of phylloxera spread to PRZs/ha	$60,000/ha	Based on previous cost estimates such as that documented in the Yarra Valley Case Study (Vinehealth Australia, 2024)
d) Risk of incursion and spread in PRZs	10%	Analyst estimate informed by previous studies and consultation
e) Risk of incursion and spread in PEZs	2.5%	Analyst estimate informed by previous studies and consultation
f) Reduction in risk of incursion and spread as a result of investment	5%	Analyst estimate – to be tested in sensitivity
g) Probability of valuable outcomes	80%	The project has led to valuable findings that have been widely shared, including through the Sustainable Winegrowing Australia Program
h) Probability of impact	75%	Updates to key protocols including the NPMP and National Diagnostics Protocol as well as other practical extension and adoption are expected to be progressed through a further three year project (AVR 2401)
i) Counterfactual	75%	Analyst estimate
Impact 2: Increased efficiency of future RD&E		
j) Value of new research project AVR 2401	$1.7 million	Three year investment by Wine Australia and project partners
k) Efficiency dividend on future research	2.5%	Analyst estimate – to be tested in sensitivity
l) Increased efficiency of future investment	$42,500	j) x k)
m) Probability of outcomes	100%	The project has already informed AVR 2401
n) Probability of impact	100%	AVR 2401 has already been contracted

Adoption costs

The estimated benefits are assumed to be net of expected adoption costs where applicable.

Counterfactual

The counterfactual assumes that while investment in phylloxera, an important industry issue, might otherwise have occurred, it is unlikely to have been of this magnitude covering the range of studies and collective actions.

Attribution

The attribution of benefits from the project - summarised in Table 9– considers any past inputs and expected future development costs required to realise beneficial outcomes. The attribution of the impacts quantified to the project are expected to be 32% being 17% for Wine Australia's contribution and 15% for other project parties' costs.

Table 9 Attribution of benefits for Project DJP 2001

Variable	Assumptions
Wine Australia costs	17%
Other project party costs	15%
Past RD&E costs	36%
Future RD&E costs	32%
Total	**100%**

Results

Table 10 below presents the modelled investment performance from the project. All past costs and benefits were expressed in 2025/26-dollar terms using the Implicit Price Deflator for GDP, while all future costs and benefits were discounted to 2025/26-dollar terms using a discount rate of 5%. A reinvestment rate of 5% was used for estimating the modified internal rate of return (MIRR). The analysis used the best available estimates for each variable, notwithstanding a level of uncertainty for many of the estimates. All analyses ran for the length of the investment period plus 30 years from the year of assessment.

The results show the total investment returning a net present value (NPV) of $9.73 million and a favourable BCR of 6.1.

Table 11 shows Wine Australia investment returning a NPV of $5.14 million and a BCR of 6.1.

Table 10 Investment criteria for total investment in DJP 2001 ($M)

Year	0	5	10	15	20	25	30
PV Benefits	$0.35	$5.87	$11.04	$11.63	$11.63	$11.63	$11.63
PV Costs	$1.90	$1.90	$1.90	$1.90	$1.90	$1.90	$1.90
NPV	1.56	$3.97	$9.14	$9.73	$9.73	$9.73	$9.73
BCR	0.2	3.1	5.8	6.1	6.1	6.1	6.1
IRR	N/A	25%	31%	31%	31%	31%	31%
MIRR	-16%	14%	16%	13%	12%	11%	10%

Table 11 Investment criteria for Wine Australia investment in DJP 2001 ($M)

Year	0	5	10	15	20	25	30
PV Benefits	$0.18	$3.10	$5.84	$6.15	$6.15	$6.15	$6.15
PV Costs	$1.01	$1.01	$1.01	$1.01	$1.01	$1.01	$1.01
NPV	$0.82	$2.10	$4.83	$5.14	$5.14	$5.14	$ 5.14
BCR	0.2	3.1	5.8	6.1	6.1	6.1	6.1
IRR	N/A	25%	31%	31%	31%	31%	31%
MIRR	-16%	14%	16%	13%	12%	11%	10%

The flow of total undiscounted costs and benefits from the project is presented in Figure 2 below.

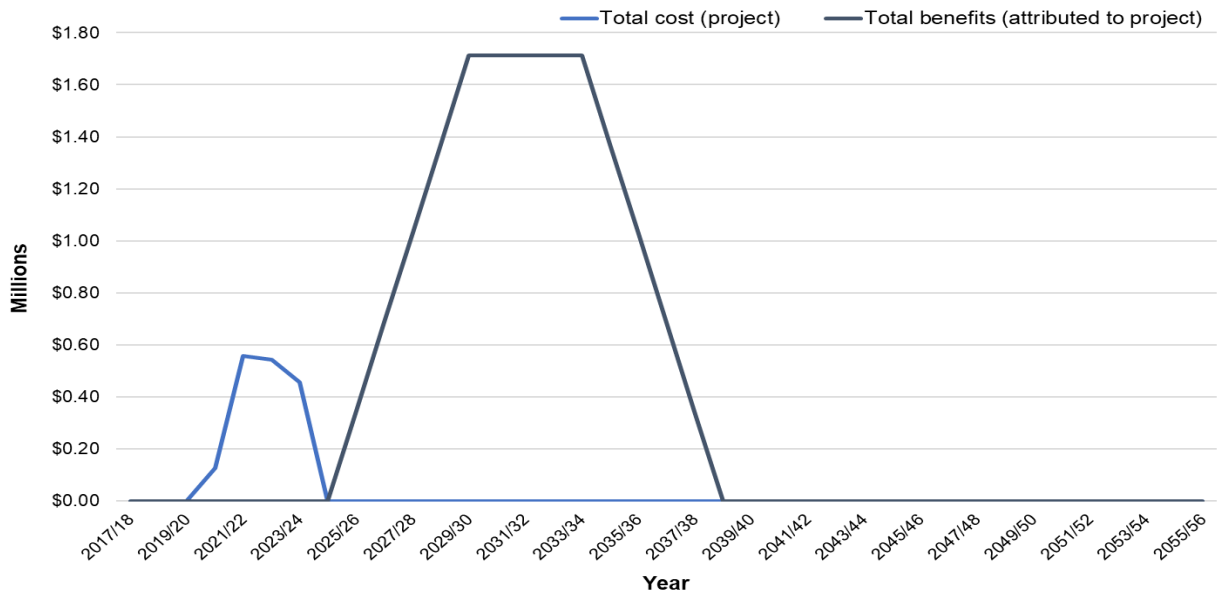


Figure 2 The flow of total undiscounted costs and benefits from DJP 2001

Sensitivity analysis

A sensitivity analysis was carried out to determine how the investment performance (NPV, BCR and MIRR after 30 years) would change based on changes to the discount rate and other key variables. The results are presented in Table 12 below.

Table 12 Sensitivity analysis for Project DJP 2001

Changes to key variables	NPV ($M)	BCR	MIRR
Standard assumption	$9.73	6.1	10%
Discount rate			
4%	$10.36	6.4	9%
6%	$9.15	5.8	11%
Reduction in risk of incursion and spread			
4%	$7.41	4.9	9%
6%	$12.05	7.3	11%

Efficiency dividend on future research			
2%	$9.73	6.1	10%
3%	$9.73	6.1	10%

Confidence ratings

The accuracy of the assessment is highly dependent on:

- The extent to which the analysis captures and quantifies the various benefits from the project, including non-market benefits (i.e. coverage of benefits)
- The level of confidence in the accuracy of assumptions used (i.e. confidence in assumptions).

An assessment of coverage and confidence ratings for this project is presented below in Table 13.

Table 13 Coverage and confidence ratings for Project DJP 2001

Factor	Rating	Comment
Coverage of benefits	Medium	While the impacts quantified are assumed to be the most significant, there are some expected social impacts, including increased capacity and improved mental health outcomes that have not been quantified
Confidence in assumptions	Medium	While there are peer reviewed and published estimates on the potential economic impact of phylloxera outbreaks, the results rely on assumptions by the analyst on the annual benefit that the project findings may lead to in terms of reducing the risk of such outbreaks and spread

Conclusions

The *Project DJP 2001: Integrated Management of Grapevine Phylloxera: Phase II* aimed to inform sustainable improvements to the management of grapevine phylloxera. The project improved disinfestation protocols for machinery, found two new resistant rootstocks, mapped genetic diversity in the King Valley, investigated soil characteristics contributing to phylloxera population dynamics, and trialled biocontrol options such as ladybugs and lacewings. The project also found all three surveillance methods (visual detection and LAMP tests on root and emergence trap samples) to be less effective but able to detect phylloxera in winter. The project has led to continuous improvements in the confidence in phylloxera surveillance and management approaches to reducing the likelihood and cost of further spread, as well as informed a new phase of the project with special attention to the King Valley.

Based on the adopted assumptions it is estimated that the project investment will likely deliver a positive economic benefit (BCR 6.1). The BCR remained positive across all modelled scenarios and is most sensitive to the assumed reduction in risk of incursion and spread. It is noted that the overall BCR is comparable to that found (BCR 5.5) in an impact assessment of *DED 1701: Integrated Management of Established Grapevine Phylloxera (Phase I)* conducted by AgEconPlus Consulting (2022).

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Appendix B: Drought Resilience (CSU 1702-9)

Background

Australian wine regions are expected to become warmer and more arid, making water management a critical challenge. While irrigation research for hot-climate vineyards is well established, cooler regions, where vines rely heavily on rainfall, have received less attention. These areas often lack large irrigation schemes to store water from wet years, leaving them vulnerable during extended dry periods. This raises important questions around understanding how much control growers have over water availability when rainfall dominates soil moisture, and how permanent ground cover affects water competition during drought.

Improving knowledge in this area is important if future drought risk in rain dependent viticulture is to be addressed without increasing reliance on irrigation. In this study, the extent of management control over water use in rain dependent viticulture was investigated to identify strategies to improve drought resilience of current and future vineyards. The study built on a two-year lead-in study where soil water dynamics and grapevine water status were monitored at three Shiraz vineyards in the Orange wine region through the 2019/20 and 2020/21 seasons.

Findings highlighted that the water competition from cover crops is significant in existing vineyards, and that there may be less scope to control this through species selection or existing management practices than is generally appreciated. In the event of longer-term dry periods that reduce irrigation storage, ground cover plants therefore represent competition for water use. Through a combination of field-based studies in vineyards in the Orange Wine Region, and water balance modelling to simulate potential drought adaptation strategies, the study found that there is still significant scope within existing water budgets to adapt to future increases in water demand. These findings suggest that current practices could be adapted to a gradual rise in water demand without the need for more water, but possibly not for a drought that extended beyond three years without increased irrigation security.

Description of the project

Project code	**CSU 1702-9**
Title	Agronomic tools to support a whole system approach to reducing water risk in rain dependent and supplementary irrigated viticulture
Research organisation	Charles Sturt University
Principal investigator	Jason Smith, Regina Billones-Baaijens, Gerhard Rossouw, Marco Hofmann Bruno Holzapfel
Wine Australia project manager	Alex Sas
Project duration	01/07/2021 – 31/03/2024
Wine Australia investment	$324,361

Rationale	Increasing rainfall variability and drought pose significant challenges for Australian viticulture, particularly in cooler regions that are predominantly rain-dependent and lack the buffering capacity of irrigation infrastructure. This study builds on prior research to develop strategies for drought resilience by examining water dynamics and ground cover management in rain-dependent vineyards without increasing reliance on irrigation.
Objectives	This project built on a two-year lead-study to develop strategies for more drought resilient vineyards and to investigate agronomic possibilities to improve drought resilience in rain dependent viticulture. Drawing together the lead-in study findings, and ideas for a combined measurement and

	modelling approach for responding to seasonal rainfall variability, six objectives of the project were as follows: 1. Collect a two-season dataset of vineyard soil water dynamics, grapevine transpiration and point measurements of mid-row water use from already established trial sites in the Orange region. In collaboration with Hochschule Geisenheim University, use this information to test and validate their vineyard water balance model for the prediction of grapevine water requirements under Australian viticultural conditions 2. Refine and continue the development of molecular techniques to allow the depth and relative root abundance of cover crop species and / or resident vegetation to be assessed from soil cores. At the Orange trial sites, characterise grapevine root distribution, the overlap with the rootzones of other species, and the relative share of plant available soil water 3. Using a combination of field and pot-based experiments, determine the extent of inherent variation in water use traits of selected cover crop species and their transpiration response to the onset of water stress 4. With the validated water balance model and parameters relating to root distribution, floor management and canopy size realistically varied, re-run historical seasons for each vineyard in progressive iterations and determine the potential effect on vine water status and soil water dynamics. Test how the measured variation in cover crop water use traits would translate differences in vineyard water use and influence the share of soil water available to grapevines through the season 5. Based on measured winter recharge of the full rootzone, seasonal rainfall forecasts and available irrigation, propose strategies for the use of canopy and vineyard floor management practices in existing vineyards that can be used to minimise the impact of within and between season rainfall variability on vineyard productivity and fruit composition 6. Based on improved understanding of functional water use traits of potential cover crop species, their influence on grapevine root distribution, and results from the companion project on ecosystems services, propose longer term strategies for the establishment of vineyards that have more natural water use efficiency and 'built-in' drought resilience.
Activities and outputs	• Plot trial sites of selected crop cover species were established in Orange at See Saw Wines Balmoral Vineyard and Angullong Wines Angullong Vineyard in mid-2019. These sites were established to investigate grapevine water requirements under Australian viticultural conditions by developing an understanding of soil and vine water dynamics, tracking rainfall, soil moisture, vine water status, vine growth and yield. Additional trial sites were set-up throughout the life of the study • Over four seasons (2019-23), the project investigated soil and plant-based measurements to investigate water use traits and inform water management strategies in high rainfall winery regions • A combined soil coring and DNA molecular study identified which plant roots were using water different soil depths. This study made a major advance in understanding of how irrigation and root competition modify the growth of the grapevine root system and access to water • A weather station was installed in 2020 at two sites, and in 2021, further instrumentation upgrades occurred to record irrigation events during the 2021/22 and 2022/23 seasons

	• Phenology, canopy growth, berry development and yield assessments were made • Ground cover water use traits were tested across field plot trials and pot experiments to compare across various common ground cover species • Water balance modelling of a pre-existing northern hemisphere model occurred to run southern hemisphere simulations and validate the model against measured plant and soil data from the Orange trial sites. The second objective was to test how variations in vineyard management practice or vineyard design change vineyard water use, and the share of water use between the vines, ground cover plant species and evaporation. In the shorter term for the benefit of existing vineyards, but also for the assessment of water risk under future climate scenarios. The model tested how changes in ground cover, row spacing, root depth and management practices affect vineyard water stress under historical climate conditions • Combined project achievements and industry implications disseminated via final report to Wine Australia, industry journal article and peer reviewed publications • Development of data providing insight to the functional role of vine and cover crop roots in relation to competition for water.
Outcomes	• New knowledge about water competition from cover crops indicating that it is significant and that there may be less scope to control this through species selection or existing management practices. In higher rainfall regions, this may not be a problem in all seasons, and irrigation would usually be sufficient to buffer shorter period of drought. In longer-term dry periods where irrigation storage is less, findings show that ground cover plants can rapidly deplete soil water in spring • New insights about microbial profiling indicating the benefits of plant diversity in the vineyard, but also highlighting the complexity in attempting to deliberately manage these and link particular populations to grapevine root function • Enhanced application of northern hemisphere water balance model, extending its scope to the southern hemisphere and therefore improving researcher knowledge and capability.
Potential impacts	• Improved management responses for grape growers in cooler, predominantly rain dependent regions during and following a drought, potentially leading to improved yield and quality, and reduced costs of production • Improved water control and management practices, leading to environmental resilience during short-term droughts and increased sustainability over the long-term • Additional researcher skills in understanding existing water management practices, enabling evidence-informed adaptation planning under future water supply scenarios • Increased ability to apply water-balancing model across a variety of crops in similar regions and systems, leading to increased researcher ability to predict future water demand trends and therefore improving the potential for growers to plan for future water supply scenarios • Contribution to improving the long-term sustainability of regional communities and Australia's agrifood sectors.

Project investment

A breakdown of Wine Australia investment in the project and contribution by others is shown by financial year and in aggregate in Table 14.

Table 14 Total investment in CSU 1702-9 (nominal)

Year ending June 30th	Wine Australia ($)	Others ($)	Total contributions
2021/22	$159,049	$257,152	$416,201
2022/23	$165,312	$266,612	$431,924
Total	**$324,361**	**$523,764**	**$848,125**

Source: Information provided by Wine Australia.

For the BCA, the cost of managing the Wine Australia funding was added to the Wine Australia contribution for the project using a multiplier of 1.12, i.e. consistent with past year assessments, overhead costs are assumed to be 12%. In undertaking the impact assessment, all past costs were expressed in 2025/26-dollar terms using the Implicit Price Deflator for GDP.

Summary of impacts

Table 15 below provides a breakdown of the expected impacts across the triple bottom line (economic, environmental, and social).

Table 15 Triple bottom line impacts, including those valued as part of this evaluation (in bold) for Project CSU 1702-9

Economic	• **Improved management responses for grape growers in cooler, predominantly rain dependent regions during and following a drought, potentially leading to improved yield and quality, and reduced costs of production.**
Environmental	• Improved water control and management practices, leading to environmental resilience during short-term droughts and increased sustainability over the long-term • Additional researcher skills in understanding existing water management practices, enabling evidence-informed adaptation planning under future water supply scenarios.
Social	• Increased ability to apply water-balancing model across a variety of crops in similar regions and systems, leading to increased researcher ability to predict future water demand trends and therefore improving the potential for growers to plan for future water supply scenarios. • Contribution to improving the long-term sustainability of regional communities and Australia's agrifood sectors.

Public versus private impacts

This project will generate both public and private impacts. Public benefits will be delivered to regional communities in cooler, rain dependent grape growing regions via improved land management decisions, leading to increased vineyard resilience, more sustainable environments and profitable agribusinesses in these regions. In generating improved soil water availability data, the work also benefits future drought planning, important at both an individual business scale and a regional and national community scale. Private benefits will be delivered directly to grape growers as a result of increased business resilience, during and post drought events.

Distribution of private impacts

Productivity gains realised by producers because of enhanced decision-making and land management practices during drought conditions will be distributed predominantly amongst individual businesses, with some flow-on impacts experienced throughout the supply chain as a result of ongoing operations.

Impacts on other Australian industries

This project has the potential to be useful for guiding future water management research in other vine crops. The findings have also contributed to a subsequent project receiving funding via the Australian Government's Future Drought Fund which is a collaboration between participants in the viticulture, cherry and apple industries.

Impacts overseas

Adaptation of the northern hemisphere water balance modelling tool creates flow-on effects internationally by increasing the ability of the tool to forecast future water scenarios globally. It is noted that findings from the project have been presented in both New Zealand and Germany.

Quantification of impacts

The main impact from the project will arise from the opportunity for grape growers in cooler, predominantly rain dependent regions to use the findings to inform management responses in the event of prevailing drought conditions to mitigate potential impacts on yield, quality and costs of production. Armed with increased knowledge about the competitive effects of cover crops during dry conditions, one feasible management response might be to terminate the cover crop if faced with an extended dry period.

For the BCA, the analysis has considered the extent to which the cost of terminating and re-establishing the cover crop might be outweighed by potential yield benefits. Historic and future climate projection data available from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Bureau of Meteorology (BOM) was used to inform assumptions on the frequency of drought events that might trigger a management response.

At this stage it was assumed that the benefits might apply to growers in cooler climate, rain dependent regions across NSW, ACT, Victoria, Tasmania, South Australia and Western Australia (including Adelaide Hills, Clare Valley, Barossa Valley, Coonawarra, Wrattonbully, Mount Gambier, Kangaroo Island, Southern Fleurieu, Orange, Murrumbateman, Tumbarumba, Alpine, Yarra, Great Southern and Tasmania). It is recognised that the project learnings may also have relevance for growers in parts of Queensland and the Northern Territory. Management responses applicable to a range of growing regions will be further tested in a new five-year project funded by the Australian Government's Future Drought Fund. The analysis recognises that the likelihood of the project outcomes and impacts being realised will likely increase as the new project progresses and tools to aid extension and more widespread adoption are further developed.

Given the further work that is yet to occur, project impacts are expected reach maximum impact by 2032/33.

Estimated benefits

An outline of the assumptions supporting the quantification of impacts are reported in Table 16 below.

Table 16 Benefit assumptions for Project CSU 1702-9

Variable	Assumption	Source/ Explanation
Impact 1: Avoided yield losses as a result of improved management responses during drought conditions in cooler, rain dependent wine growing regions		
a) Potential yield impact from cover crop in drought year	20%	Analyst estimate informed by consultation and tested in sensitivity

b) Average yield across cool climate regions	10.70 t/ha	Informed by consultation and Wheeler et al. (2022)
c) Yield impact	2.14 t/ha	a) x b)
d) Average price per tonne	$1,386 per tonne	Informed by consultation and Wheeler et al. (2022)
e) Value of potential yield impact	$2,966 /ha	c) x d)
f) Cost of terminating and re-establishing cover crop	$200 /ha	Analyst estimate informed by consultation
g) Estimated benefit of management response in drought years	$2,766 /ha	e) x f)
h) Area to which findings might apply	37,401 ha	Cooler climate, rain dependent regions E.g. Adelaide Hills, Clare Valley, Barossa Valley, Coonawarra, Wrattonbully, Mount Gambier, Kangaroo Island, Southern Fleurieu, Orange, Murrumbateman, Tumbarumba, Alpine, Yarra, Great Southern and Tasmania. (Wine Australia, n.d.)
i) Proportion of years in which drought response might be applied	15%	Information obtained from CSIRO and BOM suggests frequency of years in which annual rainfall is in the lowest 10th percentile might increase from 3 in 10 years to up to 7 in 30 years in future climate scenarios
j) Proportion of growers who might adopt management response	35%	Analyst estimate
k) Probability of outcomes	75%	The project provided useful information that can be used to inform management responses; however, a future project will further test the range of possible management responses across different growing regions and further develop tools to aid extension and adoption
l) Probability of impact	90%	There is a relatively high likelihood that more informed management responses will lead to improved yield outcomes

Adoption costs

The analysis above relies on an example management response where a grape grower would terminate and re-establish the cover crop in a drought year where competition from the cover crop is deemed to be likely to be

detrimental to crop yield in the current and/or subsequent years. Based on consultation, the cost of terminating and re-establishing the cover crop has been estimated at $200 per ha.

Counterfactual

The counterfactual assumes that drought resilience research may have occurred, but that cooler climate, rain dependent vineyard systems may not have been the focus. In the absence of this information, the approach to vineyard floor management by growers in these regions would likely be to continue to manage ground cover crops even during dry periods. Therefore, the benefits assumed in this analysis would not have occurred in the absence of investment in this project, the lead-in research and a new project that is receiving funding via the Australian Government's Future Drought Fund.

Attribution

The attribution of benefits from the project – summarised in Table 17 – considers any past inputs and expected future RD&E costs required to realise beneficial outcomes. The attribution of the impacts quantified to the project are expected to be 12% being 5% for Wine Australia's contribution and 7% for other project parties' costs.

Table 17 Attribution of benefits for Project CSU 1702-9

Variable	Assumptions
Wine Australia costs	5%
Other project party costs	7%
Past RD&E costs	5%
Future RD&E costs	84%
Total	**100%**

Results

Table 18 below presents the modelled investment performance from the project. All past costs and benefits were expressed in 2025/26-dollar terms using the Implicit Price Deflator for GDP, while all future costs and benefits were discounted to 2025/26-dollar terms using a discount rate of 5%. A reinvestment rate of 5% was used for estimating the modified internal rate of return (MIRR). The analysis used the best available estimates for each variable, notwithstanding a level of uncertainty for many of the estimates. All analyses ran for the length of the investment period plus 30 years from the year of assessment.

The results show the total investment returning a net present value (NPV) of $2.27 million and a favourable BCR of 3.2. Table 19 shows Wine Australia investment returning a NPV of $0.93 million and a BCR of 3.2.

Table 18 Investment criteria for total investment in CSU 1702-9 ($M)

Year	0	5	10	15	20	25	30
PV Benefits	$0.00	$0.26	$1.47	$2.56	$3.22	$3.27	$3.27
PV Costs	$1.01	$1.01	$1.01	$1.01	$1.01	$1.01	$1.01
NPV	-$1.01	-$0.75	$0.46	$1.55	$2.21	$2.27	$2.27
BCR	-	0.3	1.5	2.5	3.2	3.2	3.2
IRR	N/A	-12%	8%	12%	14%	14%	14%
MIRR	-100%	-6%	7%	9%	9%	9%	8%

Table 19 Investment criteria for Wine Australia investment in CSU 1702-9 ($M)

Year	0	5	10	15	20	25	30
PV Benefits	$0.00	$0.11	$0.60	$1.05	$1.32	$1.34	$1.34
PV Costs	$0.41	$0.41	$0.41	$0.41	$0.41	$0.41	$0.41
NPV	-$0.41	-$0.31	$0.19	$0.63	$0.91	$0.93	$0.93
BCR	-	0.3	1.5	2.5	3.2	3.2	3.2
IRR	N/A	-12%	8%	12%	14%	14%	14%
MIRR	-100%	-6%	7%	9%	9%	9%	8%

The flow of total undiscounted costs and benefits from the project is presented in Figure 3 below.

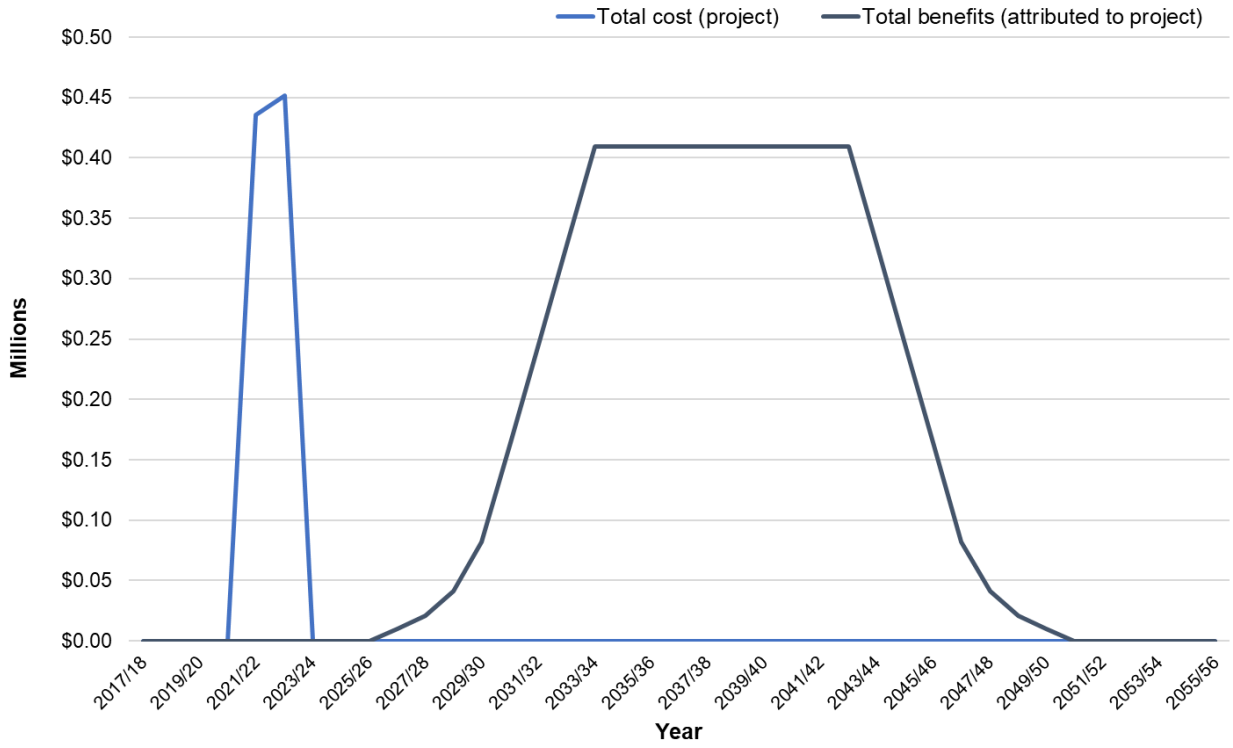


Figure 3 The flow of total undiscounted costs and benefits from CSU 1702-9

Sensitivity analysis

A sensitivity analysis was carried out to determine how the investment performance (NPV, BCR and MIRR after 30 years) would change based on changes to the discount rate and other key variables. The results are presented in Table 20 below.

Table 20 Sensitivity analysis for Project CSU 1702-9

Changes to key variables	NPV ($M)	BCR	MIRR
Standard assumption	$2.27	3.2	8%

Discount rate			
4%	$2.62	3.6	8%
6%	$1.96	2.9	9%
Potential yield impact from cover crop in drought year			
15%	$1.39	2.4	7%
25%	$3.14	4.1	9%
Drought years in which management response might be adopted			
10%	$1.17	2.2	7%
20%	$3.36	4.3	9%

Confidence ratings

The accuracy of the assessment is highly dependent on:

- The extent to which the analysis captures and quantifies the various benefits from the project, including non-market benefits (i.e. coverage of benefits)
- The level of confidence in the accuracy of assumptions used (i.e. confidence in assumptions).

An assessment of coverage and confidence ratings for this project is presented below in Table 21.

Table 21 Coverage and confidence ratings for Project CSU 1702-9

Factor	Rating	Comment
Coverage of benefits	Medium	Economic benefits realised through the mitigation of potential impacts on grape yield and quality and potential cost of production savings are expected to be the most significant impact from this project. While the analysis is based on terminating the cover crop under drought conditions, growers might ultimately apply other management responses although these are expected to yield benefits of a similar magnitude
Confidence in assumptions	Medium	Assumptions to inform the analysis have relied on a combination of published information and data sources and analyst assumptions informed by consultation with industry stakeholders

Conclusions

CSU 1702-9: Drought Resilience aimed to develop strategies for drought resilience by examining water dynamics and ground cover management in rain-dependent vineyards without increasing reliance on irrigation. The project improved knowledge around cover crop management and microbial benefits of plant diversity. It found that in long periods of drought, cover crops rapidly deplete soil water in spring. The findings suggest that current practices could be adapted in response to a gradual rise in water demand to mitigate potential impacts on grape yield and quality. One such response might be through the termination of the cover crop during extended drought conditions; however, subsequent research is underway to further test possible management responses across a number of growing regions.

Based on the adopted assumptions it is estimated that the project investment will likely deliver a positive economic benefit (BCR 3.2). The BCR remained positive across all modelled scenarios.

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Appendix C: Emissions Reduction Roadmap (EDG 2201)

Background

The Australian wine sector faces significant challenges from the direct impacts of climate change, as well as the changing expectations amongst regulators and consumers for transition to a low carbon future.

Wine production is emissions intensive across multiple stages of the value chain, including vineyard operations, winery energy use, packaging, and domestic and international transport. Prior to this project, there was no consistent, sector wide emissions baseline for Australian grape and wine production, nor a coordinated, evidence-based pathway to guide emissions reduction efforts across the industry. As a result, individual businesses faced challenges in understanding where emissions were generated, which actions were likely to be most effective, and how sector level action could support continued market access and competitiveness.

The project was initiated to address this gap by providing the Australian grape and wine sector with a clear, data driven understanding of its greenhouse gas emissions footprint and a practical pathway to reduce emissions over time. Using the 2020–21 financial year as a baseline, the project quantified Scope 1, 2 and 3 emissions across vineyards, wineries and key supply chain activities, identifying the major sources of emissions and the relative contribution of different parts of the value chain.

Beyond establishing an emissions baseline, the project assessed and prioritised emissions reduction opportunities that are realistic and achievable for the sector. The Emissions Reduction Roadmap (the Roadmap) (Wine Australia, 2023a) focuses on actions that growers, winemakers and supply chain partners can take to reduce emissions by 2030. Importantly, the project recognises that while some emissions reductions are within the direct control of grape and wine businesses, others will depend on broader changes in energy systems, transport, packaging manufacture and emerging technologies.

The development of the Roadmap was underpinned by extensive stakeholder engagement across the grape and wine community, including growers, winemakers, suppliers and industry organisations. This ensured that the Roadmap reflected real world production systems, commercial constraints and the diversity of business sizes and operating contexts within the sector. Alongside the Roadmap, companion educational resources, including an *Emissions Reduction Guide* (2023b) and a *Carbon Tools and Accounting* (2023c) guidance document were produced to support on-farm and winery level decision-making and adoption.

By providing an emissions baseline, a prioritised set of reduction initiatives, and a shared framework for action, the project supports the Australian wine sector to respond proactively to climate change risks, meet evolving market expectations, and safeguard the long-term sustainability and reputation of Australian wine.

Description of the project

Project code	**EDG 2201**
Title	Emissions Reduction Roadmap
Research organisation	Edge Environment
Principal investigator	Julian Marchant
Wine Australia project manager	Sharon Harvey
Project duration	06/06/2022 – 16/10/2023
Wine Australia investment	$304,141

Rationale	The Australian wine sector faces significant challenges from the direct impacts of climate change, as well as changing expectations from regulators and consumers. Prior to this project, the sector lacked a consistent, sector-wide emissions baseline and an evidence-based pathway to prioritise practical emissions reduction actions. The Roadmap was developed to address this gap and ensure that the industry is prepared for, and taking steps towards, the transition to a low-carbon future.
Objectives	• Provide practical advice to the wine and grape sector to contribute to emissions reduction across the industry • Focus on what is achievable by 2030 and provide cost-effective tools, knowledge and advice to support grape and wine producers.

Activities and outputs	• Engagement with over 300 grape and wine sector stakeholders, conducted through: stakeholder surveys; workshops with participation from winegrape growers, winemakers, suppliers and farm and winery advisors; a project-specific expert reference panel (ERP); interviews with key stakeholders; and meetings with sector stakeholders
	• Calculation and reporting of the sector's greenhouse gas (GHG) emissions baseline. The baseline was calculated using a variety of data sources from the 2020/21 financial year and modelling compared this emissions baseline to a 2030 target year emissions projection
	• Identification of a set of 11 emissions reduction initiatives, chosen and supported by input from the ERP, key sector personnel and information gained from stakeholder engagement. Initiatives were chosen with consideration of feasibility and likelihood of adoption
	• Modelling of emissions reduction potential for all initiatives via a marginal abatement cost curve and an emissions reduction waterfall chart. Modelling demonstrated the total savings in emissions from the year of implementation to 2030. Initiatives were ranked in order of the greatest emissions reduction potential at the 2030 timeframe
	• Key outputs included:
	  ○ A *Roadmap* document detailing the why and the what of decarbonisation for the sector and demonstrating the sector's intentions for stakeholders, supply chain partners, governments, customers, consumers and markets
	  ○ A practical *Guide*, to support the Roadmap and set out the how of emissions reduction for grape growers and winemakers, both in their own businesses and to empower collective action across the production and supply chain
	  ○ A *Tools* document, which provides an assessment of carbon accounting tools available to grape growers and winemakers
	  ○ A project *Report* suitable for Wine Australia and other peak industry bodies with technical information and details not included elsewhere.

Outcomes	• A clearly stated, coordinated approach to sector-wide emissions reduction, supporting global decarbonisation efforts • Sector-wide encouragement to implement a number of key initiatives across all three emissions scopes, with a longer-term goal of net zero by 2050.
Potential impacts	• Increases the industry's social licence to operate (SLO) which may lead to improved market access and competitiveness

	• Promotes accelerated adoption and a more efficient emissions reduction pathway • Potential for reduced business costs associated with long-term energy efficiency gains • Potential for savings from more targeted and coordinated investment in future RD&E and initiatives to support emission reduction across the supply chain • Builds industry capacity to adjust and respond.

Project investment

A breakdown of Wine Australia investment in the project and contribution by others is shown by financial year and in aggregate in Table 22.

Table 22 Total investment in EDG 2201 (nominal)

Year ending June 30th	Wine Australia ($)	Others ($)	Total contributions
2022/23	$83,930	-	$83,930
2023/24	$220,211	-	$220,211
Total	**$304,141**	**-**	**$304,141**

Source: Information provided by Wine Australia.

For the BCA, the cost of managing the Wine Australia funding was added to the Wine Australia contribution for the project using a multiplier of 1.12, i.e. consistent with past year assessments, overhead costs are assumed to be 12%. In undertaking the impact assessment, all past costs were expressed in 2025/26-dollar terms using the Implicit Price Deflator for GDP.

Summary of impacts

Table 23 below provides a breakdown of the expected impacts across the triple bottom line (economic, environmental, and social).

Table 23 Triple bottom line impacts, including those valued as part of this evaluation (in bold) for Project EDG 2201

Economic	• **Increases the industry's social licence to operate (SLO) which may lead to improved market access and competitiveness** • **Contribution to an accelerated and more optimal uptake and adoption of emissions-reducing activities, technology and initiatives, resulting in efficiency gains throughout the supply chain** • Potential for reduced business costs associated with long-term energy efficiency gains • Increased effectiveness of RD&E to support emissions reduction activities by the industry due to evidence-informed and targeted investment.
Environmental	• Contribution to a reduction in carbon emissions • Potential for reduced industrial waste and increased soil health resulting from uptake of emissions reduction initiatives and technology.
Social	• Increased sustainability of the sector and a reduced carbon footprint, ensuring retained market access and SLO both globally and domestically • Increased capacity for RDCs across Australia to develop supportive industry tools that aim to empower industries to reduce their emissions.

Public versus private impacts

This project will generate both public and private impacts. Public economic, social and environmental benefits will be realised by an overall reduction in carbon emissions. This will in turn lead to private benefits for the grape and wine sector due to increased perceptions of the industry and its place in domestic and global markets. In addition, the grape and wine sector and its supply chain will benefit by a more coordinated and efficient pathway to achieving it emissions reduction targets. The project also has the benefit of informing further RD&E in the wine industry generating benefits for both public and private investors.

Distribution of private impacts

A more efficient pathway to achieving emissions reduction targets will lead to reduced business costs across the supply chain. The Roadmap itself provides valuable information on the key sources of baseline emissions and reduction potential across industrial processes and supply chain (49%), transport (29%), winery operations (12%) and vineyard operations (10%). Improved market access and competitiveness resulting from an increase in the industry's SLO will also ultimately benefit private businesses throughout the supply chain.

Impacts on other Australian industries

This project could provide impetus and ideas for other RDCs to support their respective industries. The operational efficiencies and reduced waste through infrastructure and behaviour change could be generalised to other industries. There is also potential for the data to inform estimates of Australia's agricultural carbon footprint and to identify shared emissions-reduction opportunities across and within agricultural industries.

Impacts overseas

The project will help to retain and improve competitiveness on international markets for Australian wine particularly in the Scandinavian countries, which have higher sustainability requirements. This increases options for international consumers demanding products with improved sustainability credentials.

Quantification of impacts

For the BCA, the quantification of impacts has focused on 1) a more efficient pathway to emissions reduction and 2) improvement in the industry's social licence to operate which might ultimately increase market access and competitiveness.

The quantification of the first impact has relied on information contained in the Roadmap, which suggests that through sector-wide collaboration and action, the industry can achieve a reduction in emissions of 42 per cent by 2030 compared to a business-as-usual scenario. This reduction is based on the uptake of 11 emissions reduction initiatives across different parts of the supply chain, which have been prioritised based on modelling using a marginal abatement cost curve and an emissions reduction waterfall chart.

The quantification of the second impact acknowledges the current social and political atmosphere with a push toward net zero emissions. The analysis assumes that through a coordinated and systematic approach to emissions reduction, the project provides an incremental contribution to improving the industry's social licence to operate, benefitting sales of Australian wine in domestic and international markets, which will in turn lead to an increase in the profitability of Australian wine production.

The analysis assumes that benefits from the project will have begun to be realised following release of the Roadmap in September 2023. This acknowledges the significant amount of industry consultation that occurred during its development, but also that momentum will continue to build subject to ongoing communication, engagement and extension activities across the period to 2030. While the industry will continue to pursue a path toward net zero by 2050, the analysis assumes that activity beyond 2030 will likely be informed by the development of an updated roadmap informed by new information and modelling and therefore the project impacts will likely be superseded beyond 2030.

Estimated benefits

An outline of the assumptions supporting the quantification of future benefits and costs are reported in Table 24 below.

Table 24 Benefit Assumptions for Project EDG 2201

Variable	Assumption	Source/ Explanation
Impact 1: More efficient pathway to emissions reduction		
a) Baseline emissions in 2021	1.77 million tonnes	Emissions Reduction Roadmap (Wine Australia, 2023a)
b) Industry emissions in 2030 with priority reduction initiatives	1.02 million tonnes	Emissions Reduction Roadmap (Wine Australia, 2023a)
c) Emissions reduction attributable to 11 priority reduction initiatives	581,348 tonnes	Emissions Reduction Roadmap (Wine Australia, 2023a)
d) Net cost of 11 priority emissions reduction initiatives	$276.1 million	Calculated using project documents and background materials provided by Wine Australia, i.e. contribution made to emissions reduction by each of the 11 initiatives multiplied by the $/tonne of CO_2 equivalent as determined via the Marginal Abatement Cost Curve
e) Probability of achieving reductions	75%	The Roadmap states that there is a realistic opportunity of achieving the sector's reduction target by 2030
f) Expected net cost of emissions reduction by 2030	$207.1 million	d) x e)
g) Contribution of the Roadmap to a more efficient pathway to sector wide emissions reduction	2.5%	Analyst estimate to be tested in sensitivity
h) Probability of outcomes	80%	The development of the Emissions Reduction Roadmap was supported by extensive consultation and existing industry data largely obtained through the Sustainable Winegrowing Australia, providing a strong evidence base for identifying priority reduction initiatives
i) Probability of impact	75%	Development of a Marginal Abatement Cost Curve has informed the prioritisation of initiatives that will achieve the greatest sector wide impact
Impact 2: Maintain/improve social licence to operate		
j) Australian wine production	1,130 million litres per annum	Market Insights: Production, sales and inventory report 2024–25 (Wine Australia, 2025)

k) Profitability on wine production	$0.50 per litre	Analyst estimate of industry-wide profitability based on AgEconPlus Consulting & Gillespie Economics (2025) and stakeholder consultation
l) Proportion of sales at risk due to a loss of SLO	5%	Analyst estimate
m) Reduction in risk of loss of SLO due to sector-wide approach to emissions reduction	0.5%	Analyst estimate
n) Probability of outcomes	70%	It is likely that a collective, sector-wide approach to emissions reduction will have greater influence of societal and market expectations
o) Probability of impact	60%	There is a risk that ruling market conditions will prevent benefits from being realised

Adoption costs

The analysis relies on information generated throughout the project through the development of a Marginal Abatement Cost Curve, which estimates the cost per tonne of CO_2 equivalent for the prioritised emissions reduction initiatives.

Counterfactual

Consultation suggests that the wine sector has been proactive in its approach to emissions reduction with many activities being industry led. For this reason, the impacts quantified focus on the marginal benefits of a collective approach to emissions reduction, i.e. a more efficient, or optimal, emissions reduction pathway and an improvement in the industry's social licence to operate. The counterfactual therefore assumes that the quantified would not have been realised without investment in the project.

Attribution

The attribution of benefits from the project – summarised in Table 25 – considers any past inputs and expected future development costs required to realise beneficial outcomes. For the purpose of the analysis, it is assumed that the industry will continue to undertake promotion and extension activities to support the implementation of the roadmap valued at $60,000 per year over the period to 2030.

Table 25 Attribution of benefits for EDG 2201

Variable	Assumptions
Wine Australia costs	56%
Future promotion and extension activities	44%
Total	**100%**

Results

Table 26 below presents the modelled investment performance from the project. All past costs and benefits were expressed in 2025/26-dollar terms using the Implicit Price Deflator for GDP, while all future costs and benefits were discounted to 2025/26-dollar terms using a discount rate of 5%. A reinvestment rate of 5% was used for estimating the modified internal rate of return (MIRR). The analysis used the best available estimates for each variable, notwithstanding a level of uncertainty for many of the estimates. All analyses ran for the length of the investment period plus 30 years from the year of assessment.

The results show that the total investment returns a net present value (NPV) of $1.29 million and a favourable BCR of 4.5. As the project was entirely funded by Wine Australia, these results also represent the returns on Wine Australia's investment, as shown in Table 27.

Table 26 Investment criteria for total investment in EDG2201 ($M)

Year	0	5	10	15	20	25	30
PV Benefits	$0.33	$1.66	$1.66	$1.66	$1.66	$1.66	$1.66
PV Costs	$0.37	$0.37	$0.37	$0.37	$0.37	$0.37	$0.37
NPV	-$0.04	$1.29	$1.29	$1.29	$1.29	$1.29	$1.29
BCR	0.9	4.5	4.5	4.5	4.5	4.5	4.5
IRR	-3%	56%	56%	56%	56%	56%	56%
MIRR	3%	19%	15%	12%	11%	10%	9%

Table 27 Investment criteria for Wine Australia investment in EDG2201 ($M)

Year	0	5	10	15	20	25	30
PV Benefits	$0.33	$1.66	$1.66	$1.66	$1.66	$1.66	$1.66
PV Costs	$0.37	$0.37	$0.37	$0.37	$0.37	$0.37	$0.37
NPV	-$0.04	$1.29	$1.29	$1.29	$1.29	$1.29	$1.29
BCR	0.9	4.5	4.5	4.5	4.5	4.5	4.5
IRR	-3%	56%	56%	56%	56%	56%	56%
MIRR	3%	19%	15%	12%	11%	10%	9%

The flow of total undiscounted costs and benefits from the project is presented in Figure 4 below.

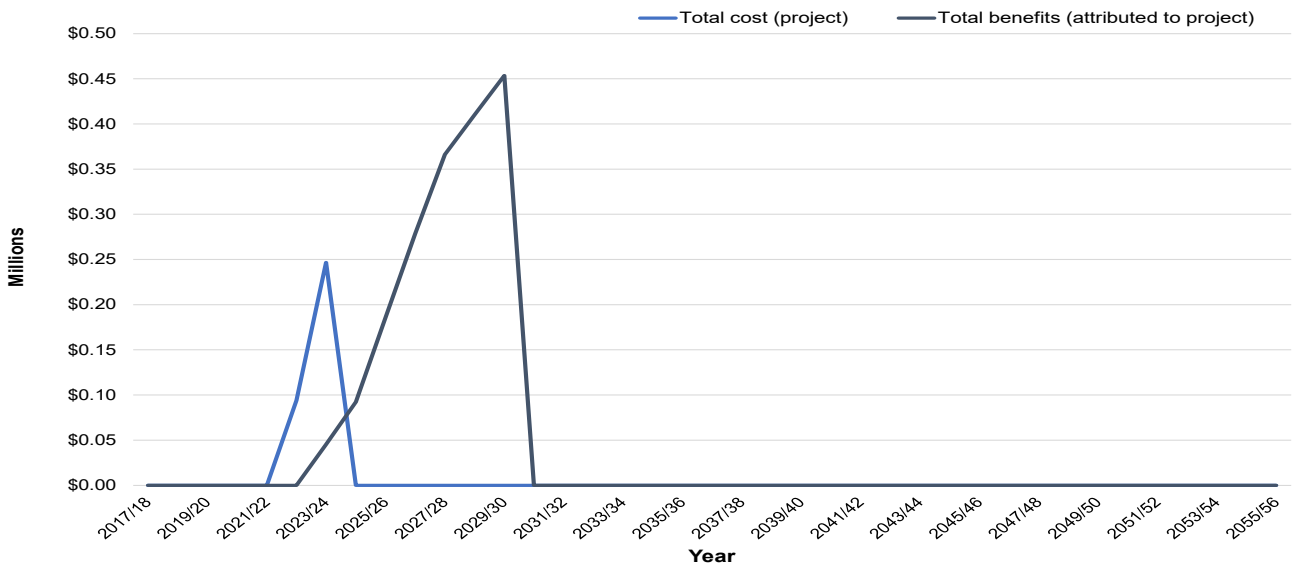


Figure 4 *The flow of total undiscounted costs and benefits from EDG 2201*

Sensitivity analysis

A sensitivity analysis was carried out to determine how the investment performance (NPV, BCR and MIRR after 30 years) would change based on changes to the discount rate and other key variables. The results are presented in Table 28 below.

Table 28 *Sensitivity analysis for Project EDG 2201*

Changes to key variables	NPV ($M)	BCR	MIRR
Standard assumption	$1.29	4.5	9%
Discount rate			
4%	$1.31	4.6	9%
6%	$1.26	4.4	10%
Efficiency dividend from the emissions reduction roadmap			
2%	$0.97	3.6	9%
3%	$1.60	5.4	10%
Reduction in risk of loss of SLO due to sector-wide approach to emissions reduction			
0%	$1.21	4.3	9%
1%	$1.37	4.7	10%

Confidence ratings

The accuracy of the assessment is highly dependent on:

- The extent to which the analysis captures and quantifies the various benefits from the project, including non-market benefits (i.e. coverage of benefits)
- The level of confidence in the accuracy of assumptions used (i.e. confidence in assumptions).

An assessment of coverage and confidence ratings for this project is presented below in Table 29.

Table 29 Coverage and confidence ratings for Project EDG 2201

Factor	Rating	Comment
Coverage of benefits	Medium	The benefits quantified cover those most likely to be attributable to the project, however, it is recognised that the project contributes to a broader range of economic, social and environmental benefits that are not quantified as part of the analysis
Confidence in assumptions	Low-Medium	It is widely recognised that it is difficult to measure changes to social licence and resultant market impacts, and while there is considerable anecdotal evidence pointing to this benefit, the quantum is uncertain. There is greater confidence in the assumptions relating to a more efficient reduction pathway which is based on the Marginal Abatement Cost Curve generated as part of the project

Conclusions

The *Project EDG 2201: Emissions Reduction Roadmap* aimed to inform a sector-wide emissions baseline and an evidence-based pathway to prioritise practical emissions reduction actions, for a low-carbon future. The project created a clearly stated, coordinated approach to sector-wide emissions reduction, and a variety of tools for assisting winemakers and grape growers. The main impacts quantified were the improved efficiency of industry abatement activities and improved social license to operate as a result of this coordinated approach.

Based on the adopted assumptions it is estimated that the project investment will likely deliver a positive economic benefit (BCR 4.5). The BCR remains favourable under all modelled scenarios.

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Appendix D: Influencing wine style and efficiency through management of oxygen during wine production (AWR 1701-3.1.5)

Background

Red and white wine fermentation systems respond differently to the addition of oxygen. Adding oxygen to white wine fermentations mainly shortens the overall fermentation time, with only minor effects on the wine's sensory characteristics. In contrast, adding oxygen during red wine fermentations provides only modest gains in fermentation performance but can significantly influence the wine's chemical composition and sensory properties.

Strategies and equipment for measuring dissolved oxygen or redox status during fermentation are often impractical, expensive, or technically challenging to implement in real-world situations. Therefore, in this study, aeration solutions that do not require information about dissolved oxygen concentration or redox status were investigated. To investigate the differences in impacts, laboratory-scale and pilot-scale trials were conducted to define airflow rate and duration metrics. Researchers also compared spontaneous and inoculated fermentations to determine whether yeast origin influences oxygen response.

The project extended beyond fermentation into wine ageing, monitoring wines with known oxygen exposure to characterise oxygen-driven chemical changes. Key moderating factors, such as metal ion concentrations, pH, and the timing and duration of oxygen addition, were assessed for their role in shaping wine stability and quality over time.

A set of educational resources was generated on the effects of aeration during fermentation in red and white wines. These resources include the different ways of undertaking aeration and the methods available to measure those effects. Extension materials related to aeration were continuously developed as a direct consequence of experimental work undertaken during the project. In the final year of the project, team members provided content for an adoption program across various formats, including webinars, podcasts, demonstration videos and web-accessible fact sheets.

Description of the project

Project code	**AWR 1701-3.1.5**
Title	Influencing wine style and efficiency through management of oxygen during wine production
Research organisation	Australian Wine Research Institute
Principal investigator	Simon Schmidt
Wine Australia project manager	Paul Smith
Project duration	01/07/2017 – 30/06/2022
Wine Australia investment	$1,158,585

Rationale	Aeration applied during active fermentation is known to have effects on fermentation performance and wine style in white and red wines respectively. An understanding of the practical approaches to achieving these effects was lacking at the project outset. A series of pilot-scale trials and collaborations was undertaken to refine the understanding of optimal schemes for white and

	red ferment aeration and to elucidate practical strategies for implementing those schemes.
Objectives	• Develop methods to assess and improve the efficiency of fermentation through the use of oxygen during alcoholic and malolactic fermentation • Generate knowledge on the scale-related impacts of processes for wineries by determining the effectiveness and impact of different practices for introducing oxygen at different scales (e.g. barrel stirring, splashy racking) • Generate data on the impact of juice exposure to oxygen (timing, point in production process, dose) on final wine composition and sensory characteristics.
Activities and outputs	• Pilot-scale investigation of aeration during fermentation of white wines and red wines. In all cases three aeration treatments were carried out in triplicate with an additional 'no-treatment' variant also performed in triplicate • Experiments testing the effects of variable aeration intensities on white and red wine (control, low intensity, medium, high). Each treatment level was applied for 48 hours. • Experiments testing effect of aeration mode on white and red wine, with variations to duration and timing. Experiment duration 24 hours or 48 hours • The effect of aeration timing and intensity of wild ferments on the microbial composition during fermentation and the chemical composition of white wine • The effect of aeration timing on wild ferments (white wine) • Pilot-scale investigation of aeration during fermentation of non-inoculated white wines. This industry trial was undertaken at Yalumba (Angaston, South Australia). After juice was destemmed and pressed into vessels, composition was tested. Aeration was applied for 24 hours, dissolved oxygen was then measured. Baumé and temperature were measured daily. The temperature was used to control the fermentation rate. Treatments were performed in duplicate. Wines were bottled at Yalumba. Analysis of higher alcohols and acetate and ethyl esters was performed. Low molecular weight sulfur compound concentrations were quantified. Wine sensory properties for each trial (within-trial comparisons only) were evaluated using quantitative sensory descriptive analysis methodology • Studies on the relationship between dissolved oxygen concentration and redox in synthetic medium. The relationship between dissolved oxygen (DO) concentration during fermentation and the redox state of the fermentation was investigated using bioreactors run at a defined temperature with slow stirring. Fermentation was conducted using a defined medium inoculated and then rehydrated. The effect of compositional variation on the relationship between DO and redox was explored by comparing standard defined medium with DO and redox values obtained when copper concentrations were increased or white wine phenolic extracts were added to the medium • Studies on the sparger arrangement, gas flow rate and fermenter scale on the effectiveness of aeration treatments • A range of extension materials were developed and delivered.

Outcomes	• Methods to assess and improve the efficiency of fermentation through the use of oxygen during alcoholic and malolactic fermentation • Knowledge on the scale-related impacts of processes for wineries by determining the effectiveness and impact of different practices for introducing oxygen at different scales (e.g. barrel stirring, splashy racking) • Data on the impact of juice exposure to oxygen (timing, point in production process, dose) on final wine composition and sensory characteristics • Knowledge on the impact on wine style and sensory properties of key oxygen modulated compounds • Improved knowledge and resources for winemakers about methods to introduce oxygen and the impacts of timing and dose of addition (ongoing), supporting decision making.
Potential impacts	• Potential for increased profitability realised through increased sales, premiumisation and/or reduced costs through improved processes for winemakers interested in using aeration during the production of wines • Increased skills and capacity amongst researchers and winemakers about the implementation of aeration at scale • Decreased reductive characters in red wines leading to improved drinking experience.

Project investment

A breakdown of Wine Australia investment in the project and contribution by others is shown by financial year and in aggregate in Table 30.

Table 30 Total investment in AWR 1701-3.1.5 (nominal)

Year ending June 30th	Wine Australia ($)	Others ($)	Total contributions
2017/18	$228,109	-	$228,109
2018/19	$205,195	-	$205,195
2019/20	$222,489	-	$222,489
2020/21	$204,190	-	$204,190
2021/22	$298,602	-	$298,602
Total	**$1,158,585**	-	**$1,158,585**

Source: Information provided by Wine Australia.

For the BCA, the cost of managing the Wine Australia funding was added to the Wine Australia contribution for the project using a multiplier of 1.12, i.e. consistent with past year assessments, overhead costs are assumed to be 12%. In undertaking the impact assessment, all past costs were expressed in 2025/26-dollar terms using the Implicit Price Deflator for GDP.

Summary of impacts

Table 31 below provides a breakdown of the expected impacts across the triple bottom line (economic, environmental, and social).

Table 31 Triple bottom line impacts, including those valued as part of this evaluation (in bold) for Project AWR 1701-3.1.5

Economic	• **Improved sensory characteristics for red wines possibly increasing demand and thus profitability of the industry** • Established aeration metrics to minimise required investment • Reduced investment costs for winemakers wanting to experiment with aeration by removing the need to purchase dissolved oxygen measurement probes.
Environmental	• No direct environmental impacts identified.
Social	• Increased red winemaker confidence to experiment with higher aeration concentrations • Increased confidence, skills and capacity amongst researchers and winemakers about the implementation of aeration at scale • Decreased reductive characters in red wines leading to improved drinking experience.

Public versus private impacts

This project will generate both public and private impacts. Improved sensory characteristics of red wines for consumers and increased knowledge and skills amongst the research and wine making community form the main public benefits from this project. Winemakers will directly benefit from this project through increased wine quality and potentially reduced costs leading to improved profitability.

Distribution of private impacts

The private benefits will largely be shared amongst individual winemaking enterprises with flow-on benefits to suppliers of compressed air equipment. Within individual winemakers, red winemakers are likely to benefit more than white winemakers due to a stronger use case.

Impacts on other Australian industries

No direct benefits to other Australian primary industries have been identified.

Impacts overseas

Aeration in winemaking is a topic of interest for the international winemaking and research community. This project will impact aeration procedures followed in winemaking in the US.

Quantification of impacts

The main impact quantified was an increase in profitability of wine making resulting from the findings of the project. Though it was noted that winemakers, especially red winemakers, were already experimenting with aeration and its effects on wine style, the main contribution of this project was to increase confidence by establishing practical approaches. The project also removed the requirement for measurement of dissolved oxygen.

This BCA focused on red wine making because of the larger applicability of project findings to the red wine sector as per the project findings and validated in consultation. In the case of red wine, the findings supported positive effects on wine style and thus product quality, which may feasibility contribute to increased wine sales and/or premiumisation. In the case of white wine, there was no such effect and while some efficiencies in the fermentation process might be achieved, these are considered marginal and offset by potential risks to wine quality. As such, it is considered that there is not yet a compelling use case for widespread adoption in the white wine making process.

For the analysis, it is assumed that benefits can begin to flow immediately to the red wine sector, particularly given the range of extension materials available and activities already undertaken by the project, but will likely ramp up over a five-year period. It is noted that the findings are most applicable to full-bodied red wine and will not be suitable to all wine making production systems.

Estimated benefits

An outline of the assumptions supporting the quantification of future benefits and costs are reported in Table 32 below.

Table 32 Benefit assumptions for AWR 1701-3.1.5

Variable	Assumption	Source/ Explanation
Impact 1: Increase in profitability of red wine making		
a) Australian red wine production	590 million litres	Wine Australia (2025)
b) Share of red wine production that will make use of research findings	25%	Analyst assumption tested in sensitivity
c) Increase in profit on wine making as a result of research findings	1.0%	Analyst's assumption tested in sensivity: project will lead to marginal improvement in profitability. That is, revenue net of change in production costs.
d) Existing wine making profit for that proportion of industry who will make use of findings	$1.34	AgEconPlus Consulting & Gillespie Economics (2025)
e) Increase in profit as a result of research findings	$0.01	c) x d)
f) Probability of outcomes	80%	Practical advice and extension materials (detailing methods to introduce oxygen and the impacts of timing and dose addition) are available to lead to improved knowledge and support decision making related to wine style and sensory properties
g) Probability of impact	50%	While wine with improved style is likely to be more profitable to winemakers, there is a risk that ruling market conditions will prevent the benefits from being realised

Adoption costs

The estimated benefits are assumed to be net of expected adoption costs where applicable.

Counterfactual

A 50% counterfactual has been assumed considering a level of experimentation that was already occurring amongst winemakers. That is, it is 50% likely that the benefits would have been realised in the absence of investment in this project.

Attribution

The attribution of benefits from the project - summarised in Table 33 – considers any past inputs and expected future development costs required to realise beneficial outcomes. Given that only the marginal impacts of this project have been estimated, this project is attributed with 100% of the benefits.

Table 33 Attribution of benefits for AWR 1701-3.1.5

Variable	Assumptions
Wine Australia costs	100%
Other project party costs	N/A
Total	**100%**

Results

Table 34 below presents the modelled investment performance from the project. All past costs and benefits were expressed in 2025/26-dollar terms using the Implicit Price Deflator for GDP, while all future costs and benefits were discounted to 2025/26-dollar terms using a discount rate of 5%. A reinvestment rate of 5% was used for estimating the modified internal rate of return (MIRR). The analysis used the best available estimates for each variable, notwithstanding a level of uncertainty for many of the estimates. All analyses ran for the length of the investment period plus 30 years from the year of assessment.

The results show that the total investment returns a net present value (NPV) of $3.88 million and a favourable BCR of 3.3. As the project was entirely funded by Wine Australia, these results also represent the returns on Wine Australia's investment, as shown in Table 35.

Table 34 Investment criteria for total investment in AWR 1701-3.1.5 ($M)

Year	0	5	10	15	20	25	30
PV Benefits	$ 0.01	$ 1.17	$ 2.51	$ 3.56	$ 4.39	$ 5.03	$ 5.54
PV Costs	$ 1.66	$ 1.66	$ 1.66	$ 1.66	$ 1.66	$ 1.66	$ 1.66
NPV	-$ 1.65	-$ 0.48	$ 0.86	$ 1.91	$ 2.73	$ 3.38	$ 3.88
BCR	0.0	0.7	1.5	2.2	2.7	3.0	3.3
IRR	-62%	1%	8%	11%	12%	12%	12%
MIRR	-45%	2%	7%	8%	9%	8%	8%

Table 35 Investment criteria for Wine Australia investment in AWR 1701-3.1.5 ($M)

Year	0	5	10	15	20	25	30
PV Benefits	$ 0.01	$ 1.17	$ 2.51	$ 3.56	$ 4.39	$ 5.03	$ 5.54
PV Costs	$ 1.66	$ 1.66	$ 1.66	$ 1.66	$ 1.66	$ 1.66	$ 1.66
NPV	-$ 1.65	-$ 0.48	$ 0.86	$ 1.91	$ 2.73	$ 3.38	$ 3.88
BCR	0.0	0.7	1.5	2.2	2.7	3.0	3.3
IRR	-62%	1%	8%	11%	12%	12%	12%
MIRR	-45%	2%	7%	8%	9%	8%	8%

The flow of total undiscounted costs and benefits from the project is presented in Figure 5 below.

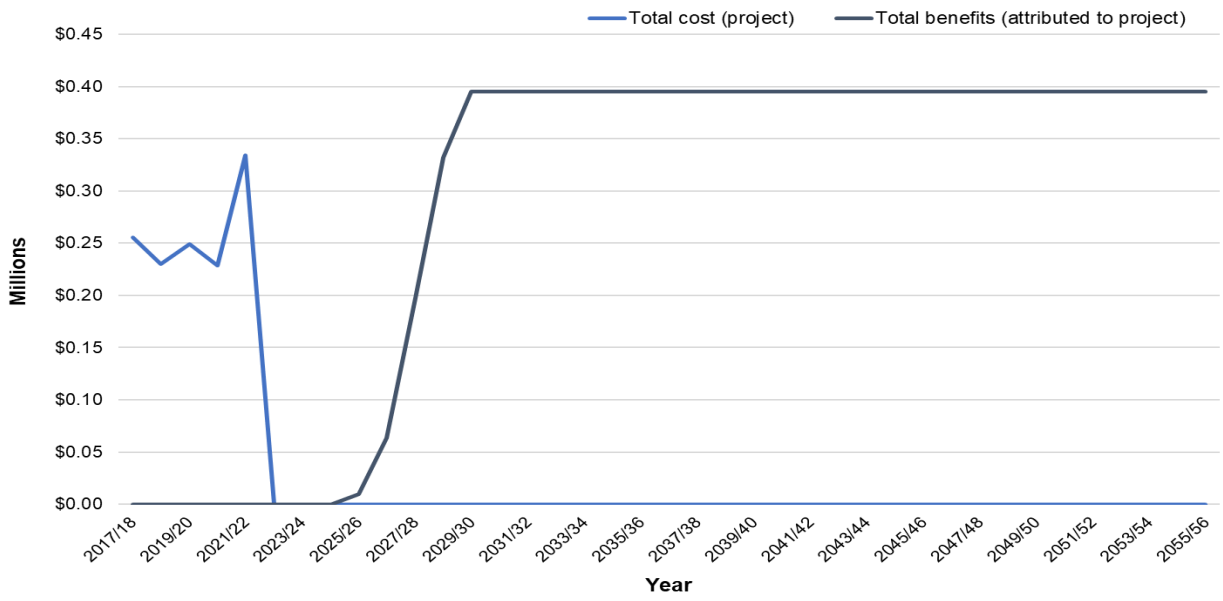


Figure 5 *The flow of total undiscounted costs and benefits from AWR 1701-3.1.5*

Sensitivity analysis

A sensitivity analysis was carried out to determine how the investment performance (NPV, BCR and MIRR after 30 years) would change based on changes to the discount rate and other key variables. The results are presented in Table 36 below.

Table 36 *Sensitivity analysis for Project AWR 1701-3.1.5*

Changes to key variables	NPV ($M)	BCR	MIRR
Standard assumption	$3.88	3.3	8%
Discount rate			
4%	$4.63	3.8	8%
6%	$3.25	3.0	9%
Share of red wine production that will make use of research findings			
20%	$2.77	2.7	8%
30%	$4.99	4.0	9%
Increase in profit on wine making as a result of research findings			
0.5%	$1.11	1.7	6%
1.5%	$6.65	5.0	9%

Confidence ratings

The accuracy of the assessment is highly dependent on:

- The extent to which the analysis captures and quantifies the various benefits from the project, including non-market benefits (i.e. coverage of benefits)

- The level of confidence in the accuracy of assumptions used (i.e. confidence in assumptions).

An assessment of coverage and confidence ratings for this project is presented below in Table 37.

Table 37 Coverage and confidence ratings for Project AWR 1701-3.1.5

Factor	Rating	Comment
Coverage of benefits	High	The chosen benefits to quantify are those most commonly cited by key stakeholders
Confidence in assumptions	Low	Quantification relied on generalised assumptions about the contribution to wine making margin which are difficult to measure. There is also some uncertainty about the proportion of red winemaker who will make use of the research findings

Conclusions

The aim of the *Project AWR 1701-3.1.5: Influencing wine style and efficiency through management of oxygen during wine production*, was to inform the practicalities of aerating red and white ferments to achieve desired effects. The project improved understanding and knowledge around aeration of red and white ferments, which has the potential to improve profitability predominantly through increased demand for red wines with improved style and sensory characteristics. The main impact of improved profitability due to improved characteristics of red wines from aeration was quantified.

Based on the adopted assumptions, this analysis has estimated the project investment will likely deliver a positive economic benefit (BCR 3.3). The result remains positive across all modelled scenarios and is most sensitive to the assumed increase in profit for those wine makers making use of the project findings.

References

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Acknowledgements

GHD would like to thank Paul Smith, Project Manager at Wine Australia for their guidance and feedback throughout the impact assessment process. GHD extends particular thanks to Dr Simon Schmidt, Research Manager from the Australian Wine Research Institute (9th March 2026) for their time during the project's consultation phase.

Appendix E: NOLO Mouthfeel and Flavour Stability (AWR 2202-3.1.2 and AWR 2022-3.1.3)

Background

Consumer demand for no- and low-alcohol (NOLO) wines has increased substantially in recent years, driven by health and lifestyle trends. While Australian producers have been able to adopt dealcoholisation technologies to meet this demand, a challenge in the production of NOLO wine is mimicking traditional full-strength wine mouthfeel and flavour stability.

To improve NOLO products and therefore appeal to more consumers seeking alternatives to alcoholic wines, this work explored the potential additives available across the wine and food and beverage sectors. Specifically, these two projects aimed to improve mouthfeel (3.1.2) and flavour stability (3.1.3) deficiencies in NOLO products.

The project focused on three broad classes of solutions:

i) commercially available additives and ingredients already used in food and beverage applications *(both mouthfeel and flavour stability)*

ii) wine-derived or wine-allowable additives at earlier stages of development *(mouthfeel only)*

iii) Glycosides extracted from grape marc and the role of amino acids *(both mouthfeel and flavour stability).*

The work was undertaken by the Australian Wine Research Institute in collaboration with NOLO producers, flavour and ingredient suppliers, and Wine Australia. Through industry consultation, informal sensory assessment and preliminary economic consideration, the project generated an evidence base to inform future investment decisions and subsequent development stages. In doing so, the project aimed to support Australian producers to improve the quality and wine-likeness of NOLO products, reduce barriers to adoption of suitable technologies, and strengthen the competitiveness of Australian wine in rapidly growing NOLO beverage markets.

Description of the project

Project code	**AWR 2202-3.1.2 and AWR 2202-3.1.3**
Title	NOLO Mouthfeel
Research organisation	Australian Wine Research Institute
Principal investigator	Wes Pearson
Wine Australia project manager	Josh Hixson
Project duration	01/03/2023 – 01/04/2024
Wine Australia investment	$323,077

Rationale	The NOLO wine category faces certain flavour and mouthfeel disadvantages compared to traditional commercial wines. Current practices to reduce or remove alcohol from NOLO wines compromise wine quality by diminishing flavour complexity, mouthfeel properties, and overall character. There is a need for innovative approaches that produce NOLO wine while retaining the mouthfeel and flavour profiles traditionally associated with high-quality wine.

Objectives	• Canvassing and assessing the viability of existing products to replace the lost mouthfeel properties resulting from dealcoholisation in NOLO wines, including texture, viscosity and/or ethanol heat sensation. This was split into two features: mouthfeel (texture, viscosity, heat sensation) and flavour stability (restoring flavour loss resulting from dealcoholisation) • Identifying novel additives currently in development.

Activities and outputs	• Identification of existing products to replace the lost mouthfeel properties resulting from dealcoholisation in NOLO wines
	• Review and screening of additives and ingredients used in food and beverage sectors that have potential to modulate mouthfeel in NOLO wine products, including assessment of their technology readiness, supply maturity and indicative cost structures
	• Consideration of regulatory status, filterability and clarity into existing NOLO production processes for candidate additives
	• Engagement with ingredient suppliers and flavour houses to obtain product information, samples and indicative pricing
	• Outputs related to mouthfeel (3.1.2) included:
	  ○ A list of commercially available (Technology Readiness Level (TRL) 7–9) mouthfeel-modulating additives used in food and beverage sectors, with indicative ICR assessments for application in NOLO wines
	  ○ A shortlist of wine-derived or wine-allowable additives (TRL 1–3) with demonstrated potential to influence mouthfeel in NOLO products
	  ○ Preliminary information on regulatory considerations, production compatibility and indicative per-litre costs for candidate solutions
	• Outputs related to flavour stability (3.1.3) included:
	  ○ A list of commercially available (TRL 7–9) additives used in food and beverage sectors, with indicative ICR assessments for application in NOLO wines, that have potential for preserving or enhancing flavour and aroma in NOLO wine products
	  ○ Preliminary information on regulatory considerations, production compatibility and indicative per-litre costs for candidate solutions
	  ○ Data, from informal sensory tastings, of glycosides and amino acid additives to enhance flavour in NOLO wine products.

Outcomes	• Contributed to a knowledge base to improve the flavour stability and mouthfeel of NOLO wines • Reduced technical uncertainty for producers seeking to improve the sensory quality of NOLO wine products • Evidence-base to inform future RD&E investment for NOLO wine products.
Potential impacts	• Potential contribution to the growth and consumer acceptance of the NOLO wine product industry by improving the quality of NOLO offerings • Enhanced ability for the wine industry to respond to consumer preferences and health and wellness trends, and maintain social responsibility • Progress towards increased profitable sales of NOLO products resulting from improved product offerings

	• Progress towards enabling producers to develop NOLO wine products that better resemble traditional wine, thereby increasing the perceived quality of both their products and the overall NOLO and wine categories.

Project investment

A breakdown of Wine Australia investment in the project and contribution by others is shown by financial year and in aggregate in Table 38.

Table 38 Total investment in AWR 2202-3.1.2 and AWR 2022-3.1.3 (nominal)

Year ending June 30th	Wine Australia ($)	Others ($)	Total contributions
2022/23	$105,000	$215,317	$320,317
2023/24	$218,077	$138,422	$356,499
Total	**$323,077**	**$353,739**	**$676,816**

Source: Information provided by Wine Australia.

For the BCA, the cost of managing the Wine Australia funding was added to the Wine Australia contribution for the project using a multiplier of 1.12, i.e. consistent with past year assessments, overhead costs are assumed to be 12%. In undertaking the impact assessment, all past costs were expressed in 2025/26-dollar terms using the Implicit Price Deflator for GDP.

Summary of impacts

Table 39 below provides a breakdown of the expected impacts across the triple bottom line (economic, environmental, and social).

Table 39 Triple bottom line impacts, including those valued as part of this evaluation (in bold) for Projects AWR 2202-3.1.2 and AWR 2022-3.1.3

Economic	• **Progress towards increased profitable sales of NOLO products resulting from improved product offerings** • Potential for research efficiencies from improved understanding of available additives and their technical readiness.
Environmental	• No direct environmental impacts identified.
Social	• Enhanced ability for the wine industry to respond to consumer preferences and health and wellness trends, and maintain social responsibility • Reduced risk of reputational damage to Australian wine associated with poor-quality NOLO offerings • Spillover benefits to employment and income generation due to additional profitable sales of NOLO products.

Public versus private impacts

The potential impacts identified will accrue mostly to private beneficiaries, with some broader indirect public impacts. Private benefits will occur due to potentially increased additional profitable sales as a result of improved offerings. Public benefits may be realised by enabling the wine industry to effectively increase their ability to

support broader lifestyle choices, ensuring social and economic outcomes continue to be realised through social activity.

Distribution of private impacts

Progress towards improved NOLO products will directly benefit producers as a result of increased technical knowledge. An improved consumer experience will generate increased sales of Australian NOLO products in domestic and export markets, contributing to increased profitability along the supply chain, from the retailers through to producers.

Impacts on other Australian industries

Food and beverage sectors may benefit as a result of increased sales of additives throughout their supply chains.

Impacts overseas

This project has the potential to increase or maintain the reputation of the Australian wine industry overseas as lifestyle choices globally move towards lower alcohol options.

Quantification of impacts

For this BCA the quantification of impacts focused on winemaker profit on additional sales of wine-like NOLO. This comes from an increase in demand for NOLO products due to increased resemblance to traditional wine. Usually, NOLO sales are substantially lower than traditional wine sales due to inferior mouthfeel characteristics and lower flavour stability. The market benefit of improved wine like NOLO products has the potential to be twofold: first by increasing consumption among people who are already drinking NOLO products; and second by increasing the number of people who drink NOLO products.

In conducting this analysis, it was recognised that NOLO products have a lower gross margin than traditional wine due to added costs of alcohol removal and now additives to improve mouthfeel and flavour stability, and an unwillingness by the market to pay a premium for NOLO wine products to offset these additional costs.

The BCA used sales data from the IWSR and assumed a staggered increase in the realisation of benefits over a five-year period. The delay in the realisation of benefits recognises that further development is required to inform the potential adoption of project findings. In reality, it is expected that the quantified impact of an increase in profitable NOLO sales will be attributable to these projects, previous Wine Australia investment (including AWR 1701-3.10 and AWR 1701-3.20) and further RD&E work to which the project research organisation and other industry partners are now contributing.

Estimated benefits

An outline of the assumptions supporting the quantification of future benefits and costs are reported in Table 40 below.

Table 40 Benefit assumptions for AWR 2202-3.1.2 and AWR 2022-3.1.3

Variable	Assumption	Source/ Explanation
Impact 1: Winemaker profit on additional sales of Wine-like NOLO		
a) Current wine-like Australian NOLO sales (litres)	14.2 million	IWSR data, provided to the project by Wine Australia; source not publicly available (Wine Australia Senior Analyst, personal communication, April 2024).
b) Projected increase in wine-like NOLO sales with quality	15%	Analyst estimate

improvements such as improved mouthfeel and flavour stability		
c) Profit on making of wine-like NOLO products	$0.85 per litre	Analysts estimate given NOLO production is typically less profitable than traditional wine production
d) Probability of outcomes	50%	The project has contributed to the knowledge base to improve the flavour stability and mouthfeel of NOLO wines however further work is required to ensure commercial readiness
e) Probability of impacts	70%	It is likely that overall quality improvements in wine-like NOLO products will lead to increased sales over time

Adoption costs

Adoption costs have been factored into the assumed gross margin for NOLO wine production.

Counterfactual

The counterfactual assumes that the benefits attributed to this project would not have been realised.

Attribution

The attribution of benefits from the project - summarised in Table 41– considers any past inputs and expected future development costs required to realise beneficial outcomes. The analysis assumes that an increase in profitable NOLO sales as a result of overall quality improvements will be attributable not just to these two projects, but to previous Wine Australia investment, including AWR 1701-3.10 and AWR 1701-3.20, as well as a new RD&E investment being undertaken by the project research organisation and other industry partners valued at approximately $6.7 million.

Table 41 Attribution of benefits for AWR 2202-3.1.2 and AWR 2022-3.1.3

Variable	Assumptions
Wine Australia costs	5%
Other project party costs	5%
Past research	10%
Future RD&E	80%
Total	**100%**

Results

Table 42 below presents the modelled investment performance from the project. All past costs and benefits were expressed in 2025/26-dollar terms using the Implicit Price Deflator for GDP, while all future costs and benefits were discounted to 2025/26-dollar terms using a discount rate of 5%. A reinvestment rate of 5% was used for estimating the modified internal rate of return (MIRR). The analysis used the best available estimates for each variable, notwithstanding a level of uncertainty for many of the estimates. All analyses ran for the length of the investment period plus 30 years from the year of assessment.

The results show the total investment returning a net present value (NPV) of $0.06 million and a slightly favourable BCR of 1.1. Table 43 shows Wine Australia investment returning a NPV of $0.03 million and a BCR of 1.1.

Table 42 Investment criteria for total investment in AWR 2202-3.1.2 and AWR 2022-3.1.3 ($M)

Year	0	5	10	15	20	25	30
PV Benefits	$0.00	$0.13	$0.35	$0.52	$0.65	$0.75	$0.84
PV Costs	$0.78	$0.78	$0.78	$0.78	$0.78	$0.78	$0.78
NPV	-$0.78	-$0.64	-$0.43	-$0.26	-$0.13	-$0.02	$0.06
BCR	0.0	0.2	0.4	0.7	0.8	1.0	1.1
IRR	N/A	-20%	-4%	1%	3%	5%	5%
MIRR	-52%	-9%	0%	3%	4%	5%	5%

Table 43 Investment criteria for Wine Australia investment in AWR 2202-3.1.2 and AWR 2022-3.1.3 ($M)

Year	0	5	10	15	20	25	30
PV Benefits	$0.00	$0.07	$0.18	$0.26	$0.33	$0.38	$0.42
PV Costs	$0.39	$0.39	$0.39	$0.39	$0.39	$0.39	$0.39
NPV	-$0.39	-$0.32	-$0.22	-$0.13	-$0.06	-$0.01	$0.03
BCR	0.0	0.2	0.4	0.7	0.8	1.0	1.1
IRR	N/A	-21%	-4%	1%	3%	5%	5%
MIRR	-52%	-9%	0%	3%	4%	5%	5%

The flow of total undiscounted costs and benefits from the project is presented in Figure 6 below.

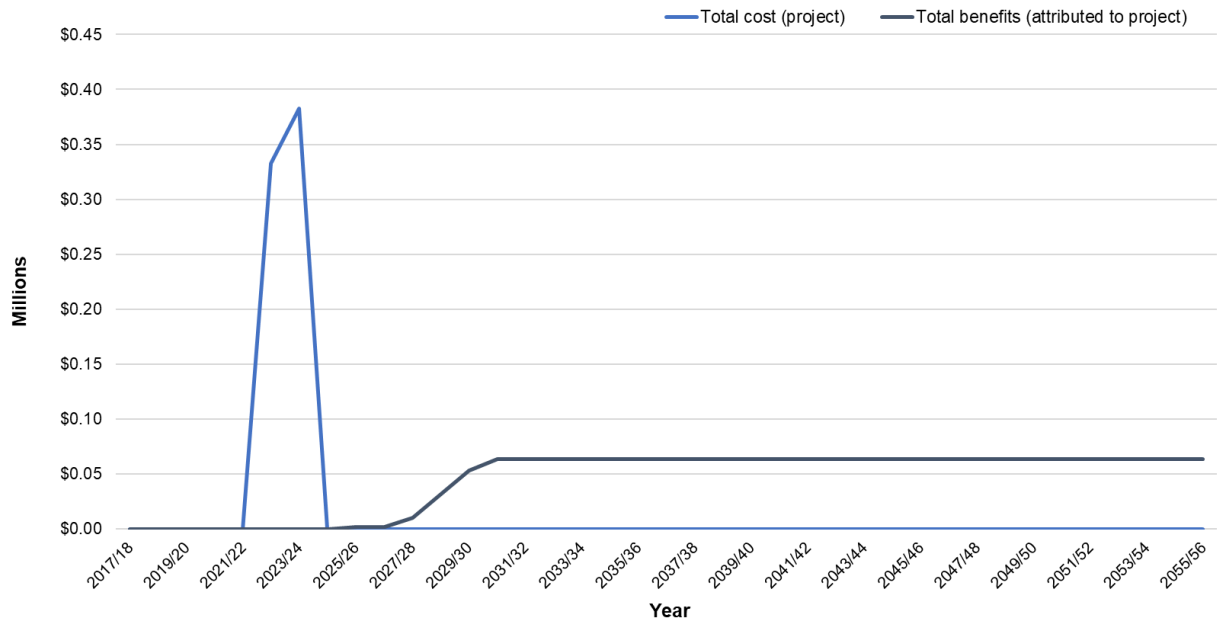


Figure 6 The flow of total undiscounted costs and benefits from AWR 2202-3.1.2 and AWR 2022-3.1.3

Sensitivity analysis

A sensitivity analysis was carried out to determine how the investment performance (NPV, BCR and MIRR after 30 years) would change based on changes to the discount rate and other key variables. The results are presented in Table 44 below.

Table 44 Sensitivity analysis for Projects AWR 2202-3.1.2 and AWR 2022-3.1.3

Changes to key variables	NPV ($M)	BCR	MIRR
Standard assumption	$0.06	1.1	5%
Discount rate			
4%	$0.18	1.2	5%
6%	-$0.04	0.9	6%
Projected increase NOLO sales with quality improvements			
10%	-$0.22	0.7	4%
20%	$0.34	1.4	6%
Estimated gross margin on wine-like NOLO production			
$0.70	-$0.09	0.9	5%
$1.00	$0.21	1.3	6%

Confidence ratings

The accuracy of the assessment is highly dependent on:

- The extent to which the analysis captures and quantifies the various benefits from the project, including non-market benefits (i.e. coverage of benefits)
- The level of confidence in the accuracy of assumptions used (i.e. confidence in assumptions).

An assessment of coverage and confidence ratings for this project is presented below in Table 45.

Table 45 Coverage and confidence ratings for AWR 2202-3.1.2 and AWR 2022-3.1.3

Factor	Rating	Comment
Coverage of benefits	Medium	The analysis covers the main economic benefit, however, there are some expected social benefits which have not been quantified
Confidence in assumptions	Low	There is a degree of uncertainty in the expected increase in NOLO wine-like sales resulting from product improvements, though the market potential is widely recognised. There is also currently a lack of published data on the gross margins for NOLO production, although anecdotally, margins are much tighter than for traditional wine making

Conclusions

The projects *NOLO Mouthfeel and Flavour Stability (AWR 2202-3.1.2, AWR 2022-3.1.3)* aimed to improve the mouthfeel and flavour stability of no or low-alcohol wines to better resemble traditional wines and improve consumer experience. The project generated a list of commercially available additives used in the food and beverage sector, with potential to influence mouthfeel and flavour stability in NOLO wines. The impact quantification focused on increased winemaker profit from additional sales of wine-like NOLO products.

Based on the adopted assumptions, this analysis has indicated that the project investment will likely deliver a marginal positive economic benefit (BCR 1.1), although the result was found to be negative under changes to certain assumptions.

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Pearson, W., Hixson, J. (2024). *Identification of existing products to replace the lost mouthfeel and to restore flavour loss resulting from dealcoholisation in NOLO wines.* Final Report prepared for Wine Australia Project AWR 2202-3.1.2 and 3.1.3.

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Appendix F: Future Leaders 2025 (WAC 2419)

Background

The Australian wine industry has been tested by unprecedented market volatility. Very high tariffs imposed in late 2020 on wine exports to China effectively shut down what was once a $1.2 billion annual export market and sent shockwaves through all levels of the value chain. In 2025, these effects were still impacting the industry, alongside climate challenges, global oversupply of wine, changing consumer preferences, and diversification pressures. These challenges underscore a critical business insight for Wine Australia: the future of Australian wine depends on adaptable, strategic and courageous leadership.

Since 2006, Wine Australia has invested in the Future Leaders program, an initiative committed to diversify leadership across regional, state and national wine and grape organisations. In 2025, this program received continued funding with the aim of driving meaningful change across Australia's wine industry. The Program identifies and empowers mid-career professionals and underrepresented voices, equipping them with the confidence, vision and courage to lead the industry through current and future challenges.

Delivered through five immersive, two- to three-day in-person intensives held across Australia's wine regions, as well as a virtual session and coaching opportunities, the program strategically aims to leverage the geographical diversity of participants as a strength. Each session is designed to offer a powerful, hands-on learning environment that encourages collaboration, courage and creativity.

Future Leaders is widely considered a deliberate investment in the industry's long-term competitiveness, embedding leadership excellence, fostering innovation and ensuring the Australian wine community remains globally respected, sustainable and adaptive across generations.

Description of the project

Project code	**WAC 2419**
Title	Future Leaders 2025
Research organisation	Pragmatic Thinking Pty Ltd
Principal investigator	Alison Hill and Darren Hill
Wine Australia project manager	Jo Hargreaves
Project duration	29/10/2024 – 15/12/2025
Wine Australia investment	$242,000

Rationale	Challenges such as climate impacts, global oversupply of wine, changing consumer preferences and diversification pressures all underscore the need for the Australian wine industry to be guided by leaders that are adaptable, strategic and courageous. Investments in people aim to develop the skills to drive the sector forward, adopt research outcomes and innovation, contribute to a sustainable and profitable sector, and build networks to support future contributions.
Objectives	• Prepare emerging leaders to strengthen the wine and grape industry's resilience • Build leadership capability at individual, regional and sector levels

	• Equip emerging leaders with tools to navigate complexity, influence change, and strengthen collaboration across regions and organisations.
Activities and outputs	• Development of 2025 program and applicant selection criteria. Subsequent in-person assessment and selection of applicants, followed by delivery and development of welcome pack and three staged welcome videos • Deliberate curation of participants across the wine value chain, as well as selection of a diverse range of 'leaders' within the industry • Training of coaches (from the leadership alumni), including a half day training session prior to program commencement and a second session during the program • Delivery and management of the program, including five 2-3-day in-person intensives held across Australia's wine regions and a half day virtual session • Networking dinner involving coaches, participants and one representative from Wine Australia • Provision of focused and on-going coaching to the Future Leaders cohort via a WhatsApp group. Coaches (total 15) held six individual 1-hour sessions with each participant • Evaluation of the program by both Wine Australia and Pragmatic Thinking, as well as participant feedback, for future improvements • Alumni group meetings and graduation, including the development of a resource book (*Thought Leadership, Volume 5*) that consolidated participant essays written as part of the program • Fifteen industry-trained leaders.
Outcomes	• Leadership and skill development, equipping participants with practical tools and strategies to enhance decision-making, communications and strategic capabilities • Networking and connectivity via a supportive alumni community and trusted industry partner (coach), as well as a well-connected value chain • Participants experience personal growth, confidence, heightened self-awareness, and a renewed understanding of leadership values • Contribution to a practical and sustainable leadership talent pipeline with skills and capabilities aligned to industry strategic priorities • Alumni who actively contribute to governance, innovation and organisational performance across industry organisations and community groups.
Potential impacts	• Improved earnings potential for individuals able to take advantage of new opportunities for career progression • Value generated through more highly skilled and trained industry personnel willing to volunteer their time to participate in forums at both the industry and community level • Increased attraction and retention of people to the Australian wine industry through building its reputation as an industry offering tailored opportunities to its participants • Improved profitability, sustainability and competitiveness of the Australian wine industry from more capable leaders.

Project investment

A breakdown of Wine Australia investment in the project and contribution by others is shown by financial year and in aggregate in Table 46.

Table 46 Total investment in WAC 2419 (nominal)

Year ending June 30th	Wine Australia ($)	Others ($)	Total contributions
2024/25	$184,750	$18,000-	$202,750
2025/26	$99,398	$241,875	$341,273
Total	**$284,148**	**$259,875**	**$544,023**

Source: Information provided by Wine Australia.

Wine Australia's overall project costs included an initial project investment of $242,000, standard project management and overhead costs (estimated using a multiplier of 1.12), and an additional $42,148 on the program to provide for travel reimbursement for alumni to attend the selection panel meeting, travel reimbursement for coaches attending the Melbourne session, publishing of the Thought Leadership book and for some catering and room hire costs incurred throughout the program, including the wider industry sessions and the graduation event.

It is also noted that participants self-invest a considerable amount of money to participate in the program. Costs include all travel and accommodation for intensive sessions, excluding the first which is met by the project costs. Each participant (i.e. the program cohort) was estimated to have incurred $1,000 for arranging travel and accommodation for each of the five face-to-face sessions. This estimate was extrapolated based on the actual reimbursement costs provided by Wine Australia to coaches who attended the Melbourne session. Additionally, everyone involved (i.e., program cohort, coaches and selection panel members) incurred an opportunity cost of attending the program. This was calculated based on an assumed average daily wage and number of days attended. We estimated a total opportunity cost of $195,000 for the program cohort, $46,875 for the coaches and $18,000 for the selection panel based on average annual salaries of $150,000, $167,500 and $180,000 respectively.

In undertaking the impact assessment, all past costs were expressed in 2025/26-dollar terms using the Implicit Price Deflator for GDP.

Summary of impacts

Table 47 below provides a breakdown of the expected impacts across the triple bottom line (economic, environmental, and social).

Table 47 Triple bottom line impacts, including those valued as part of this evaluation (in bold)

Economic	• **Increased earning potential of individual participants over the long-term, as well as improved access to employment opportunities** • **Value generated through more highly skilled and trained industry personnel willing to volunteer their time to participate in forums at both the industry and community level** • Enhanced ability for leaders in the sector to diversify income and distribute knowledge across industry via new pathways (such as coaching, policy and positions on boards and committees) • Improved profitability, sustainability and competitiveness of the Australian wine industry from more capable leaders.
Environmental	• Improved consideration and knowledge sharing of the industries sustainability priorities, creating opportunity for improved decision-making and more responsible environmental stewardship

	• On-country session with a First Nations educational organisation contributed to an increased understanding of Indigenous perspectives surrounding Caring for Country principles, important as the industry faces increasing climate uncertainty and climate-related consumer pressure.
Social	• Contribution to government, industry and community causes through an increased willingness to participate in collective forums • Sharing of knowledge, tools and resources across roles and regions, enhancing systemic and sector-wide perspectives • Increased attraction and retention of people to the Australian wine industry through building its reputation as an industry offering tailored opportunities to its participants • Increased understanding of mental health and wellbeing management as a leader, arising from increased knowledge of the tools available for stress management.

Public versus private impacts

This investment will generate direct private benefits to program participants due to increased earnings potential and vertical career progression. It is expected that alumni will gain easier and quicker access to more opportunities and likely be preferred candidates for vertical career progression sooner. Private businesses will experience in-direct flow-on benefits as a result. Public benefits will be realised from improved decisions related to environmental management and health and wellbeing, including in relation to mental health. Evidence suggests that alumni often join boards and committees and, because of voluntary participation via these channels, will contribute to shaping public policy outcomes affecting both the sector and regional areas.

Distribution of private impacts

Private benefits are concentrated to the program's participants and the businesses they are engaged in from across the supply chain. Candidates are deliberately selected to ensure diversity across roles and regions, delivering decision-making capability, coordination and skill across the sector.

Impacts on other Australian industries

Indirect benefits may be realised via distribution of tools, resources and knowledge, as well as a rise in more evidence-informed decisions being made throughout supply-chains within, and adjacent to, the sector. Evidence from past programs suggest that alumni will likely join various committees and boards within their regions and communities, which will also distribute knowledge across regions and industries. Public health in regions will also experience flow-on effects as a result of increased knowledge surrounding mental health and wellbeing.

Impacts overseas

Some international benefits will be gained due to the sector's business resilience in Australia, particularly when considering future climate and market uncertainty.

Quantification of impacts

For the BCA, the quantification of impacts has focused on 1) increased earning potential from participating in the program, and 2) additional volunteer days providing benefits for industry and community.

The first impact arises from an increase in skills thus increasing productivity and profitability of participants. This may lead to an increase in employability and speed up promotions. Quantification of additional income from participation has been informed by the average self-perceived monetary value of participants at program start and completion (as collected as part of the program's evaluation process), consultation and previous assessments of similar people and capacity type programs invested in by Rural RDCs. As the program is targeted at mid-career professionals typically in their mid-thirties, the benefits were assumed to be realised across the course of their

career, i.e. the full 30-year timeframe, however, considered to peak five years after having completed the program before tapering off over the remainder of the period.

The second impact comes from a better-connected and increasingly committed cohort of middle managers for the industry and regional communities. This may lead to an increase in number of volunteer days over and above what participants may have contributed had they not participated in the program. Each of the additional volunteer days was quantified by accounting for average assumed daily wage rates of participants.

Estimated benefits

An outline of the assumptions supporting the quantification of future benefits and costs are reported in Table 48 below.

Table 48 Benefit assumptions for WAC 2419

Variable	Assumption	Source/ Explanation
Impact 1: Additional earnings potential of program participants		
a) Number of people trained in the Future Leaders program	15	Project reports
b) Average starting salary	$120,000	Estimated from evaluation reports
c) Maximum average additional earnings potential on an annual basis	$10,000	Analyst estimate based on program evaluation reports, stakeholder consultation and past assessments
d) Probability of outcome	100%	Participant survey feedback and past experience confirms project outcomes
e) Probability of impact	80%	Wine Australia regularly collates information across the entire Future Leaders cohort which indicates a high likelihood that benefits are realised and sustained over time
Impact 2: Additional volunteer days contributed to industry and community		
f) Average starting salary	Commencing at $120,000 and increasing over time as per Impact 1	As per Impact 1
g) Number of hours worked per year	1,800	Analyst estimate
h) Number of hours worked per day	7.5	Analyst estimate
i) Average daily wage of program cohort	$500	(b * e)/d
j) Number of additional volunteer days	4	Analyst estimate assuming an additional day per quarter per year compared to the counterfactual

k) Probability of outcome	100%	Participant survey feedback and past experience confirms project outcomes
l) Probability of impact	80%	Wine Australia regularly collates information across the entire Future Leaders cohort which indicates a high likelihood that benefits are realised and sustained over time

Adoption costs

Contributions by the selection panel and program participants have been included in the overall project investment costs. No further adoption costs have been considered in the analysis.

Counterfactual

The counterfactual considers that many of the program cohort seeking an opportunity like Future Leaders may have had access to other general leadership programs. It is unlikely however that knowledge gained from other programs would have contributed to increased sector connectivity, broad strengthening of the supply-chain, or sector-wide leadership capacity building to the same extent as Future Leaders. It is also likely that the type of person participating in Future Leaders might already contribute their time voluntarily to industry and community causes, although the program is expected to reinforce and ultimately increase this level of personal commitment. The assumptions in the analysis for both increased earning potential and contribution of voluntary time are considered to be attributable to the investment in the Future Leaders program.

Attribution

The attribution of benefits from the project – summarised in Table 49 – considers any past inputs and expected future development costs required to realise beneficial outcomes. The attribution of the impacts quantified to the project are estimated to be 55% attributable to Wine Australia.

Table 49 Attribution of benefits for Projects WAC2419

Variable	Assumptions
Wine Australia costs	55%
Other project party costs	45%
Total	**100%**

Results

Table 50 below presents the modelled investment performance from the project. All past costs and benefits were expressed in 2025/26-dollar terms using the Implicit Price Deflator for GDP, while all future costs and benefits were discounted to 2025/26-dollar terms using a discount rate of 5%. A reinvestment rate of 5% was used for estimating the modified internal rate of return (MIRR). The analysis used the best available estimates for each variable, notwithstanding a level of uncertainty for many of the estimates. All analyses ran for the length of the investment period plus 30 years from the year of assessment.

The results show the total investment returning a net present value (NPV) of $1.09 million and a favourable BCR of 2.9. Table 51 shows Wine Australia investment returning a NPV of $0.60 million and a BCR of 2.9.

Table 50 Investment criteria for total investment in WAC2419 ($M)

Year	0	5	10	15	20	25	30
PV Benefits	$ 0.01	$ 0.43	$ 0.86	$ 1.13	$ 1.35	$ 1.53	$ 1.67
PV Costs	$ 0.58	$ 0.58	$ 0.58	$ 0.58	$ 0.58	$ 0.58	$ 0.58
NPV	-$ 0.57	-$ 0.16	$ 0.27	$ 0.54	$ 0.76	$ 0.94	$ 1.09
BCR	0.0	0.7	1.5	1.9	2.3	2.6	2.9
IRR	N/A	-3%	12%	15%	16%	17%	17%
MIRR	-100%	2%	7%	8%	8%	8%	8%

Table 51 Investment criteria for Wine Australia investment in WAC2419 ($M)

Year	0	5	10	15	20	25	30
PV Benefits	$ 0.01	$ 0.24	$ 0.48	$ 0.62	$ 0.74	$ 0.84	$ 0.93
PV Costs	$ 0.32	$ 0.32	$ 0.32	$ 0.32	$ 0.32	$ 0.32	$ 0.32
NPV	-$ 0.32	-$ 0.09	$ 0.15	$ 0.30	$ 0.42	$ 0.52	$ 0.60
BCR	0.0	0.7	1.5	1.9	2.3	2.6	2.9
IRR	N/A	-3%	12%	15%	16%	16%	17%
MIRR	-100%	2%	7%	8%	8%	8%	8%

The flow of total undiscounted costs and benefits from the project is presented in Figure 7 below.

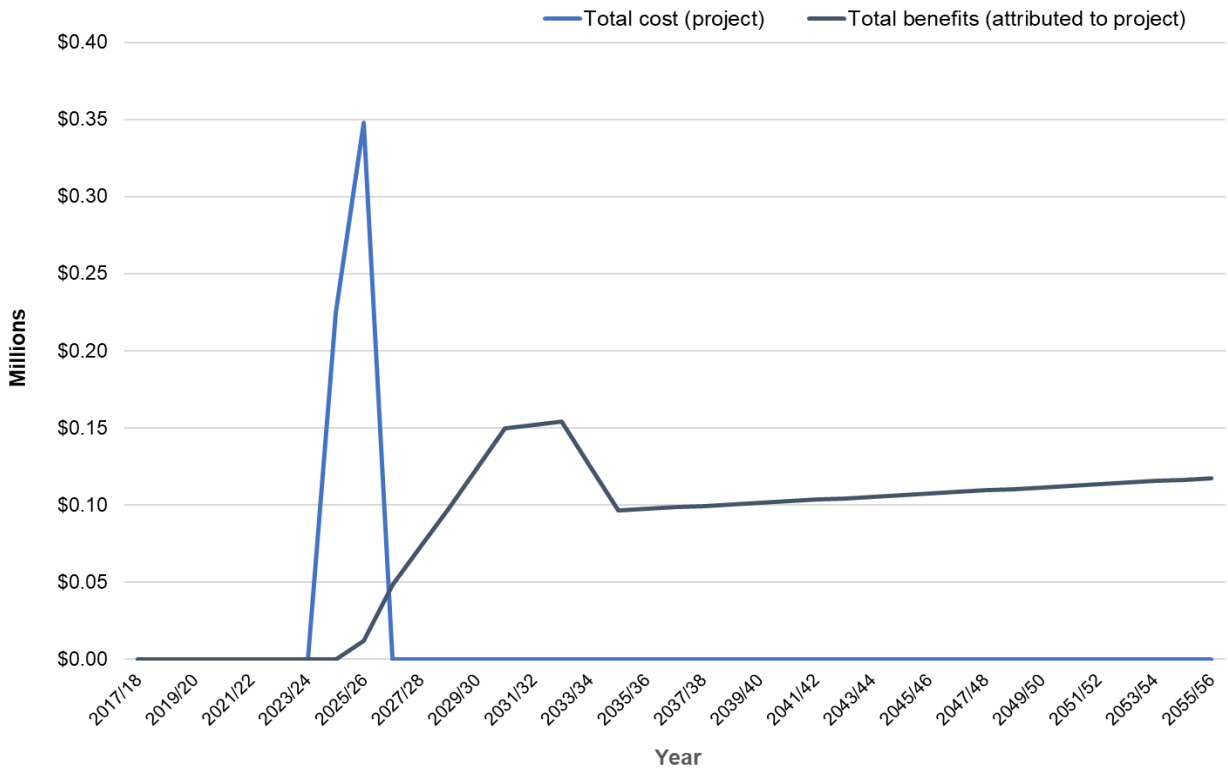


Figure 7 The flow of total undiscounted costs and benefits from WAC 2419

Sensitivity analysis

A sensitivity analysis was carried out to determine how the investment performance (NPV, BCR and MIRR after 30 years) would change based on changes to the discount rate and other key variables. The results are presented in Table 52 below.

Table 52 Sensitivity Analysis for Project WAC 2419

Changes to key variables	NPV ($M)	BCR	MIRR
Standard assumption	1.09	2.9	8%
Discount rate			
4%	1.30	3.2	7%
6%	0.91	2.6	9%
Estimated additional earnings over the course of career from participation			
- 20%	0.83	2.4	8%
+20%	1.35	3.3	8%
Number of additional volunteer days			
3	0.94	2.6	8%
5	1.24	3.1	8%

Confidence ratings

The accuracy of the assessment is highly dependent on:

- The extent to which the analysis captures and quantifies the various benefits from the project, including non-market benefits (i.e. coverage of benefits)
- The level of confidence in the accuracy of assumptions used (i.e. confidence in assumptions).

An assessment of coverage and confidence ratings for this project is presented below in Table 53.

Table 53 Coverage and confidence ratings for WAC 2419

Factor	Rating	Comment
Coverage of benefits	Medium-High	The benefits quantified are the main economic benefits however there are a range of social and environmental benefits associated with the program that are well recognised but difficult to quantify
Confidence in assumptions	High	Program evaluation findings, past program experience and previous benefit costs analysis of RDC people and capacity investments provide relatively good confidence in key assumptions

Conclusions

The overarching aim of Project WAC2419: Future Leaders 2025 was to provide training to emerging wine industry leaders, creating capable leadership that will help the industry navigate uncertainty, influence change and increase collaboration across regions and organisations. The project built connections between participants and equipped them with leadership skills and practical tools enhancing decision-making, communication and strategic capabilities. The main impacts of additional earnings potential for participants and value from additional contribution of volunteer days benefiting industry and communities were quantified.

Based on the adopted assumptions, this analysis has estimated the project investment will likely deliver a positive economic benefit (BCR 2.9), which remained positive under all modelled scenarios. While slightly higher, the BCR is consistent with a previous assessment of the Wine industry's investment in leadership development conduced in 2017, which estimated a BCR of 2.7 (AgEconPlus Consulting & Gillespie Economics, 2017).

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Acknowledgements

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