The AWRI 2013–2018

Excellence Integrity Passion

Supporting the Australian grape and wine industry through world class research, practical solutions and knowledge transfer

The Australian Wine Research Institute

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Message from the Board

The Board members of The Australian Wine Research Institute (AWRI) are delighted to present this five year plan for the Research, Development and Extension (RD&E) activities of the AWRI from 2013–2018.

The plan builds on the successes of the previous AWRI seven year RD&E plan, but is also a reflection of the industry's current position and direction.

It is an aspirational plan which outlines the activities that the Australian grape and wine sector has asked the AWRI and its collaborators to undertake, subject to appropriate funding. The themes and projects align with priorities identified in the Grape and Wine Research and Development Corporation (GWRDC) Strategic research, development and extension plan 2012-2017. They were scoped and refined during extensive industry consultation to target areas where outcomes can be achieved that will make a difference.

The plan provides a starting point and clear direction; it is likely to evolve over the next five years in line with emerging opportunities, changes to industry priorities and needs, and available funding.

The principal aim is the conduct of RD&E that leads to timely, relevant and valuable outcomes for industry. In some cases the AWRI will act as the project lead agency, while in other cases the AWRI will play a supporting or facilitating role. Collaboration will be pursued whenever it leads to a faster, more cost effective or higher quality result.

The plan draws on the AWRI's role as both an integral part of the Australian grape and wine industry and an internationally-recognised centre of excellence. It demonstrates the AWRI's commitment to supporting sustainability, competitiveness and innovation in the Australian grape and wine industry by:

- describing the consultation and review process that informed the development of this 2013–2018 plan;
- presenting the plan's objectives, aligned with priorities set by industry and the Australian Government;
- outlining a range of projects designed to deliver practical, cost-saving knowledge, measures and new technologies to enhance the productivity of the grape and wine value chain; and
- summarising, in brief, outcomes from recent research, development and extension activities.

The Board believes that the projects in this plan will support the industry resilience needed to deal with current challenges, and enhance industry's flexibility to adapt to inevitable changes over the five year period.

As always, the AWRI's priority is to support the long-term success and sustainability of the Australian wine industry through technical excellence and innovation, not just for the next five years, but far into the future.

Board of the AWRI
(from left to right)
Dr John Harvey, Bathe Wines;
Mark Watson, Water Utilities Australia
Jim Brayne, McWilliam's Wines;
Peter Dawson (Chair), Peter Dawson Consulting;
Liz Riley, Vitibit Pty Ltd;
Louisa Rose, The Yalumba Wine Company;
Dr Dan Johnson, The Australian Wine Research Institute;
John Angove, Angove Family Winemakers;
Brett McKinnon, Orlando Wines;
Paul Conroy, Treasury Wine Estates Ltd.

Structure of the plan – at a glance

Theme 1: Environment and sustainability

1.1 Reduce inputs and environmental footprint across the value chain	1.1.1 Improving winery energy efficiency
	1.1.2 Capitalising on the carbon economy
	1.1.3 Improving the environmental and economic performance of the Australian wine supply chain
	1.1.4 Assisting industry to adopt renewable energy technologies
1.2 Capture the full value of clonal resources for key Australian varieties	1.2.1 Assessing diversity and clonal variation of Australia's grapevine germplasm
1.3 Reduce the economic and environmental impact of pests and diseases and the techniques used to manage them	1.3.1 Understanding genetic variation in grapevine diseases and the genetic basis for pesticide resistance
	1.3.2 Improving the consistency of description and measurement of disease
	1.3.3 Regional benchmarking of viticultural spraying practices

Theme 2: Consumers, customers and markets

2.1 Identify and secure new market opportunities through consumer insights	2.1.1 Identifying and securing new market opportunities through consumer insights
	2.1.2 Genetics of odour perception and wine preferences
2.2 Build and safeguard brand Australia	2.2.1 Collecting and disseminating information regarding agrochemicals registered for use and maximum residue limits in Australian viticulture
	2.2.2 Origin verification and detection of counterfeit Australian wines
	2.2.3 Informing wine consumers through understanding issues of wine consumption, health and nutrition
	2.2.4 Increasing Australia's influence in market access, safety, regulatory and technical trade issues
2.3 Improve market access through anticipation and removal of trade barriers and regulatory constraints	2.3.1 Emergency response capability

Theme 3: Improving products and processes

3.1 Objective measurement and target setting of grape and wine style	3.1.1 Identification and origin of volatile compounds responsible for important wine sensory attributes
	3.1.2 Assessment of relationships between grape chemical composition and grape allocation grade
	3.1.3 Flavour precursors: contribution to wine aroma, in-mouth sensory properties and flavour release
	3.1.4 Factors affecting wine texture, taste, clarity, stability and production efficiency

3.2 Optimise primary and secondary fermentation for effective production of targeted wine style	3.2.1 Are there regional micro-organisms, and can they be harnessed to produce regionally distinct wine styles?
	3.2.2 Enhanced winemaking outcomes and wine style diversification through provision of fit-for-purpose yeast starter cultures
	3.2.3 Defining the nutritional drivers of yeast performance and matching yeast to must
	3.2.4 Efficient and reliable malolactic fermentation to achieve specification wine style
	3.2.5 Safeguarding and realising the potential of the Australian wine microbial germplasm collection
3.3 Novel products and effective processes	3.3.1 Technologies and strategies for the production of lower-alcohol wine
	3.3.2 Influencing wine style through management of oxygen during winemaking
	3.3.3 Capturing and re-using aroma compounds entrained in fermentation gases
	3.3.4 Developing simplified sparkling winemaking processes which reduce production costs while replicating the flavour and textural properties of wines produced using traditional methods
	3.3.5 Development and application of process analytical technologies for effective winemaking process control
	3.3.6 Producing less-processed, allergen-label-free, wines
3.4 Reduce cost of production	3.4.1 Novel products utilising existing winery capital equipment, surplus grapes and winery waste
	3.4.2 Reducing wine movements during production
	3.4.3 Evaluating alternatives to barrel maturation
	3.4.4 Identifying cost reduction opportunities by mapping the grape and wine value stream
3.5 Reduce the economic impact of taints and faults	3.5.1 Fault and taint remediation strategies and technologies
	3.5.2 Ensuring the continued efficacy of *Brettanomyces* control strategies for avoidance of spoilage
	3.5.3 Formation and fate of positive and negative sulfur compounds
3.6 Deliver sound product to the marketplace	3.6.1 Maximising quality during bulk wine transport

Theme 4: Extension and adoption

4.1 Drive productivity, sustainability and profitability through facilitating rapid adoption of R&D outcomes	4.1.1 The staging and conduct of extension programs
	4.1.2 Specialised technical troubleshooting and responsive helpdesk services for the Australian wine sector
	4.1.3 Library service
	4.1.4 Communication with stakeholders
	4.1.5 Development of web and mobile-based extension tools
4.2 Align supply chains with industry needs	4.2.1 Evaluating and enabling adoption of new technologies
4.3 Enhance national outreach and promote regional engagement	4.3.1 Tailored regional research, development, adoption and extension through regional nodes
4.4 Improve intellectual capital available to the Australian wine industry	4.4.1 Contributing to undergraduate and postgraduate education programs of relevance to the Australian wine industry

Theme 5: Service capabilities and foundational datasets

5.1 Service capabilities and foundational datasets	5.1.1 Enhancing data capture and integration for re-use and data mining
	5.1.2 Chemistry, sensory, chemometrics and development capacity
	5.1.3 Efficient management and administration
	5.1.4 International scientific exchange program

"The support that the AWRI provides to the Australian wine industry is critical to ensure that the industry keeps pace with technological advances..."

Iain Jones, *Treasury Wine Estates*

Putting Industry First

Planning for sustainability, profitability and innovation in the Australian wine industry

This plan has been developed with extensive industry consultation and review, in order to address the significant challenges currently faced by industry. Changing consumer preferences, a strong Australian dollar, intense international competition, reduced water availability, climate uncertainty, an increased focus on the role of wine in society and increasing competition for agricultural land have played, and will continue to play, a significant role in the sustainability of the sector. Research, development and extension activities must address these challenges if the profitability of the sector is to be improved.

Reviews and industry consultations continue to reveal that the Australian grape and wine sector highly values the services provided by its own RD&E organisation, the AWRI. In a 2012 review more than 100 letters from industry representatives – primarily grape and wine producers – highlighted the importance of the AWRI's capabilities in supporting a competitive wine industry.

However, as industry priorities evolve, the AWRI's activities and objectives must evolve accordingly. The AWRI interacts with the Australian grape and wine sector on a daily basis and is informed by the direction of its industry-elected Board.

In addition, a specific, comprehensive consultation and review process was conducted in late 2012, with 36 workshops held across six states and the ACT. More than 200 industry personnel representing 135 stakeholders including peak body, state and regional based associations, winemaking and grapegrowing organisations (small, medium and large) provided input into the development of projects. This included the 15 largest producers (responsible for over 70% of Australia's crush).

As a result of this process, and substantial internal planning, 113 project ideas were refined to the final list of 50 projects, grouped under 17 theme headings.

These projects respond to many of the priorities outlined in the Grape and Wine Research and Development Corporation (GWRDC) 5-year plan 2012-2017, are based on industry priorities and integrate research, development and extension activities.

The consultation process is an ongoing one and does not cease with the publication of this plan. Industry feedback is welcomed and actively sought.

Key directions 2013–2018

Build on the past and reorient for the future
The plan builds on the achievements of the 2006-2013 AWRI Research, Development and Extension plan, but shifts the emphasis and direction of future RD&E to align with current industry priorities and feedback.

Save costs for grape and wine producers
By integrating engineering practices into research, development and extension activities, the plan will deliver new projects targeting cost savings as well as value creation. This plan addresses the impact of temperature fluctuations, packaging and transport logistics on wine quality, value chain mapping, and development of technologies which allow greater automation and real-time decision making.

Increase focus on wine mouth-feel and 'texture'
Great wines are often distinguished by their mouth-feel or 'textural' qualities. While continuing the existing work of the AWRI in flavour and aroma, this plan presents new projects focused on textural characteristics to secure a market advantage for Australian winemakers.

Harness the power of genomics technologies
To capitalise on the power and widespread adoption of genome sequencing in the life sciences, this plan contains projects that will draw on genomics tools to deliver practical solutions for identifying, understanding, improving and/or managing pests and diseases, bacteria and yeast strains, and grape varieties and clones. It will also investigate the link between human genomics and consumer preferences.

Explore the grape to wine interface

Integrating research from across the value chain, the plan includes a focus on the 'grape to wine' interface. Taking a holistic approach, and collaborating with other agencies, the goal is greater understanding of the processes and compositional changes that occur as grapes are transformed into wine.

Inform current transport and packaging practices

Manufacturing, storage, packaging and transport practices in the Australian wine sector have changed significantly in the last decade. This plan will evaluate practices such as bulk shipping and offshore bottling, and recommend risk-management practices where appropriate.

Exploit advances in information technology

To keep pace with advances in information technology, this plan offers new ways to store, access and publish information, exploiting faster broadband networks and larger storage capacities. It will focus on new apps, such as that developed for the popular 'Dog Book', web-based process control applications, and a range of extension activities using digital platforms, such as webinars.

Meet the needs of industry at national, regional and local level

This plan is aligned with Australian Government priorities and industry requests in proposing nationally-relevant 'research' activities at the AWRI hub in Adelaide to maximise efficient use of infrastructure and maintain critical mass; regionally-relevant 'development' through the formation and maintenance of a network of nodes in partnership with states and regions; and locally-relevant 'extension' through regular Roadshows, personal contact and improved use of electronic media. These initiatives will increase the AWRI's emphasis on extension and adoption.

Offer optimal outcomes through flexibility

To deliver maximum returns, this plan includes projects expected to deliver tangible benefits over the short-term (1-2 years), medium-term (2-4 years) and long-term (5 years+). Not all projects will be conducted simultaneously, and will proceed at different rates to maximise flexibility and align with industry priorities over time.

Maximise the collaborative network

This plan contains a large number of projects. In some cases, the AWRI will act as the lead agency, while in others the AWRI will act as a supporting agency to other lead agencies. It is designed to make best use of both the AWRI's core capabilities and collaborative networks with other Australian and overseas research organisations.

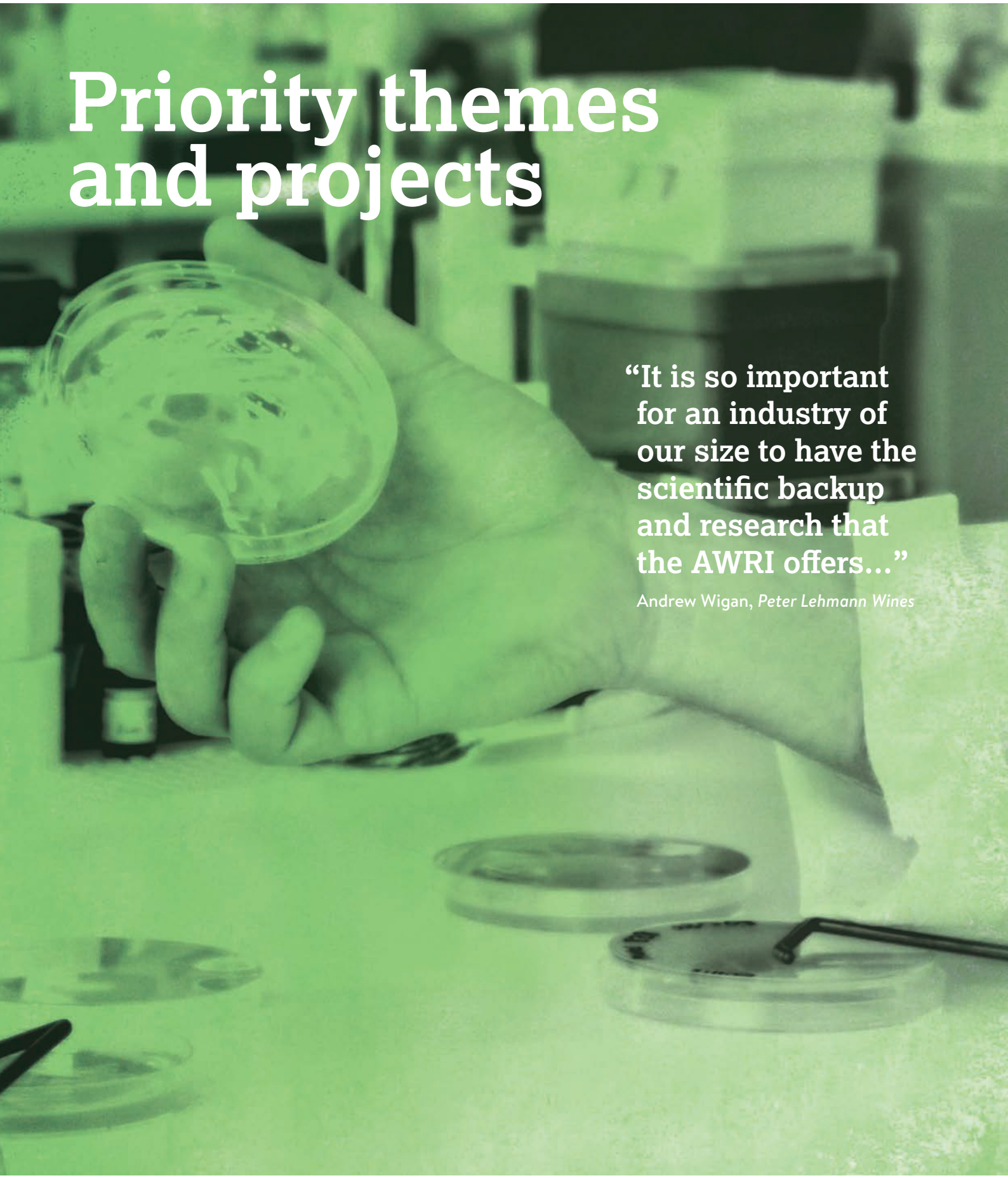
Improve technology adoption

To facilitate new technology evaluation and improve the speed of adoption in industry, this plan will seek to benchmark new technologies and product categories that have the potential to make a substantial difference to the Australian wine sector.

Respond in an emergency

This plan ensures that the AWRI retains its capability and capacity to respond to emergencies that have a direct effect on Australia's grape and wine sector. In addition to those projects that respond to new priorities, the AWRI's technical expertise in troubleshooting, emergency response and extension remain integral to 2018 and beyond.

Priority themes and projects



"It is so important for an industry of our size to have the scientific backup and research that the AWRI offers..."

Andrew Wigan, *Peter Lehmann Wines*

Theme 1: Environment and sustainability

1.1 Reduce inputs and environmental footprint across the value chain

Environmental custodianship is an important element of modern industry. Australian wine producers must strive to achieve best practice in the use of energy and other resources throughout the production chain. Tools to reduce the environmental footprint of producing and delivering wine to consumers will be developed. Economic returns to producers will be generated by minimising energy requirements (and cost), efficient use of winery 'waste', and maintenance and/or growth of key markets by meeting customer and/or consumer environmental requirements.

Focus areas include:

- Reducing energy use through efficient refrigeration systems
- Developing alternative processing technology to eliminate or reduce energy demand
- Enabling the wine sector to capitalise on Australian Government sustainability/environment initiatives, e.g. the Clean Energy Future program
- Identification of opportunities to improve environmental and economic performance and communication of environmental credentials to customers and consumers
- Wine sector-specific trials of renewable energy technologies and assistance with their adoption
- Quantifying the nature and magnitude of emissions from viticulture and identifying opportunities for reduction by modifying operational practices

1.1.1 Improving winery energy efficiency

1.1.2 Capitalising on the carbon economy

1.1.3 Improving the environmental and economic performance of the Australian wine supply chain

1.1.4 Assisting industry to adopt renewable energy technologies

1.2 Capture the full value of clonal resources for key Australian varieties

Clones of grape varieties can vary markedly in their physical characteristics and can produce distinctly different wine styles. Matching site, variety, clone and rootstock together has a major influence on the ability to grow grapes to specification for a defined wine style, and therefore on the profitability of a vineyard. There is a need to better understand Australia's germplasm to inform planting decisions and understand how to extract maximum value from current and future vineyard plantings. The genetic basis of clonal variation will be determined for Chardonnay, Shiraz and Cabernet Sauvignon in the first instance, and wines will be made from each investigated clone to evaluate the impact of clone on objective and measurable wine characteristics. This project will build on existing grapevine genome sequencing studies and produce knowledge that, with time, is likely to be used as the basis to make informed decisions in germplasm breeding and selection programs, and in-the-field vineyard management decisions such as clonal identification and matching clone to site.

1.2.1 Assessing diversity and clonal variation of Australia's grapevine germplasm

1.3 Reduce the economic and environmental impact of pests and diseases and the techniques used to manage them

Management of vineyard pests and diseases has major environmental, social and economic consequences, and is an important element of regulatory frameworks in domestic and international markets. Preventative and/or control strategies, and the manner of their application, are constantly evolving. An improved understanding of the genetics of pests and diseases and the basis of pesticide resistance will inform control strategies. New tools for monitoring vineyard diseases will inform decision-making, and spray programs that most effectively control outbreaks will be identified.

This theme will also seek to establish objective benchmarks for grape disease, e.g. an industry-wide definition of what is meant by the term '2% bunch rot', and use those objective benchmarks to develop analytical tools to measure grape disease.

Establishment of best practice spraying benchmarks will highlight opportunities to reduce the environmental impact of viticultural practices and create case studies for dissemination to growers.

1.3.1 Understanding genetic variation in grapevine diseases and the genetic basis for pesticide resistance

1.3.2 Improving the consistency of description and measurement of disease

1.3.3 Regional benchmarking of viticultural spraying practices

Theme 2: Consumers, customers and markets

2.1 Identify and secure new market opportunities through consumer insights

The past and future success of the Australian wine industry is linked to providing products with attributes that consumers value, and for which they are prepared to pay a premium and/or favour repeat purchase. The AWRI will assist efforts to gather information regarding the intrinsic and extrinsic properties of wine in major and emerging markets for Australian wine, providing producers with information regarding desirable wine styles for target market segments.

Focus areas include:

- Providing technical support to consumer insight and market access projects undertaken by industry organisations
- Assessing the consumer response to chemical compounds in wine
- Building a knowledge base that links wine composition with sensory and consumer preferences
- Evaluating consumer response when assessing wines blind compared to when informed of wine identity
- Assisting industry to identify how target products can be made based on results of this project
- Testing individuals for sensitivity to different aroma compounds, and analysing the data in the context of their genetic sequence data to identify relevant genes

2.1.1 Identifying and securing new market opportunities through consumer insights

2.1.2 Genetics of odour perception and wine preferences

2.2 Build and safeguard brand Australia

All Australian wine producers benefit from the positive engagement of governments, customers and consumers with the Australian wine category. Wine must meet a range of technical regulations, which differ from country to country. Australia must also maintain an active involvement in the setting of, and compliance with, those technical standards by developing and communicating robust data that support evidence-based policy decisions. Australia must also actively contribute to key policy platforms and frameworks, and provide a consumer guarantee that a wine is a 'product of Australia'.

The AWRI will contribute to these efforts through the following focus areas:

- Continuing to produce a list of Australian Pesticides and Veterinary Medicines Authority (APVMA)-registered products (insecticides, fungicides and herbicides) for viticulture with recommended withholding periods
- Integrating the information in the AWRI 'Dog Book' with label information and with web-based vineyard management platforms
- Evaluating strategies and building a database (and/or validating existing databases) with the aim of establishing a robust way to quickly ascertain the authenticity of an unknown wine sample
- Collating and disseminating credible and scientifically sound information regarding wine and health/nutrition
- Serving on key national and international industry, government and other relevant boards, committees and working groups in order to maintain effective relationships with key regulatory stakeholders
- Providing accurate, appropriate and timely regulatory, scientific and technical position and supporting papers when required/requested
- Supporting the efforts of Wine Australia Corporation and the Winemakers' Federation of Australia in establishing robust regulatory frameworks in domestic and export markets

2.2.1 Collecting and disseminating information regarding agrochemicals registered for use and maximum residue limits in Australian viticulture

2.2.2 Origin verification and detection of counterfeit Australian wines

2.2.3 Informing wine consumers through understanding issues of wine consumption, health and nutrition

2.2.4 Increasing Australia's influence in market access, safety, regulatory and technical trade issues

2.3 Improve market access through anticipation and removal of trade barriers and regulatory constraints

Australian wine is periodically subject to technical trade barriers in domestic and international markets. The industry requires an effective emergency response capability to anticipate and rapidly and confidentially address technical trade barriers as and when they arise.

2.3.1 Emergency response capability

Theme 3: Improving products and processes

3.1 Objective measurement and target setting of grape and wine style

Many Australian wine producers seek to achieve specific wine styles to suit specific markets, a critical component of which is sourcing a sufficient quantity of grapes of suitable style. Markers for measuring style have long been sought to inform grapegrowing and winemaking. However, relatively few objective measures of grape characteristics which can be directly related to wine style are currently available. A suite of projects will be undertaken to better understand and manage the chemical and biochemical drivers of sensory attributes in wine. These projects will also aim to enhance the setting of objective compositional targets which assist grapegrowers to grow grapes to specification, i.e. grapes which contain compounds or precursor compounds that drive consumer preference. In addition, the extent to which yield influences objective compositional targets will be explored.

Focus areas include:

- Identification of chemical compounds that lead to wine characteristics such as 'raisin', 'porty' or 'jammy'; 'oxidation'; stone fruit (apricot/peach); 'greenness' and bitterness
- The effects of extraneous/exogenous natural products on grape flavour composition
- Development of winemaking practices to extract maximum value from fruit
- The 'packaging' and integration of existing and new measures of grape/wine style to facilitate adoption
- Compounds that act as the backbone of desirable in-mouth 'textural' attributes
- Tannins, polysaccharides and proteins (and their interactions), and the properties and importance of wine colloids
- In-mouth sensory properties of lower alcohol products
- The effect of dissolved gases on key aspects of wine structure such as acidity, sweetness, and perceived freshness, in still table wines, lower alcohol wines and frizzante styles
- How different grape and juice handling steps (harvesting, transportation, destemming, crushing, draining, pressing and juice clarification) influence juice solids content

3.1.1 Identification and origin of volatile compounds responsible for important sensory attributes

3.1.2 Assessment of relationships between grape chemical composition and grape allocation grade

3.1.3 Flavour precursors: contribution to wine aroma, in-mouth sensory properties and flavour release

3.1.4 Factors affecting wine texture, taste, clarity, stability and production efficiency

3.2 Optimise primary and secondary fermentation for effective production of targeted wine style

As a low-cost but highly influential input into the winemaking process, yeast and bacteria present a clear opportunity for tailoring wines to meet defined styles. In addition, indigenous yeast and bacteria might play an important role in the formation of what are regarded as regional wine characteristics. New yeast and bacteria strains will be developed to meet winemakers' requirements, drawing on the potential of existing regional diversity and the AWRI microbial germplasm collection assembled over the past 50 years. In addition, the drivers of efficient primary and secondary fermentations will be characterised.

Focus areas include:

- Investigation of microbial diversity throughout Australian vineyards and non-grapegrowing regions as potential reservoirs of new, desirable yeast and bacterial strains
- Development of yeast strains with defined fermentation performance and wine style properties
- Understanding how different yeast strains perform in different grape juices and how winemakers can proactively manage risk of suboptimal ferments
- Identification of bacterial strains that perform malolactic fermentation (MLF) efficiently and under difficult conditions
- Identifying how yeast and bacteria form desirable aroma compounds
- Developing a comprehensive knowledge base of the impact of MLF strain, inoculation regime and compatibility with currently available and 'to be' developed yeast strains on MLF efficiency and flavour development
- Maintaining and improving the utility of the Australian wine industry microbial germplasm

3.2.1 Are there regional micro-organisms, and can they be harnessed to produce regionally distinct wine styles?

3.2.2 Enhanced winemaking outcomes and wine style diversification through provision of fit-for-purpose yeast starter cultures

3.2.3 Defining the nutritional drivers of yeast performance and matching yeast to must

3.2.4 Efficient and reliable malolactic fermentation to achieve specification wine style

3.2.5 Safeguarding and realising the potential of the Australian wine microbial germplasm collection

3.3 Novel products and effective processes

The Australian wine industry is unable to compete in export markets on the basis of production cost, and must continuously innovate to meet market demands and remain competitive. Existing products and practices will be evaluated, and new products and practices recommended to aid production of wines with attributes that consumers value.

Focus areas include:

- Technologies and strategies for the production of lower-alcohol wines while maintaining flavour and aroma
- Improving the understanding of the impact and management of oxygen for modulation of wine style
- Maximising formation of aroma compounds and evaluating the use of aroma collection to allow targeted back additions and/or new product development opportunities
- Understanding the chemistry, physics and kinetics of flavour and texture development in sparkling wine, including mousse and bead; and practices that enable improvement of desirable attributes at minimal cost
- Improving the understanding, flexibility and cost effectiveness of various processes, such as fermentation, filtration, pressing, phenolic extraction and stabilisation through investigating process analytics with 'new-generation' sensors, instrumentation and predictive control algorithms
- Developing and evaluating methodologies for alternative fining agents/practices and the production of preservative-free wine products

3.3.1 Technologies and strategies for the production of lower-alcohol wine

3.3.2 Influencing wine style through management of oxygen during winemaking

3.3.3 Capturing and re-using aroma compounds entrained in fermentation gases

3.3.4 Developing simplified sparkling winemaking processes which reduce production costs while replicating the flavour and textural properties of wines produced using traditional methods

3.3.5 Development and application of process analytical technologies for effective winemaking process control

3.3.6 Producing less processed, allergen-label-free, wines

3.4 Reduce cost of production

Key drivers of cost in winemaking include grapes, juice/wine losses, asset utilisation, maturation, labour and packaging. Projects will be conducted to reduce the cost and/or ensure optimal outcomes from the making, storing and ageing of wine.

Focus areas include:

- Extracting additional value from investments into vineyards and winery capital equipment through new products
- Opportunities and technologies to reduce the number of processing steps and movements in medium and large-scale wineries
- The underlying processes and technologies that can achieve similar results to barrel maturation at lower costs on a large-scale
- Establishing priority processing technology opportunities and cost reduction focus areas through value stream mapping, activities based costing, and process mapping projects across a range of winery demographics
- Opportunities and technologies to enable the extension of the harvest window to smooth intake workflows, grape yield management, process efficiencies and capital utilisation

3.4.1 Novel products utilising existing winery capital equipment, surplus grapes and winery waste

3.4.2 Reducing wine movements during production

3.4.3 Evaluating alternatives to barrel maturation

3.4.4 Identifying cost reduction opportunities by mapping the grape and wine value stream

3.5 Reduce the economic impact of taints and faults

Faults and taints can arise at a number of points throughout the wine production chain. Prevention may not always be possible, e.g. with smoke taint and unfamiliar contamination sources. Others, such as *Brettanomyces* spoilage, can be managed in the short-term but, require winemakers to evolve their management strategies. Tools to manage the likelihood and economic impact of taints and faults will be developed, allowing grapegrowers and winemakers to generate a financial return from grapes and wines that would otherwise be discarded.

3.5.1 Fault and taint remediation strategies and technologies

3.5.2 Ensuring the continued efficacy of *Brettanomyces* control strategies for avoidance of spoilage

3.5.3 Formation and fate of positive and negative sulfur compounds

3.6 Deliver sound product to the marketplace

The manner in which wine is packaged and distributed is evolving. Australian wine must maintain, and be seen to maintain, its integrity through to the point of consumption.

Focus areas include:

- Identifying opportunities to improve packaging operations, including optimal bottling temperatures, management of fill heights, microbial contamination and total package oxygen levels
- Assessing the extent of quality loss throughout distribution chains and evaluating the relative importance/impact of temperature, oxygen ingress, tainting and scalping for different packaging technologies and materials
- Developing guidelines and tools to ensure that wine reaches its market in optimum condition

3.6.1 Maximising quality during bulk wine transport

Theme 4: Extension and adoption

4.1 Drive productivity, sustainability and profitability through facilitating rapid adoption of R&D outcomes

The value of research and development is only realised in industry when implemented effectively and efficiently. A range of extension mechanisms will be utilised to encourage adoption of R&D outcomes, including proven mechanisms such as the AWRI Roadshows and a technical problem solving capability, along with an increasing focus on electronic media.

Focus areas include:

- Providing a highly experienced help-desk for technical problems encountered by producers
- Conducting investigations to identify and solve complex technical problems, preventing sub-standard or tainted fruit/wines entering the supply chain
- Assisting producers to manage insurance claims based on technical matters such as those arising from the supply of inferior processing aids, additives or packaging products
- Monitoring industry-wide technical trends and emergencies, generating information which can be applied to the prioritisation of research activities
- Developing content for, organising and staging:
  - the AWRI Roadshow seminars across Australian wine regions on a two-year rotational basis
  - the AWRI Roadshow workshops across Australian wine regions on a three-year rotational basis
  - the Australian Wine Industry Technical Conferences, and other wine-related conferences
  - the AWRI Advanced Wine Assessment Course®, and other wine tasting courses
  - themed Research to Practice® workshops
- Through the AWRI's John Fornachon Memorial Library providing support to producers and other stakeholders through strategic sourcing, management and dissemination of relevant electronic and print resources
- Media liaison and production of a large range of electronic and hard-copy industry publications, including the AWRI website, Annual Report, eNews and email broadcasts, Technical Review, the AWRI Report, 'Ask the AWRI' column, trade articles and the 'Dog Book'
- Developing new technology platforms for dissemination of research outputs from the AWRI and other organisations, including:
  - mobile device apps as decision-support systems to support winery and vineyard operations
  - cloud-based web applications
  - email and web-based communications optimised for mobile device access
  - e-Learning tools consisting of 3D visualisation and interaction to connect and engage
  - collaborative learning via webinars and social media tools
- Evaluating the effectiveness of AWRI extension platforms and identifying opportunities to increase adoption of information

4.1.1 The staging and conduct of extension programs

4.1.2 Specialised technical troubleshooting and responsive helpdesk services for the Australian wine sector

4.1.3 Library service

4.1.4 Communication with stakeholders

4.1.5 Development of web and mobile-based extension tools

4.2 Align supply chains with industry needs	Competitive advantage can be captured when customised equipment and production processes are used to create high value product attributes. Most Australian winemakers use off-the-shelf processing methods, additives and equipment. Researchers will work with suppliers to ensure that the Australian industry can access the tools needed to create high value, profitable products. In addition, Australian winemakers will benefit from independent testing and proof-of-performance data on new products that reduces the risk of adopting a new product.	4.2.1 Evaluating and enabling adoption of new technologies
4.3 Enhance national outreach and promote regional engagement	The National Primary Industries RD&E Framework - Wine Sector Strategy calls for national 'R', regional 'D' and local 'E'. Formation of regional 'nodes' of activity in a number of Australia's grapegrowing and winemaking regions allow regionally-relevant R&D priorities to be identified and tailored RD&E solutions to be provided. The nodes have proven to be effective mechanisms to foster adoption, through direct and active collaboration with industry partners. Subject to continued support from the relevant regions, the four existing AWRI nodes will be maintained, with the staffing and project portfolios of each continuing to match the priorities of the region. Opportunities for additional nodes will be explored with regional partners.	4.3.1 Tailored regional research, development, adoption and extension through regional nodes
4.4 Improve intellectual capital available to the Australian wine industry	The robust education and professional development of Australia's winemaking community and the research community that supports it are important pre-requisites to the Australian wine industry's technical capacity. The AWRI will contribute to tertiary teaching programs at a number of institutions delivering wine science, wine marketing or associated courses, and continue to host and/or mentor Honours, Masters by Research and Doctoral students in wine-related disciplines.	4.4.1 Contributing to undergraduate and postgraduate education programs of relevance to the Australian wine industry

Theme 5: Service capabilities and foundational datasets

5.1 Service capabilities and foundational datasets

The RD&E outcomes of the AWRI are underpinned by an efficient service capacity that:

- provides infrastructure and training to simplify mechanisms to record experimental results with enhanced data provenance;
- provides the technical support capabilities required to undertake the projects outlined in this plan and, in some cases, by third party research agencies, including the provision of experienced technical officers and capital equipment required for such capabilities;
- manages governance, legal affairs, financial affairs, IT, human resourcing, OH&S and information networks; and
- facilitates the exchange of international scientific thought leaders in grape and wine science, for the benefit of Australian grape and wine science, and the Australian industry itself.

5.1.1 Enhancing data capture and integration for re-use and data mining

5.1.2 Chemistry, sensory, chemometrics and development capacity

5.1.3 Efficient management and administration

5.1.4 International scientific exchange program

Alignment with industry and government priorities

AWRI Theme	GWRDC Strategic Themes	Rural RD&E priorities	National Research Priorities	National RD&E framework
Reduce inputs and environmental footprint across the value chain	Climate adaptability	Natural resource management	An environmentally sustainable Australia	Nationally-relevant research and development undertaken at a world-class facility
Capture the full value of clonal resources for key Australian varieties	Germplasm (grapevine)	Productivity and adding value	Frontier technologies for building and transforming Australian industries	
Reduce the economic and environmental impact of pests and diseases and the techniques used to manage them	Vineyard profitability	Climate variability and climate change Biosecurity Technology		
Identify and secure new market opportunities through consumer insights	Consumer insights	Supply chain and markets	Promoting and maintaining good health	
Build and safeguard brand Australia	Market access			
Improve market access through anticipation and removal of trade barriers and regulatory constraints				
Objective measurement and target setting of grape and wine style	Objective measures of quality and assessment systems	Productivity and adding value	Frontier technologies for building and transforming Australian industries	Applied research and development undertaken with industry partners and through a network of regional nodes
Optimise primary and secondary fermentation for effective production of targeted wine style	Germplasm (yeast and bacterial)	Supply chain and markets		
Novel products and effective processes	Process efficiency	Technology		
Reduce cost of production				
Reduce the economic impact of taints and faults				
Deliver sound product to the marketplace				
Drive productivity, sustainability and profitability through facilitating rapid adoption of R&D outcomes	Adoption	Innovation skills		
Align supply chains with industry needs		Supply chain and markets		
Enhance national outreach and promote regional engagement				Proactive extension activities that meet regional and sub-regional needs
Improve intellectual capital available to the Australian wine industry	Developing people	Technology		

“Its ability to disseminate results and information make it an ideal “one stop shop”… the AWRI has certainly provided value to our company.”

Doug McWilliam, *McWilliam’s Wines*

Resourcing the plan

The projects in this plan have been proposed and/or endorsed through industry consultation as being priorities for investment.

The activities of the AWRI are largely funded by Australian winemakers and grapegrowers through their investment body, the Grape and Wine Research and Development Corporation (GWRDC), with matching funding from the Australian government.

Investment from other domestic and international granting bodies and private investors will also be sought across the project portfolio, particularly for those projects that do not attract sufficient support from GWRDC.

Detailed costings and outputs will be regularly monitored for each project to ensure maximum returns and benefit for grape and wine producers. Where possible, returns will be measured in dollar terms to assess return on investment.

Not all projects will commence immediately, however the AWRI aims to undertake all projects throughout the lifetime of the plan. Many projects are scalable, allowing the detailed outputs to be adjusted to reflect the level of investment achieved.

A status update will be maintained at ***http://www.awri.com.au/about_the_AWRI/rde-plan/project-status*** for all projects in this plan, with relevant contact details.

Facilities

The AWRI operates from purpose-built facilities at the Waite Campus in Urrbrae, South Australia. The Waite is recognised as one of the world's leading agricultural research precincts, hosting over 1,000 researchers and undertaking RD&E to the value of more than $150 million annually.

Facilities of particular relevance to the delivery of this plan include, well-equipped laboratories for chemical and biological research activities, small- and pilot-scale winemaking and access to experimental vineyards.

Co-located with the AWRI at the Waite are the other members of the Wine Innovation Cluster (WIC), a grouping of Australia's leading grape and wine RD&E entities. WIC represents more than half of Australia's grape and wine science capability.

Regional nodes of the AWRI have so far been established in Griffith, Hobart, the Hunter Valley and Melbourne. Node staff members have access to local research and analytical facilities, as well as commercial wine production sites where novel process optimisation technologies are tested and developed.

Many projects in this plan will be conducted in conjunction with research facilities in other parts of Australia and overseas, and/or in conjunction with industry vineyards and winery sites.

People who deliver

The AWRI employs a vibrant group of people with a diverse range of backgrounds and qualifications, working together to support the priorities of Australian grape and wine producers. Originating from more than fifteen countries, they bring unique perspectives, expertise and skills to the delivery of projects in this plan.

More than half of the AWRI's employees hold a Bachelor's degree in either Science or Agricultural Science. More than a quarter hold a PhD, and just less than a quarter hold a Master of Science, Business or Commerce.

AWRI employees work closely with visiting researchers and students who also contribute towards achieving the outputs of this plan. Approximately two-thirds of the people who make up the AWRI are funded by GWRDC.

Full details of the AWRI employees and their qualifications can be found at ***http://www.awri.com.au/people/employee_profiles/***

Collaborative network

The AWRI has more than 100 active formal collaborations with academic and industry partners all over the world, plus several hundred informal industry collaborations. The AWRI is also a founding member of the Wine Innovation Cluster. Most projects in this plan will involve at least one collaborating organisation.

In some cases, the AWRI will act as the project lead agency while in others the AWRI will play a supporting or facilitating role. The principal aim is the conduct of RD&E that delivers outcomes for industry, and collaboration will be pursued whenever it leads to a faster, more cost effective or higher quality result.

Potential collaborators are encouraged to approach the AWRI.

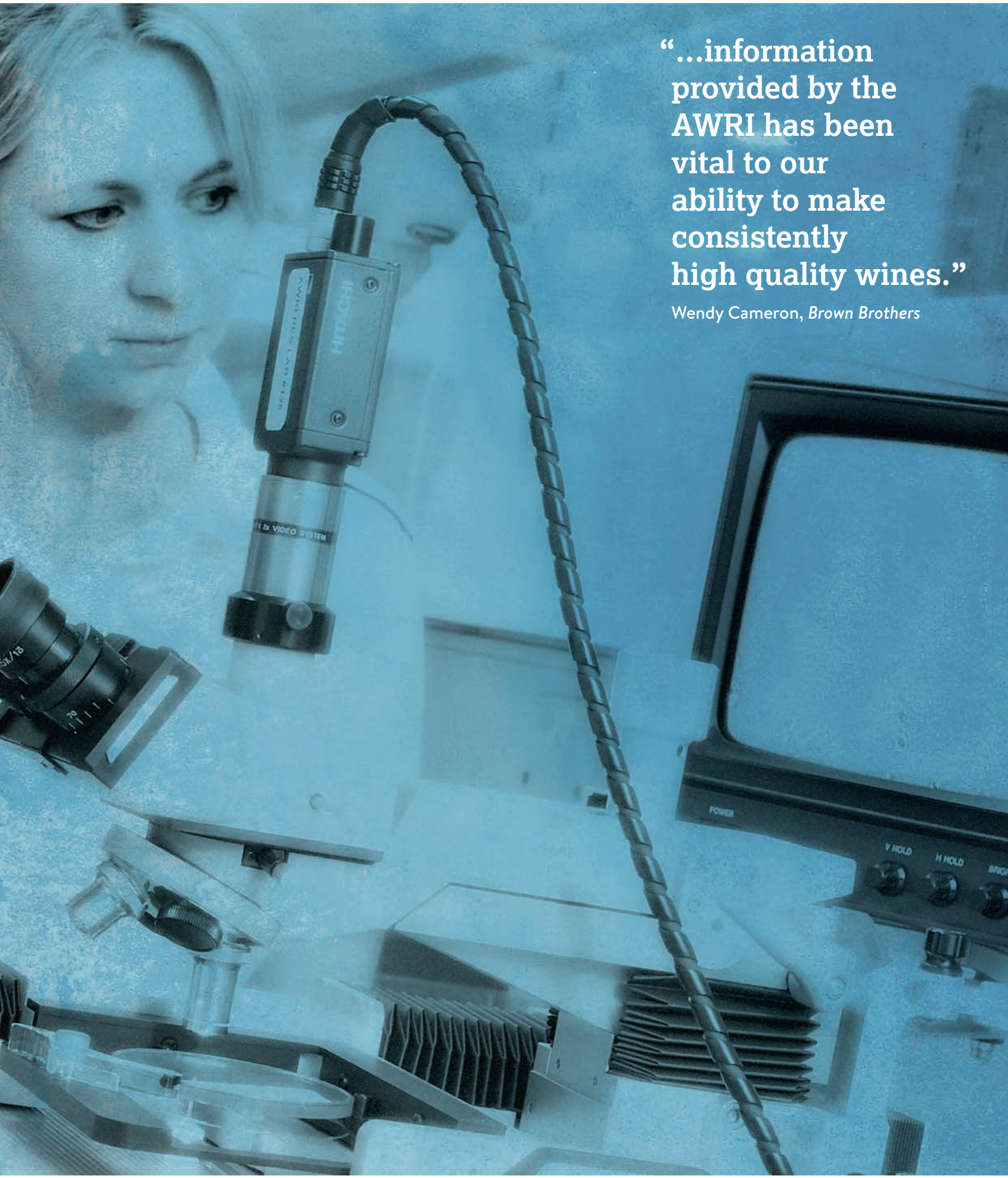
Taking technology to the user

RD&E at the AWRI is undertaken in the broader context of increased profitability and sustainability of Australia's grape and wine industry. Timely communication of results is a key priority and the RD&E intellectual property management strategy favoured by the overwhelming majority of the Australian wine industry is rapid dissemination and adoption. This principle is captured within the intellectual property policy of the Winemakers' Federation of Australia.

Wherever possible, the AWRI favours timely and tailored extension through a combination of peer-reviewed and industry publications, scientific conferences, industry-focused events and electronic media. Every effort is made to ensure that the Australian industry gains maximum benefit from research outputs even within an environment of open international communication.

Formal intellectual property protection and commercialisation is undertaken only when a compelling case can be made that this strategy will result in faster, fairer or better outcomes for the Australian wine industry. Past examples where this approach has been taken include the commercialisation of novel yeast strains, the availability of complex new analytical methods via commercial laboratories and new applications of spectroscopy.

The AWRI Commercial Services group provides fee-for-service activities designed to assist individual producers to access and adopt analytical methods, technologies and knowledge. More than 70,000 analyses are conducted each year, meeting regulatory requirements for a large proportion of Australia's exported wine and supporting informed decision making.



"...information provided by the AWRI has been vital to our ability to make consistently high quality wines."

Wendy Cameron, *Brown Brothers*

About the AWRI

The Australian Wine Research Institute (AWRI) is an organisation dedicated to the advancement of the Australian grape and wine industry. Established in 1955 and governed, operated and largely financed by Australia's grape and wine producers, the AWRI is the 'engine room' of pre-competitive research, development, extension (RD&E) and technical innovation for the Australian wine industry.

It is a company limited by guarantee that does not have share capital – it considers its 'shareholders' to be Australian levy payers. Grapegrower and winemaker levy payers directly nominate and vote on the composition of the AWRI's Board and work directly with the AWRI to improve the productivity of the whole industry.

The AWRI's governance model, scope and culture of industry interaction are all directly attributable to its foundation as being driven by industry, for industry. Practising grapegrowers, winemakers and other industry professionals on the AWRI's Board are responsible for representing the industry's priorities, guiding the direction of RD&E and ensuring that levy- and tax-payer funds are appropriately applied.

The AWRI is the only organisation in Australia devoted to grape and wine RD&E. It is 'the first port of call' in any industry emergency and devotes substantial time and resources to extension and practical uptake.

The strategic direction, plans and projects of the AWRI are contained within its constitution and this RD&E plan.

Key stakeholders

The AWRI's key stakeholders are:

- Members of the Australian grape and wine industries, including their peak bodies: the Winemakers' Federation of Australia and the Wine Grape Growers Australia
- Regional and State associations
- Australian and State governments
- Grape and Wine Research and Development Corporation
- Wine Australia Corporation
- The AWRI's national and international collaborators, including other industry and government bodies and research organisations
- Members of the AWRI Board and AWRI employees
- Wine industry suppliers

"I am aware of no other wine research institution in the world where the conduit between research and winemakers is as short, direct and beneficial as between the AWRI and Australian industry."

Michael Hill Smith AM MW,
Shaw + Smith

Organisational structure and capabilities

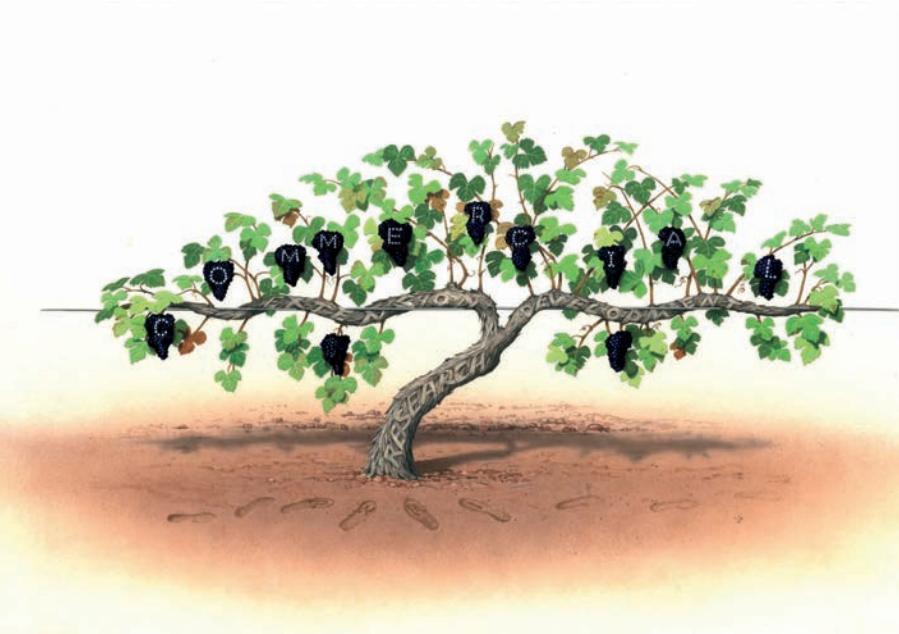
The AWRI's operational activities can be broadly grouped into four key functions.

1. Research: Fundamental and applied research into wine composition, style and sensory characteristics. Specific areas of expertise include chemistry, biochemistry, microbiology, molecular biology, systems biology, metabolomics, genomics, bioinformatics, chemometrics, engineering, packaging, process science, sensory science, spectroscopy, mass spectrometry, oenology (winemaking) and viticulture (grapegrowing).

2. Development: Translating and packaging research outcomes from Australia and overseas into useable applications and fostering their adoption by grape and wine producers through mechanisms including a network of nodes established in grapegrowing and winemaking regions.

3. Extension and Education: Communication to the Australian industry of Australian and international grape and wine research, development and practical solutions through a range of knowledge-dissemination activities including articles in trade journals and peer-reviewed publications, electronic newsletters and bulletins, AWRI publications, the AWRI website, regular in-field seminars and workshops in grapegrowing/wine regions, webinars and technical troubleshooting services. Support with technical and industry emergency issues, regulatory and other technical industry affairs, event management and RD&E knowledge management.

4. Commercial Services: Fee-for-service analytical facilities, 'market-pull' proof-of-concept studies, product benchmarking and technical validation, export certificates and site audits.



Delivering value to Australian grape and wine producers

A results-driven culture

The AWRI is responsive to the expectations and requirements of its many stakeholders, particularly the grapegrowers and winemakers of Australia. Recent highlights of its activities include:

Benefits for consumers

- Better quality wines through improvements in wine composition and the winemaking process
- Increased consumer satisfaction through product offerings based on sensory studies that identify the drivers of wine quality and style
- Less likelihood of quality loss due to bottle closures
- Constant monitoring of compositional trends in Australian wine
- Improved communication based on objective wine style information
- Active support for a culture of product integrity in the Australian wine industry

Support for grapegrowers

- Technical troubleshooting and help-desk services for grapegrowers
- Rapid responses to industry emergencies, e.g. bushfires
- Measurement of smoke taint in grapes and strategies to mitigate the effects
- Elucidation of colour/quality relationships in grapes
- Identification of key flavour and aroma compounds and their origin
- Analysis of grape composition using rapid spectral tools
- Provision of easily accessible information on maximum residue limits in export markets, including annual publication of *Agrochemicals registered for use in Australian wine*, with access via the web and smartphone/tablet apps

- Provision of targeted technical and information services to grapegrowers
- Provision of technical information to industry associations such as Wine Grape Growers Australia to inform policy decisions

Advantages for winemakers

- Improved fermentation management including the development of novel wine yeast strains, the supply of microbial cultures; and a better understanding of the drivers of stuck and attenuated fermentations e.g. nitrogen levels
- A detailed understanding of wine yeast and bacteria and their roles in influencing wine style, drawing on modern genomics tools
- Understanding and development of management strategies related to temperature and oxidation, red wine colour and phenolics and wine instabilities
- Rapid measurement of wine parameters using spectral methods, and utilisation of these approaches in both real-time decision making in the winery and in communicating wine style to consumers
- Improved approaches to measuring and managing oxygen in wine, including total package oxygen, increasing control of shelf-life and wine style development
- Identification of wine taints and faults, development of strategies to eliminate or mitigate them, and methods to analyse their levels in wine, including taints from smoke exposure, *Brettanomyces* and 'reductive' compounds
- Optimisation of wine flavour through the identification of key components of grape, wine and oak flavour, including identification of the pepper compound, rotundone, and the source of the minty 'eucalyptus' aroma
- Through a suite of analytical methods, measurement and monitoring of a range of important aroma compounds from the vineyard through to post-bottling
- Provision of targeted technical and information services to winemakers including emergency response services
- Fostering positive trends in the key measurements of wine composition (e.g. free to total SO_2 ratios, volatile acidity and 4-ethylphenol)
- Non-destructive analysis of bottled wine, allowing for optimal stock rotation and an ability to sort 'good' wine from 'bad'
- Process improvements in the use of refrigeration and alternatives to bentonite reducing production costs and wine losses
- Provision of technical information to industry associations such as the Winemakers' Federation of Australia to inform policy decisions
- Conduct of consumer sensory projects in key markets leading to a better understanding of consumer preferences and paving the way for new product development
- An improved understanding of the mechanisms and triggers for haze formation in white wine

Assistance to the Australian Government

- Provision of technical information to underpin international regulatory negotiations and evidence-based policy decisions
- Technical support for the compliance and regulatory activities of Wine Australia Corporation

Collaborating with wine industry suppliers

- Generating new products demanded by growers and winemakers by partnering with and providing technical services to supplier companies
- Objective benchmarking and proof of performance testing for supplier products

Ongoing points of engagement with the wine sector value chain (per annum figures unless noted otherwise)

- Investigate ~1,000 problem samples and provide confidential, expert advice and opinions to the relevant company
- Respond to ~20 requests each working day regarding technical information, professional advice and scientific articles
- Deliver > 200 presentations to industry, scientific and student audiences reaching >2,000 people
- Stage >15 AWRI Roadshow workshops and seminars
- Supply technical information through a website that receives >320,000 page views, e-broadcasts, web-portals, webinars, mobile apps and Library databases.
- Conduct >70,000 analyses through the AWRI's Commercial Services
- Distribute >11,000 copies of the agrochemical 'Dog Book'
- Communicate with and inform >2,500 industry stakeholders via the e-mail database on topical issues (eBulletins) and bi-monthly eNews
- Coordinate and disseminate information relating to climate adaptation through a number of Australian Government funded programs
- Advance wine education through conduct of professional development courses including the Advanced Wine Assessment Course, themed masterclasses and other tasting programs
- Anticipate and proactively respond to industry emergencies, e.g. bushfires, chemical taints
- Engage with regions through the formation and maintenance of regional nodes
- Stage, with partners, the triennial Australian Wine Industry Technical Conference and other conferences and symposia

"We view the AWRI as our first point of call for technical advice and also look to the AWRI as Australia's leading provider of new winemaking knowledge."

John Griffiths, *Faber Vineyard*

"...the support provided by AWRI continues to give the Australian wine industry one of the most significant competitive advantages available anywhere in the world..."

Jeremy Dineen, *Josef Chromy Wines*

"The AWRI is recognised and envied around the world as a preeminent provider of research and technical excellence."

Brett McKinnon, *Orlando Wines*

"The AWRI plays a critical role in Australia's wine business, providing high tech problem solving, education and adaptability options to our sector."

Pete Bissell, *Balnaves of Coonawarra*

"I can't speak too highly of the AWRI."

Chester Osborn, *d'Arenberg*

"...we view the AWRI as an industry partner and resource which adds considerable value to our business..."

Dan Buckle, *Domaine Chandon*

"The value of the AWRI to the Australian wine industry is difficult to measure, but I have absolutely no doubt that without it we would be a much poorer and less advanced industry."

John Angove AM, *Angove Family Winemakers*

"To simply view the AWRI as technical support undersells the value they can add. At Wirra Wirra we have experienced first hand the benefits of the R&D program through practical winemaking trials. The results are evident where it counts – in the bottle."

Andrew Kay, *Wirra Wirra Vineyards*

"...I feel certain I speak for many international journalists working in the wine field in stressing the exceptional value of the AWRI's work to Australia's image and influence as a wine-producing nation overseas."

Andrew Jefford

"The AWRI is an amazing resource with personable and approachable individuals only too willing to assist us improve what we are doing. Problem solving, world leading lab analysis and groundbreaking research are all readily available."

Patrick Coutts, *Salitage Wines*

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