



# *Sustainable Agriculture Action Plan*

- Sustainable Agriculture in the Wine Industry for Cabernet Sauvignon and Red Bordeaux (CAB) Wine Production in Paso Robles, California

Created in collaboration with members of the Paso Robles CAB (Cabernet & Bordeaux) Collective and wine industry stakeholders. Funded by Montana State University, with Western SARE as the host institution. Written and prepared by Linda Sanpei, PRCC Executive Director, and Francine Errico, Must Writing Services.





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# 1. Introduction

## 1.1 Introduction

The Sustainable Agriculture Action Plan for Cabernet Sauvignon and red Bordeaux (CAB) Wine Production in Paso Robles is a pilot document developed by the Paso Robles CAB Collective winegrape growers, winemakers, marketers, proprietors, and other wine industry stakeholders for Western SARE (Sustainable Agriculture Research and Education).

**The plan addresses the specific needs of the Paso Robles CAB winegrape growing and wine production industries so they can adapt to the challenges presented by climate change, sustain their economic benefit to the local community, improve sustainability models, and continue to produce world-class quality wines.**

This Sustainable Agriculture Action Plan is intended to assist all sectors of the wine industry in understanding the barriers to implementing sustainable practices across the vineyard, winery, distribution, and marketing sectors and serves as a roadmap to develop future strategies by identifying key priorities for research, regulations, education, and innovation for Paso Robles CAB winegrape growers and producers and the wider wine industry.

The needs and priorities identified by Paso Robles CAB winegrape growers and producers are specific to their unique climate change challenges, terroir, and sustainability practices. It takes an expansive and holistic view of both the wine industry and the geographical region of the Paso Robles AVA. The plan highlights the complexity of sustainable agriculture due to individual farming conditions, the diversity of the AVA, and the various sectors of practice within wine production (winegrape growing, wine making, wine marketing, wine distribution); all of which have diverse and varied needs. Exploring sustainable issues from the Paso Robles CAB producer's perspective serves as a snapshot of many of the issues faced by the wider wine industry relating to sustainable agriculture and exposes some unique concerns and barriers. It highlights important research and education opportunities specific to CAB production in Paso Robles and can be used for the broader wine industry to help evolve sustainable agriculture and climate-smart practices necessary in these ever-changing times and period of uncertainty.

This Sustainable Agriculture Action Plan supports the mission of SARE to advance innovations that improve profitability, environmental stewardship, and quality of life in American agriculture and hopes to inspire groundbreaking research and education for CAB winegrape growers in the Paso Robles AVA and other AVAs within the Western United States. This information can be used by university researchers and extension specialists, regulators, elected officials, the USDA, and other potential funders and partners to address the identified agricultural needs and help increase the adoption of sustainable agricultural practices for Paso Robles CAB wine grape growers and producers and the broader wine industry. The plan was funded by Montana State University, with Western SARE as the host institution.

## 1.2 Development of the Plan

The Sustainable Agriculture Action Plan was created in consultation with members of the Paso Robles CAB Collective (PRCC) and wine industry stakeholders. It involved a Powerhouse Workshop, an AI Swarm Session, and independent interviews, conducted from January to March 2023. The plan was informed by research on sustainability in the wine industry and current models of sustainable agriculture practices, climate change in Paso Robles, and attributes of the Paso Robles AVA.

Notably, the development of the plan began during the worst drought California had experienced on record and was finalized as more than 14 atmospheric river storms pounded the area over the 2022/23 winter leading to the tenth wettest year to date over the past 129 years (January – February 2023). Record-breaking rain, nearly eight inches above normal, resulted in the US Drought Monitor declaring San Luis Obispo County to no longer be in drought status. At the time of completing this report, it is unknown the long-term effects this additional water supply would have on groundwater recharge for the Paso Robles Ground Water Basin, however, reports from various climate change experts have suggested that the groundwater supplies will likely take some time to recharge, and the Californian agriculture industry would still feel the effects of drought conditions in the months and years to come.



# 2. Sustainable Agriculture in the Wine Industry

## 2.1 What is Sustainable Agriculture?

According to UC Davis Sustainable Research and Education Program, sustainable agriculture is a series of agricultural practices employed by farmers to meet a society's need for food and textiles without compromising the ability of future generations to meet their own needs. This viewpoint stems from the enormous costs of modernization of the agricultural sector, including mechanization, increased use of chemicals, specialization, and government policies which favored maximizing production. Although these changes produced many positive effects and allowed fewer farmers with reduced labor demands to make most of the food and fiber in the U.S., it also came with high costs such as topsoil depletion, groundwater contamination, and overuse, the decline of family farms, substandard living and working conditions for farm laborers, increased costs of production, and the disintegration of economic and social conditions in rural communities. (1)

*“Sustainability rests on the principle that we must meet the needs of the present without compromising the ability of future generations to meet their own needs.”*  
**(UC Davis)**

With the growing challenges of climate change over the past 20 years, sustainable agriculture has been developing and evolving with an emphasis on questioning practices that contribute to climate change problems, harm the environment, and leave negative and lasting impacts on future generations. Today, the push for sustainable agriculture is gaining increasing support and acceptance. Not only does sustainable agriculture address many environmental and social issues, but it also offers innovative and economically viable opportunities for growers, laborers, consumers, policymakers, and many others in the entire agriculture system so they can ensure sustained agriculture practices for generations to come.

**Sustainable Agriculture Research and Education (SARE) encourages farmers and ranchers to develop new, innovative strategies to produce and distribute food, fuel, and fiber in a sustainable manner. It recognizes strategies vary by industry and by individual farms, however, those working for sustainability often follow the same long-term goals across a whole farm approach which include:**

- **Productivity:** Grow enough food and fiber to meet humanity's needs
- **Stewardship:** Enhance the quality of the land, water, and air; and make the most efficient use of nonrenewable resources
- **Profitability:** Maintain the economic viability of farms and ranches
- **Quality of Life:** Promote the resilience and well-being of producers, their families, and society as a whole (2)

Sustainable agriculture's model to integrate a healthy environment, economic profitability, and social and economic equity, involves the agriculture system chain in its entirety; from growers to producers, distributors to retailers, and consumers to waste managers. Depending on the particular agriculture practice and the system chain it employs, sustainability will look very different with various practices implemented around individual, regional, and industry needs.

For agriculture growers, their sustainable farm practices may center around promoting soil health, minimizing water use, and lowering pollution levels on the farm. For consumers and retailers, sustainability may involve finding value-based food and products grown using methods promoting farmworker well-being and environmentally sound practices or which add value to the local economy. Researchers are also crossing disciplinary lines in their roles often combining biology, economics, engineering, chemistry, and community development in their research activities around sustainability.

Sustainable agriculture also involves negotiation, communication, and clear messaging especially when competing interests between farmers and the community arise. In these cases, sustainability models aim to bring both parties together to understand and solve problems to ensure continued agriculture production in a sustainable way.

### Key Areas of Widely Adopted Sustainable Practices:

									
Healthy Soils	Water Efficiency	Energy Efficiency	Pest Management	Waste Management	Air Quality/ Carbon Footprint	Wildlife & Pollinator Habitats	Economic Viability	Employees & Human Resources	Neighbors & Community



## 2.2 Climate Change

Sustainability runs parallel to climate change and its impacts on agriculture. Climate change is defined by the United Nations as “long-term shifts in temperatures and weather patterns”. (3) Scientific evidence and observations suggest global warming occurred during the late 20th and early 21st century. Such warming is likely caused by greenhouse gas emissions, and the scientific community has reported if such emission levels continue, global temperatures could rise by 2 – 9.7 degrees Fahrenheit (4) changing seasonal climate and increasing the frequency and magnitude of extreme weather events. This will have significant impacts on agriculture.

Sustainability and climate-smart agricultural practices work to both mitigate the effects of climate change as well as providing solutions for adaptation. Working collectively, the agriculture industry can have substantial impacts on mitigating climate change by protecting systems, enhancing biodiversity, restoring soil health, and improving livelihoods throughout the world.

**Agriculture currently makes up approximately 40% of the global landmass. R Lal from the Carbon and Management and Sequestration Center, Ohio State University, concludes that carbon sequestration (through such methods as soil restoration, woodland regeneration, no-till farming, cover crops, nutrient management, manuring and sludge application, water conservation and harvesting, efficient irrigation, agroforestry practices) has the potential to offset five to 15% of all global fossil fuel emissions and highlights the importance agriculture, and in particular carbon sequestration, can play in positively offsetting current greenhouse gas levels. (5)**

## 2.3 Climate Change Challenges in the Wine Industry

Climate change has been identified as the biggest risk the international wine industry faces and creating its greatest challenge: unpredictability. (6) Changes in growing seasons, temperatures, and precipitation have a significant impact on the global wine industry due to the extremely sensitive nature of grapes and the fact making wine is an incredibly precise and scientific process. Winegrapes are amongst the most sensitive and nuanced agricultural products and are highly susceptible to changes in climatic conditions. Winegrapes grow in a very narrow geographical band and within specific climate ranges where temperatures during the growing season average 54-72 degrees Fahrenheit. Any slight change in temperature can bring about significant impacts on the yield and quality of established wine varieties, which were selected to best suit the local climate at the time of planting. With each degree of temperature increase, higher alcohol-by-volume (abv) measures soon result, affecting the quality and style of wine produced.

Furthermore, climate change increases threats from viruses and pests in the vineyards with warmer weather increasing the number of breeding cycles and the number of overall pests. Warmer temperatures also increase the threat of vineyard destruction with damage from wildfires and often resulting in smoke taint in wines (which affects the wine’s quality and drinkability).

**A study in Proceedings of the National Academy of Sciences concluded premium wine production requires a delicate balance of low risk of frost damage, the absence of extreme heat, and adequate heat accumulation. Based on its modeling, this same study gave a dire warning to the US wine industry, projecting “premium winegrape production area in the conterminous United States could decline by up to 81% by the late 21st century” due to a combination of climate change effects including increasing temperatures, frosts, prolonged extreme heat days and plantings of inferior warmer climate varieties. Its modeling concluded wine production in many areas of the US may be eliminated altogether. (7)**

It is not lost on researchers that winegrape growing can serve as a snapshot of future trends for various agricultural sectors. Changes are apparent globally; In July 2022 Reuters reported France saw its smallest harvest since 1957, costing around \$2 billion in sales and confirming climate change effects on yield. It highlighted one vineyard in Champagne that produced nothing for the first time in its centuries-old history when it would normally produce 50,000 bottles. This was a direct result of too much rain followed by a heatwave. Hail damage in some regions also contributed to a smaller harvest. The report continued that the timing of harvest was reported to be consistent with the eight-year trend of being 3 weeks earlier than normal and although some enjoyed exceptional quality due to vine stress, many acknowledged they were lucky with late rains. (8)

In many wine regions around the world, growing seasons are now warmer and longer, winters are warmer, and plants are responding with earlier bud break, flowering, and harvest. Ripening has changed, producing higher levels of alcohol and changing the style of wine. Pests and diseases are changing, soil erosion and fertility are becoming significant issues, and the presence of either too much or too little water is determining the long-term viability of winegrape growers.

With the quality of wine affected by too much rain or not enough, temperatures that are too high or too low, adaptation and mitigation through sustainability are becoming even more vital to the wine industry.

The wine industry is trying to respond to climate change challenges through a series of sustainable practices. Water shortage issues are being addressed globally with dry farming, controlled irrigation, water sensors, and planting less water-thirsty clones and rootstocks. Pests are being managed with IPM (Integrated Pest Management) by eliminating the root cause of pests using a variety of approaches. Some are using biodynamics and regenerative agriculture to increase soil health, and others are using a variety of sustainable agriculture and climate-smart practices. However, many still experience barriers to sustainability.



With more than 1100 different grape varieties grown today under a variety of conditions globally and harvest data stretching back centuries, there are many opportunities to review which varieties grow best to suit changing conditions within a region. (9) An example of this is the formal approval by France's Institut National de l'Origine et de la Qualité (INAO) who, after two years of research, approved the use of four new red and two new white grape varieties in the Bordeaux region. The experimental Bordeaux red grapes (Arinarnoa, Castets, Marselan, and Touriga Nacional) will be used to blend with the traditional six red Bordeaux varieties—Cabernet Sauvignon, Cabernet Franc, Merlot, Malbec, Carménère and Petit Verdot.

Changing best practices to the needs of each vintage is becoming a continually adaptive science needed to ensure quality wine. In some cases, vineyard managers are choosing to delay pruning; increase vine trunk height to reduce leaf area; limit leaf-thinning to protect grapes from the sun; adapt plot sites to minimize hydric stress; harvest at night; and reduce plant density.

Globally, many vineyards are turning to traditional methods of production, including regenerative agriculture and agroforestry. Some are using cover crops, such as grasses and legumes, and brassicas like mustard and grapeseed. These are planted in between rows of vines to reduce erosion, supply nutrients to the soil, aerate the soil, as well as creating a habitat for birds and insects. Specially designed grape sunscreen is being sprayed on grapes to prevent sunburn on the grape skins, while others are trialing canopies. Some vineyards are also utilizing treated wastewater for irrigation to be more waterwise.

Other climate-smart practices, such as reducing or eradicating the use of pesticides, piloting climate-resistant grape varieties, and using precision farming technology (drones and AI, drip irrigation systems, and real-time soil sensors to optimize soil and vine health) are being explored. Wineries are even looking to re-design their cellars to make them more sustainable, some using gravity instead of pumps to move the crushed grapes to flow into tanks. Alternative energy sources are being addressed with solar panels, geothermal energy, and electric vehicles.

Climate-smart practices are also extending to packing, distribution, and shipping. Technologies are being developed for reducing or eliminating heavy glass bottles, and innovations such as lightweight, recyclable, degradable bottles, cans, pouches, bag-in-box, and refill containers, are being considered by the wine industry. Flat bottles are increasingly being used, including for premium wine, which has a lower carbon footprint than traditional glass, takes up 40% less space, and is a tenth of the weight of glass, making them easier and more efficient to transport.

However, the Sustainable Wine Roundtable (a global independent, nonprofit organization with international member and stakeholders) raises the concern the global and US wine industries remains fragmented in their approaches to combat climate change and sustainability. It identified that the wine industry experiences challenges with sharing data, cooperating collectively, and implementing best practices, (if these have even been defined and standardized), and the issue of regulation is constantly being debated. (10)

## 2.4 The Wine Industry and Sustainable Agriculture

*“At the very heart of the fine wine world is an understanding that we are simply stewards at any given moment, that the greatest wine will be made by our grandchildren and great-grandchildren, and that our duty, therefore, is to protect what we have inherited and strive to bequeath a healthy future. Sustainability is all we do.”*

**Clare Tooley, Master of Wine Boisset's Collection,  
– Reuters 2022**

**Beyond climate change, sustainability in the wine industry requires a holistic approach focusing on entire farming ecosystems, the terroir, the soil, the wildlife and plants, and the people who work the land. It integrates the concepts of economics, ecology, and community for both grape growing and wine production.**

The wine industry is very diverse, large in size, and globalized in scale, encompassing many different production systems and cultures, various management choices, and multiple arrays of monitoring and solutions. The California Sustainable Winegrowing Alliance and SIP Certified cite between 60 and 120 different sustainable practices used by vineyards and wineries. This creates complex and often, at times, overlapping sustainable models within this agricultural sector.

Sustainability in the wine industry, particularly in viticulture and winemaking, has gained increased international attention over recent years, with significant increases in published papers and publications reported from 2016 to 2020. A paper published by Costa et al. uncovered a total of 223 articles published under the title of “Sustainability and Viticulture”, and a further 1766 papers focusing on “Sustainability and Wine” for the ten-year period of 2010 to 2020. Additionally, they reported the Google Scholar database to show 16,700 references on “Sustainability and Viticulture” and 50,200 on “Sustainability and Wine” for the same ten-year period. The sheer volume of research and discussion on wine industry sustainability topics could make it overwhelming for the industry to gain a clear picture of what is happening, where it is happening, and how to access this information in a meaningful and tangible way. (11)

**Both globally and domestically, the wine industry acknowledges that to continue to produce quality grapes and wines, not just now but also for future generations, and to mitigate and adapt to climate change, they must implement sustainable practices which aim to preserve natural resources, protect ecosystems and the environment, contribute to the economic viability of their businesses and to the livelihood of their communities.**



The challenges facing the wine industry in the Pacific Northwest are many and could have a significant impact. California is the fourth largest wine-producing region in the world, and its growers have a history of producing excellent quality grapes for winemaking. It also makes up 81% of US wine production. (12) The California wine industry has understood the need to select grape varieties best suited for regional climatic conditions and soil (terroir). This has helped grapegrowers and winemakers maximize their profit margins and reduce the need for additional inputs. Grapegrowers constantly face many challenges, including environmental, global, and regulatory pressures. Continued steep international and domestic competition in the wine industry is forcing California winegrape growers to respond to consumer expectations for quality wine and adhere to environmental and social standards. Grape varieties, growing conditions, and grape prices vary significantly by region, even within California. These variables, plus economic constraints can determine the degree to which specific viticultural practices are implemented.

At a regional level, Paso Robles CAB Collective members have a deep desire to be innovators, be model stewards of the land, and lead the way in sustainable agriculture to continue to produce world-class quality wines in the face of climate change and environmental and regulatory changes. Their mission to educate media, trade, and consumers on the quality of Cabernet Sauvignon and red Bordeaux varieties produced in Paso Robles extends to telling the story of sustainability and stewardship for the land.

## 2.5 Environment, Economy, and Equity

There appears to be consensus in the wine industry that sustainability must encompass three sectors:

- **A Healthy Environment**
- **Economic Viability**
- **Social Equity and Human Resources**

### Healthy Environment

**Investment by growers and vintners in sustainable practices needs to also account for the “natural capital” that is the ecosystem. Personal commitment to land stewardship and increasing regulatory requirements are among some of the reasons growers are farming in more sustainable ways and minimizing impacts on the environment. Growers and vintners realize their return on investment includes more than just cash flow, but also a sustained ecosystem. Wineries can be stewards of the environment by implementing practices that reduce waste and greenhouse gas emissions and are more energy efficient. They are looking at their supply chain choices to ensure their environmental values align. Pillars of a healthy environment include healthy soils, water conservation, energy conservation, pest management, waste management, air quality and carbon footprint, wildlife and pollinator habitats, and supply chains.**

### 2.5.1 Healthy Soils

Soil is a living ecosystem that nourishes and feeds plants, biodegrades waste, absorbs carbon, and ensures the availability of water. Healthy soil is the foundation of sustainable vineyards, imperative for quality wine, and a priority for vineyard managers. The roots of a vine make up a third of the grapevine structure. While leaves feed the vines sugar, it is the roots that sustain the remainder of the vine. Soil provides the roots with water, nutrients, and air, and the healthier and more biodiverse the soil, the better access the vine has to vital nutrients. Natural processes used to improve vine health ultimately reduce the need for fertilizers. Cover crops help increase the turnover of organic matter, can add important nutrients, and enhance the health of the soil. As cover crops can also compete with vine growth, they must be selected according to the regional and individual characteristics of the vineyard. Growers can also prevent erosion and protect soil health by reducing soil compaction and minimizing soil disturbance through reduced tillage. Monitoring soil health, analyzing organic matter, and measuring inputs and outputs are key sustainable practices. Plant tissue analysis can also guide nutrient application. Efficient use of nutrients can reduce inputs, cut greenhouse gas emissions, and reduce groundwater leaching.

### 2.5.2 Water Conservation

According to the Sustainable Winegrowing Alliance 2020 report, effective water management and conservation from the vineyards to the winery have the greatest impact on wine quality and sustainability than any other single practice. (13)

#### 2.5.2.1 Water Conservation: In the Vineyard

Winegrape growers understand the need to optimize water use for both conservation and to provide the ideal conditions for quality fruit production. This requires balancing viticultural knowledge, in-depth knowledge of the vineyards, and the application of technology to support and enhance irrigation planning.

Where soils are deep enough, some winegrape growers can practice dry farming, mitigating the need for irrigation. However, due to geographic location and typology, not all vineyards can be dry-farmed and must utilize some form of irrigation to produce their crops. Drip irrigation, which involves applying water directly to each vine with just enough quantity to support the vine’s growth, is now widely used. This gives growers the ability to decide how much water to apply and when, so water wastage is kept to a minimum. However, to be effective and efficient, drip irrigation systems must be managed for optimal efficiency, and issues such as clogged emitters can negate the benefits of the system altogether. Growers must continually monitor flows, inspect lines, and record water use to ensure efficient delivery of water via the drip systems and track water use to further reduce water usage over time. Drip irrigation systems also need proper scheduling to control how much water to apply and when. Growers can use numerous plant and soil-based methods to determine irrigation efficiency and improve winegrape quality.

The development of a water management strategy and best management practices (BMPs) by the vineyard is fundamental to water conservation. With this, growers target using the minimal amount of water necessary to achieve optimal yield and quality goals. Runoff from excess irrigation can cause excess vine growth and results in more canopy management, often with lower-quality grapes and wines. Some growers use deficit irrigation approaches which intentionally apply water stress to the vines during specific growth stages to improve the quality of the grapes. This form of conservation also results in lower water usage and less energy to pump it.

### 2.5.2.2 Water Conservation: In the Winery

In the winery, water conservation is also important to reduce water consumption and improve efficiency. Water is a critical element in the winemaking process, from crushing and pressing to fermentation and aging and then bottling the final product. Water is required for sanitizing tanks and barrels and cleaning the bottle lines, and these processes are among the top uses of water in the winery. Knowing how much water and the amount needed for all these tasks is crucial to determining the supply and cost of water for each season. To calculate this, many wineries install water meters to monitor water use at key operational points during specific operations like crush, fermentation, and bottling. Some wineries have extended this to monitor water over the entire system. With such information, water conservation plans can be prepared to make water use more efficient. As part of the sustainability model, and with water being a limited natural resource, the winery's conservation of water is extremely important.

### 2.5.3 Energy Efficiency

Energy is necessary throughout the winemaking process from the vineyard to the winery. It is essential for powering equipment and refrigeration. Many vintners and vineyard managers have been motivated by the uncertainty and continually increasing costs of electricity and fuel to measure and monitor their energy use and save money by conserving natural resources. Conservation and efficiency measures can include upgrading lighting, insulating tanks and piping, installing variable frequency drives on pumps and motors, and installing dissolved oxygen sensors for processing water treatment. These measures are enhanced by taking internal actions such as energy conservation training (implementing policies to turn off equipment and lighting when not in use), shifting to night harvesting to reduce ambient heat stored in grapes and thus cooling requirements, and the appointment of staff or teams to investigate, implement, monitor, and further improve energy efficiency practices and equipment. Many wineries and vineyards are also installing solar panels as part of their renewable energy strategies. These combined efforts have resulted in vintners and vineyard managers being able to prioritize and implement energy-saving measures with reductions in energy consumption and related energy costs, as well as greenhouse gas emissions. (14)

### 2.5.4 Pest Management

Pests and diseases can have major impacts on yield and wine quality and reduce the overall lifespan of the vine. Winegrape growers deal with multiple pest problems throughout the year and are often faced with the presence of a combination of pests and viruses at the same time. These can include pathogens, nematodes, insects, mites, weeds, and vertebrates. Traditionally these have been treated with pesticides, which can risk polluting the soil and groundwater and cause health issues for staff. (15) Monitoring for pests in the vineyard during the growing season is often the first step in pest management. Once identified, there are a number of approaches vineyard managers use to deal with pest management, including Integrated Pest Management (IPM), Best Management Practices (BMPs), and certified organic pest management. IPM is a multi-faceted approach to controlling pests with an aim to reduce the use of pesticides. This technique involves combining biological, cultural, and chemical tools to minimize the risk to the operations' economic return, workers' and community health, and other environmental risks. In some cases, pest management can also be accomplished with the introduction of beneficial insects. By planting specific cover crops which attract these beneficial insects, they, in turn, eat pests, including mites, mealy bugs, and aphids. Other measures they use for pest management include leaf removal, hedgerows, sanitation, dust control, and irrigation. (16)

For those wineries looking at export markets to Europe, pesticide use and changes in viticulture are being forced as the European Union is increasing restrictions on specific substances in the wine.

### 2.5.5 Waste Management

Reducing waste is important for the sustainability of the environment, and the wine industry has the unique ability to reuse or recycle most of the materials used to produce wine. These materials include items such as cardboard, paper, metal, glass, and plastic. By developing and implementing a focused waste management plan, most wineries can reduce the amount of waste going to landfills and save on costs. A waste management plan assesses the number of products purchased which end up in the dumpster and clearly defines strategies for reducing waste. It may also identify products that have excessive packaging leading to increased disposal costs. Wineries can also choose suppliers who actively reduce the amount of packaging which comes with their materials and supplies, and some suppliers have even developed additional systems for reusing containers, recycling packaging, and reprocessing waste. Employees are at the heart of a successful recycling and waste reduction program, and investing time to educate and train all staff members in waste management is imperative. By helping winery staff identify, separate, and recycle materials, the winery will not only save money, but it will encourage recycling in the broader community.



Wineries can establish an environmentally preferred purchasing (EPP) system to reduce the amount of waste going into the landfill. The California Sustainable Winegrowing Alliance describes EPP as a process for selecting products or services that have a reduced effect on human health and the environment compared to competing products or services that serve the same purpose. (17) However, to be effective, this process requires an investment of time as wineries seek information about the environmental attributes of the products and services from their vendors and suppliers.

### 2.5.5.1 Compost

Composting is an integral part of sustainable wine grapegrowing. The winemaking process generates a considerable amount of waste. After every crush, wineries are left with skins, pulp, seeds, stem leaves, and other residues from winemaking after the juice has been pressed and fermented. Waste sent to the landfill decomposes and emits methane and greenhouse gases. The main solid byproducts and residues generated include pomace (62%), lees (14%), stalks (12%), and dewatered sludge. (18) Creating nutrient-rich compost from these byproducts not only solves a pollution problem (waste ending up in the landfill) but can also reuse matter to promote the sustainability and health of the vineyard. Compost benefits vineyards by helping increase the soil's water-holding capacity, building organic matter, and reducing the potential for erosion. Using compost in combination with cover crops enhances soil life and promotes healthy vines.

Healthier grapevines yield better quality fruit which produces better quality wines. Increasing the permeability of the soil structure not only helps vine roots penetrate deeper to retrieve the necessary nutrients but also offers a natural source of nitrogen, phosphorus, and potassium. Nitrogen becomes an essential nutrient for vines during two periods: after bud break to veraison (coloring of the berries) and from harvest to leaf fall.

### 2.5.6 Air Quality and Carbon Footprint

Many vineyards and wineries are implementing measures to protect air quality and reduce emissions into the atmosphere. Although the wine industry's overall contribution to air quality might be perceived as minimal, it is generally acknowledged the combined efforts of the individual businesses will continue to make a difference and are an important part of the sustainable agriculture model. Many efforts by individual vineyards and wineries are through voluntary assessments and efforts to decrease emissions while maintaining the economic viability of the business. These efforts can be seen in the vineyard, winery, and in packaging and distribution. According to a study conducted by the California Sustainable Winegrowing Alliance on California wine's carbon footprint, more than half of the carbon that results from making a bottle of wine is generated by packaging and transportation. (19)

With business, regulatory, and social pressures to reduce greenhouse gas emissions, many wineries and vineyards are looking at ways to reduce their carbon footprint. Consumers and international markets

are now looking for, and in some instances demanding, products that are carbon neutral. Practices aimed at reducing carbon can include transportation, renewable energy sources, carbon sinks, circular waste management, new energy systems, low input viticulture, soil management, and water use efficiency and conservation. (20)

Carbon sequestration is an important climate-smart practice that builds and maintains the health of the soil so it can capture more carbon dioxide from the atmosphere. Soil carbon is the glue that holds the soil together. It impacts water infiltration, reduces erosion, and increases fertility within the soil. Carbon sequestration involves reducing or minimizing soil disturbance and maintaining and enhancing soil biological activity through maximizing carbon inputs such as cover crops. In this way, vineyards can actually capture carbon dioxide and increase soil health at the same time.

Increasing energy efficiencies in the winery (refrigeration, lighting, insulating task) and using renewable energy sources also reduce carbon impacts. Wine packaging requires high energy outputs due to necessary materials, such as glass and cardboard, and packaging design and decisions on which ones to use can significantly reduce a winery's carbon footprint. (21)

The mode of transport used to distribute wine can also significantly impact a business's carbon footprint. Currently, most California wineries are using trucks and road transport which increases greenhouse gas emissions. Rail transport has a reduced carbon footprint. However, not all wine regions are serviced by rail, limiting their choices of transportation options.

### 2.5.7 Wildlife and Pollinator Habitats

Vineyards can be excellent locations for creating pollinator and wildlife habitats. Although grapes do not need insect pollination to set fruit, the creation of pollinator habitats in the vineyards can support declining pollinator populations. Such habitats also attract beneficial insects, which can prey on vineyard pests and help restore the environment, creating attractive landscapes, improving soil health, and helping to restore carbon. (22)

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## Economic Viability

**The sustainable agriculture model includes the need for economic viability. The wine industry as a business is considered economically viable if the economic benefits exceed its economic costs. The economic costs are not the same as financial costs, and in the sustainability model, environmental impacts are also considered a cost.**

Economic viability can result from environmental conservation measures such as diversifying energy portfolios to include more efficient energy sources and reducing greenhouse gas emissions.

### 2.5.8 Marketing

Sustainable Agriculture Research and Education include marketing as part of the economic viability of sustainable practices. It identifies that diversity of marketing techniques can make agricultural productions more resilient to market fluctuations and encourages strong branding, studying potential markets, processing of value-added products (such as wine), and the use of a variety of sales channels such as direct marketing, and sales to retail and aggregators. (23)

The marketing of sustainable wines has enormous potential. The Wine Institute investigated this in a webinar in 2020 sharing international research on consumer and trademarkets which highlighted trends toward purchasing sustainable wines. New data and insights on perceptions by consumers and trade concerning sustainable winegrowing, certification, and practices showed increasing market demand for sustainably produced wine. Younger consumers of legal drinking age, in particular, were significantly more engaged with sustainability and viewed this as vital to protect future resources. Communicating and marketing sustainable values is therefore becoming more critical in the sustainability model for wine producers, especially to Millennials and Gen Z. (24)

### Social Equity and Human Resources

**Agriculture production is both hard work and a way of life. Social equity and sound human resource practices are crucial for thriving farmers, farm workers, and their families. Health and well-being, the next generation of producers, community engagement, innovative business management, equity and social justice are all examples of important social topics. (25)**

### 2.5.9 Employees

It is widely recognized that effective management of human resources (HR) is vitally important to the sustainability of any organization. Employing and retaining a skilled and efficient workforce in the vineyard and winery operations can lead to improved productivity and profitability. Providing training focused on conservation and efficiency, such as programs targeting water and energy conservation and recycling, not only promotes sustainability and a healthy environment but supports the organization's bottom line.

California has strong regulatory requirements around worker health and safety, for which vineyard and winery operations must comply. In addition, many wine producers implement human resource best practices resulting in higher levels of employee satisfaction, production, and retention. The sustainability model advocates that hiring, developing, managing, and rewarding employees appropriately will help sustain and improve productivity, efficiency, and innovation.

### 2.5.10 Neighbors and Community

Wine growers and the surrounding community depend on each other. The wineries and vineyards create jobs and provide professional development, which in turn enhances and strengthens the quality of life and economic prosperities of their surrounding towns, cities, and regions. Sustainability incorporates the concepts of being a good neighbor and building stronger communities with the preservation of natural landscapes, creating employment opportunities, employee volunteerism, promotion of tourism, and payment of taxes. Many growers and winemakers are also active members of the local community where they live and work, contributing time and resources to help neighbors, organizations, and institutions thrive.

At times, potential conflicts regarding land use, natural resources, public services, and community-related issues may arise. Sustainability advocates continuing conversations and using problem-solving initiatives with the greater community. Staying current with information and understanding the concerns of the local community can help the wine industry navigate and negotiate any potential conflict. Two of the largest barriers to effective problem-solving are a lack of communication and misinformation. These can be minimized with proactive interactions. Wine growers should invest time and resources in researching local issues, understanding different perspectives, attending community meetings and workshops, and ensuring their industry perspectives are represented.

## 2.6 Current Landscape of Sustainable Agriculture in Wine Country

**According to California Sustainable Winegrowing Alliance, 55% of California winegrape acres are certified sustainable (over 5500 vineyards and nearly 350,000 acres), as well as 82% of California wine is made in a certified way.**

Organizations dedicated to supporting sustainability programs, certification and education include: California Sustainable Winegrowing Alliance, California Association of Winegrape Growers, Lodi Wine Winegrape Commission, Napa Green, Napa Valley Vintners, Sonoma County Winegrowers, Vineyard Team, Wine Institute, California Association of Resource Conservation Districts, California Land Stewardship Institute, California Green Business Network, Demeter Certified Organic, CCOF Certified Organic.

All certification programs are voluntary and often require a combination of self-assessments and third-party audits.





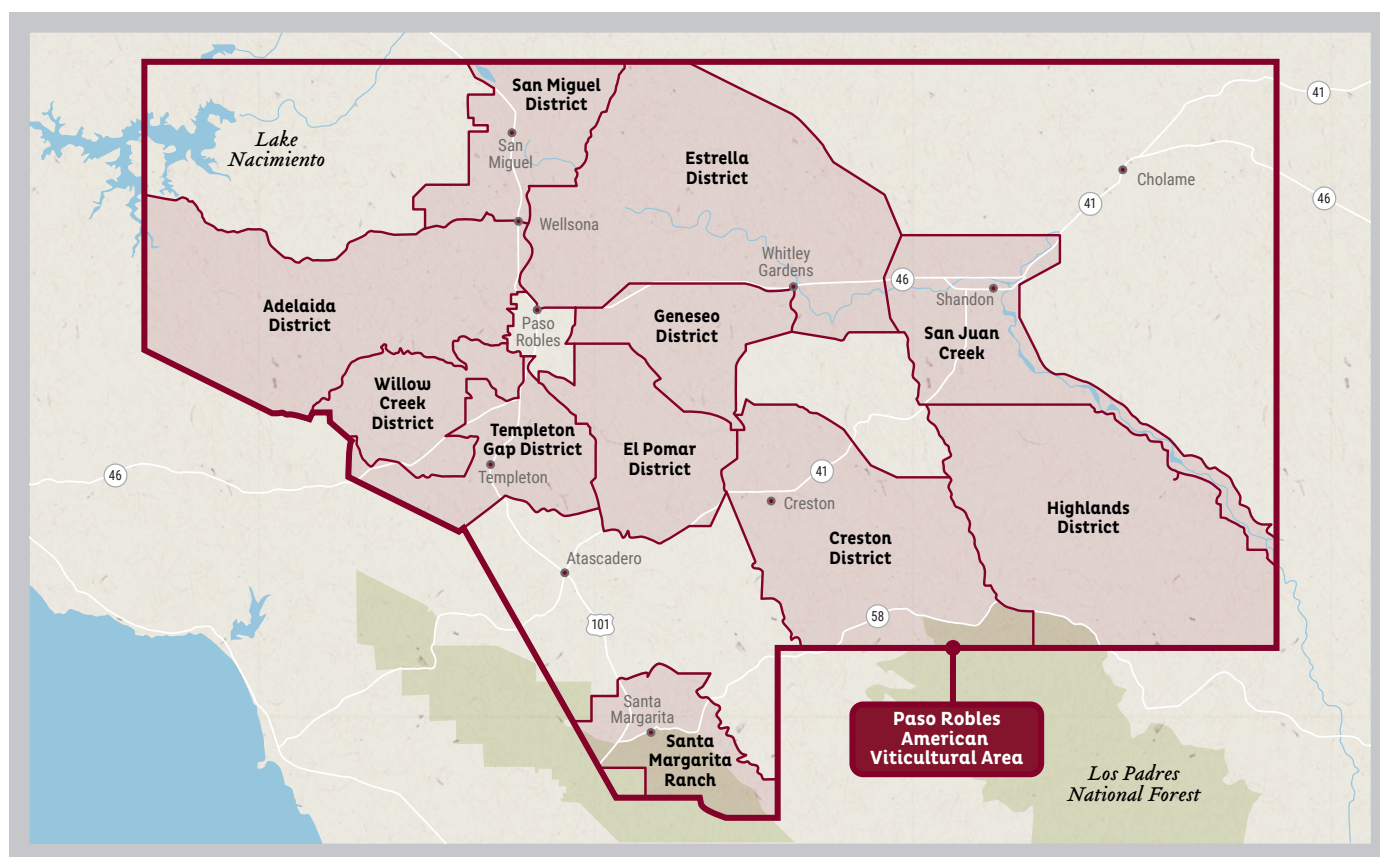
## 2.7 Paso Robles AVA

The Paso Robles American Viticulture Area (AVA) was established by the US Alcohol and Tobacco Tax Bureau in 1983, recognizing the region's unique growing qualities for wine grapes. Situated between San Francisco and Los Angeles along California's Central Coast, Paso Robles Wine Country encompasses approximately 40,000 acres of planted acres of winegrapes and over 200 wineries. It is the primary source of agriculture production for San Luis Obispo County, generating over \$1.9 million in total economic output and employing over 13,000. (26)

In Paso Robles Wine Country, CAB is King. The temperate days, cool nights, and well-drained soil of Paso Robles echo the growing conditions of St. Emilion, Bordeaux, France, inspiring the region's independent producers to produce world-class wines from the winegrapes they grow. The AVA is known for high-quality red wine production with significant dominance by Cabernet Sauvignon and Bordeaux blend varieties (Cabernet Franc, Merlot, Petit Verdot, Malbec, and Carmènère). Together these CABs now represent over 60% of the overall plantings (23,000 acres), with a significant contribution to the overall economic impact of the region.

**In 2014, 11 sub-districts in the Paso Robles AVA were acknowledged within the 612,000 total AVA acres. It contains 30 distinct soil series, containing the most calcareous and siliceous soils in California. With the Western Boundary only six miles from the Pacific Ocean, the AVA enjoys the greatest diurnal swing in California. (25) Situated in the northern sector of San Luis Obispo County, Paso Robles AVA has a dry, hot-summer Mediterranean climate. From 1942 until 2022, the city of Paso Robles has had an average annual rainfall of 14.2 inches. Groundwater is the main source of irrigation water in the AVA, and the majority of planted acres lie within a groundwater basin classified by the Sustainable Groundwater Management Act (SGMA) as high priority and critically over-drafted. (27)**

Before the flooding rains of December 2022 through March 2023, the region had been experiencing its worst drought, lasting more than five years. In 2022 Drought.gov reported San Luis Obispo County was experiencing its driest year to date over the past 128 years (January to August 2022). In addition, NASA and NOAA both reported global temperatures had risen 2.1 degrees Fahrenheit since 1880 and the ten warmest years since 1880 have occurred since 2005. It is evident Paso Robles is entering a new era of significant challenges with water supplies and extreme heat events consistent with climate change models.



## 2.8 Effects of Climate Change on Paso Robles

In a recent study conducted by California Polytechnic State University, San Luis Obispo (Cal Poly), climate change is highlighted as the leading cause of reduced yield and quality of grape production in the Paso Robles AVA. (28) Wine grapes are among the most sensitive and nuanced agricultural products and are highly sensitive to climate change. Variations in temperature, water for irrigation, frosts, pests, and other climate implications pose a significant threat to the grapes and wine industry of Paso Robles. As any slight change in temperatures can significantly impact the yield and quality of established wine varieties. These environmental factors pose a concern for Paso Robles CAB Collective winegrape growers.

**Grapevines are affected by air temperature during their vegetative cycle. Although grapevines need heat buildup for their maturation and physiological development, temperatures above that which are considered ideal for a given grape variety may lead to unbalanced ripening and potential shifts in harvest timings. Prolonged high temperatures can influence secondary metabolism and change the grapes' sugar accumulation and acid concentration. Precipitation is also essential in controlling soil water balance and plant water status, particularly in non-irrigated vineyards. Severe dryness can be very problematic, especially during bud break to flowering. Prolonged dryness in the Paso Robles AVA growing season may reduce grapevine growth, limit sugar development, and produce lower fruit yield.**

The Cal Poly study revealed that while yield may only be affected by increasing temperatures, it will be the quality of the grapes which will be at the most risk, (29) and it is the quality that contributes to Paso Robles CAB market share and competitiveness in the wine market. An effect on quality could affect the brand and the price per ton for the Paso Robles winegrapes and threaten the overall economic return of the region.

This estimated effect on the quality of grapes in the wine industry will also come from anticipated water shortages, extended periods of heat waves, and increased temperatures during the winegrape growing seasons. Such climate change issues are likely to negatively affect harvests and change the ripening of grapes beyond the threshold for the specific varieties currently grown in the Paso Robles AVA. (30) Flooding events may also cause harm to vines, as well as impacts from wildfires. Paso Robles is beginning to see these effects, and although the quality is still being maintained, it is a threat they cannot dismiss.

*“Adaptation to climate change is thus increasingly recognized as crucial for the sustainability of the Paso Robles AVA and other California wine grape growing sectors.” (31)*

Tapan B Pathak concludes in his study on Climate Change Impacts on California Agriculture, that “since agriculture in California is very diverse and each crop responds to climate differently, climate adaptation research should be locally focused along with effective stakeholder engagement and systematic outreach efforts for effective adoption and implementation.” (32) Paso Robles winegrape growers and producers seek to understand their unique challenges so they can create and implement such adaptations and mitigation practices.



## 2.9 History of Paso Robles Cabernet Sauvignon

In the 1970s, under the guidance of U.C. Davis enologist André Tchelistcheff, Dr. Stanley Hoffman planted some of Paso Robles' first Cabernet Sauvignon grapes. These notable plantings flourished on Hoffman's 1,200-acre ranch near the old Paderewski Ranch in the hills of Adelaida, about eight miles west of downtown Paso Robles.

His Hoffman Mountain Ranch – now owned by DAOU Family Estates and Adelaida Vineyards & Winery – provided the first large-scale modern facility in the area. Cabernet Sauvignon became the rising star among varieties grown on the central coast of California, creating a buzz among discerning wine circles across the globe. Paso Robles has tripled in the past decade from 75 bonded wineries to more than 200 and has grown from 5000 vineyard acres in 1983 to over 40,000 planted vineyard acres in 2023.

Today the region is known largely for its family-owned and operated artisan wineries, with about two-thirds producing less than 5000 cases. In 2016, Paso Robles was named Best Wine Region in the West by Sunset Magazine; top critics say Paso Robles Cabernets are a match for top Californian wines. In 2018 the USDA indicated 31.5% growth in the Cabernet Sauvignon plantings over the past 5 years, and in 2020 the Paso Robles AVA officially becomes the second-largest producer of Cabernet Sauvignon in California. (33)



## 2.10 Paso Robles CAB Collective

Formed in 2012, the Paso Robles CAB (Cabernet and Bordeaux) Collective (PRCC) strives to promote the full potential of the Paso Robles AVA (American Viticulture Area) in producing superior-quality classic and age-worthy Cabernet Sauvignon and red Bordeaux wines to consumers, trade, and media worldwide. It also promotes sustainable agriculture amongst its members and is dedicated to understanding the implications of climate change on CAB winegrapes and investing in educating and helping its members face these challenges.

The PRCC is a nonprofit organization with a board of nine directors. Three of these are permanent members who cooperated closely to found the original organization: DAOU Family Estates, J. Lohr Vineyards & Wines, and JUSTIN Vineyards.

Open to all wineries that produce Cabernet and Bordeaux varieties (Cabernet Sauvignon, Cabernet Franc, Merlot, Petit Verdot, Malbec, and Carménère), members are afforded the opportunity to collaborate with other members, resulting in a continuously expanding network of industry professionals and tenured experts on everything from viticulture and wine production to marketing and sales. (34)

The Paso Robles CAB Collective is well positioned not only to be a snapshot of the Californian wine industry but also to provide regional focus so solutions can be found for its unique growing conditions amongst a collective group. They are inspired to work together to ensure the longevity of quality wine production in the Paso Robles region for generations to come. Most wineries and vineyard members of the Collective have been practicing sustainable agriculture and climate-smart practices for many years. Their concerns regarding climate change, barriers to sustainable practices, and calls for research, education, and innovation speak to their continued search for adaptive and mitigating solutions so they can continue to produce quality CAB in Paso Robles.







## 3. Process of Study

- This study seeks to identify the research, education, regulatory, infrastructure/innovation, and financial needs specific to the Paso Robles Cabernet Sauvignon and Red Bordeaux wine grape growing industry to adapt to the challenges of climate change, sustain its economic benefit to the local community, and continue to produce world-class quality wines. The process to identify these needs included a Powerhouse Workshop, a Swarm Session, and independent interviews with industry representatives and stakeholders. It is hoped that with such vital research, education, and innovation, this unique wine industry and its rural community can be safeguarded and sustained for future generations.

### 3.1 Powerhouse Workshop

To investigate the key issues and possible solutions relating to sustainable agriculture practices and climate change mitigation and adaptation, the Paso Robles CAB Collective held a Powerhouse Workshop in January 2023. The Workshop was part of the investigation process to provide essential information for the Swarm Session which followed in March. The Powerhouse workshop was attended by 16 key PRCC members and wine industry representatives with diverse roles in the wine industry, including winemakers, vineyards managers, marketing personnel, winery owners, researchers, academia from the Cal Poly Wine and Viticulture and Sustainable Agriculture departments, as well as local and state wine industry representation.

**The Powerhouse Workshop sought to identify: the top sustainability issues, the barriers to implementing sustainable practices, the concerns regarding climate change and its effects on winegrape growing in Paso Robles, and the subsequent education, research, regulation, and infrastructure needs of the Paso Robles wine industry and the broader wine industry.**

#### 3.1.1 Top Sustainability Issues

Research regarding the actual definition of agriculture sustainability by the wine industry, nationally and globally, indicates possible confusion about how sustainable agriculture is defined and what practices it includes. The Workshop investigated the need for a time range to define agriculture sustainability to give it a more concise framework. A period of five generations was generally agreed upon as an acceptable range to give more relevance to the activities and practices employed by farmers to achieve sustainability for generations to come.

Attendees highlighted areas of importance relating to sustainability for CAB producers and Paso Robles as water availability and quality, water conservation, soil health, safe and healthy working conditions for employees, labor issues, electrification/renewable energy use, maintaining viable businesses, practices which save money and conserve resources, pesticide reduction, environmental improvements,

costs, the need to produce vigorous rootstocks with tolerance for less water, organic solutions to water salinity, regenerative practices, and vine architecture. There was also a need for stakeholder agreement on future directions amid climate change, commitment to shared responsibilities from those stakeholders, reasonable and actionable goals, stated timelines and deadlines for these goals, and continual assessment of progress.

Although not necessarily related to sustainable agriculture practices, another pandemic was mentioned as a concern for the wine industry to remain economically viable.

#### 3.1.2 Top Climate Change Fears

Workshop attendees were asked to identify their top climate change concerns, which were: accessibility and availability of water, salinity in the water, wildfires, smoke taint, extreme weather events, extreme heat, increased temperatures, frost, soil degradation, unsafe working environments, pests, compressed harvest, not enough time for flavor formulation, decoupling of the sugar, phenolics, and alcohol, vigorous climate, rootstocks, cost of goods, and overall crop adaptability.

There was discussion about the challenges associated with growing Cabernet grapes, which as a variety, may not be as adapted to Paso Robles as it is for Bordeaux (i.e. Cabernet as a maritime varietal being grown in a Mediterranean climate in Paso Robles). It was noted that Bordeaux's grapes needed extra ripeness, but this was not necessarily the case for Paso Robles, and perhaps the Paso Robles wine industry needed to look at what worked best for its AVA, not what works best in Bordeaux.

On a more global level, there was concern about the inability of humankind to act in response to climate change issues, current farmland/crops may no longer be viable in a given region, uninhabitable regions across the earth developing because of extreme heat and droughts, adaptations too slow to be effective, the irreversible effects of climate change, and the availability of food.

### 3.1.3 Barriers Faced Regarding the Implementation of Sustainable Agricultural Practices

When asked about the barriers the attendees experienced in implementing sustainable practices, the following barriers were identified: cost, time and energy, profitability, having more vineyards focused on sustainable practices, the short-sightedness of the industry, and time and energy to brainstorm solutions. The various soil types present in Paso Robles also created many different challenges for Paso Robles, compared to other AVAs.

The group was asked if cooperation among wine industry stakeholders was a barrier and participants were consistent in their belief that many in the Paso Robles wine industry partnered with local sustainability groups, and worked very well together.

### 3.1.4 Research Needs: To Access Sustainable Practices

Workshop attendees were asked about the research they would like to see within the wine industry and specific to Paso Robles CAB, which could help them access sustainable practices. For some, there was a feeling that there might already be available research on their areas of interest and concern. Accessing or knowing where this research existed was identified as a significant issue.

The group concluded further research was needed on soil salinity and water quality in Paso Robles, and there was a need to understand exactly what the groundwater in Paso Robles was like in terms of quality and salinity. Water salinity, especially later in the growing season, was an issue of concern. CAB grapegrowers identified the need for research to understand how this salinity affected the vines long term and the overall quality of wine being produced.

Cover crops were another important discussion point and it was identified these were being planted based on a feel-good factor or the availability of a couple of products available from local nurseries. The group identified a need for research on what varieties actually grew best for the terroir of Paso Robles.

The practice of dry farming appeared to be an area with differing opinions. Some concluded dry farming was only possible for some winegrape growers in Paso Robles as it depended on each vineyard's individual soil and rain conditions. It was identified that dry farming took substantial time and effort to achieve and that this could also be a barrier. However, others felt it was essential to research this possibility to see if dry farming could be successful for Cabernet Sauvignon in the Paso Robles AVA.

Some wineries stated they had already been able to reduce irrigation by 30-40%, and one of the vineyards was currently trialing below-surface irrigation (although this had issues with leaks, weed growth, and in some cases, using more water usage instead of less). Irrigation techniques and technologies were areas of high interest for research by the group.

The group also discussed precision agriculture, battery storage for renewable energy, mechanization (labor issues), predicting droughts and heat events, rootstocks with tolerance for less water and increased

salinity, the potential for carbon sequestration, water conservation/capture, trellising, and row orientation best suited to heat, pesticide residuals in wine, grape skin resiliency to UVA and UVB light, organic regenerative management and biodiversity options

### 3.1.5 Education Needs

Workshop attendees were asked what education they or others needed regarding issues, barriers, and concerns within their industry.

Wildfires and smoke taint were areas of concern. The group felt more education was needed for the local industry and the consumer on the impacts of smoke taint. Due to Paso Robles not having as severe experiences with fires compared to other West Coast AVAs, there was a sense that Paso Robles had less knowledge of surrounding smoke taint than others along the Northwest Coast. It was acknowledged that research around smoke taint, its effects, and mitigation, already existed or was ongoing, but accessing and digesting this information was not always available to the wine industry at large. The attendees were also interested in innovation to deal with grapes affected by smoke taint, perhaps with precursor and sensors, and with testing and cleansing fruit. The group felt consumers did not always understand smoke taint, and misguided perceptions were potentially harmful to wine sales. Educating consumers that smoke taint was not dangerous and, in many instances, undetectable to taste was essential, and perhaps the wine industry needed to engage and inform consumers with presentations on this subject.

Workshop attendees wanted to know what options were available for them to be keynote speakers at presentations to educate both the industry and consumers about what they were doing regarding sustainability. There was a general feeling the community and the consumer were unaware of their efforts. Washington State was referenced for its webinar, and it was suggested that the PRCC could investigate how to join this webinar or look for options within their regional organizations and certification bodies.

The group identified a significant distinction between certifying a winery sustainable and certifying a vineyard. More education on what sustainable agriculture was and how it was practiced in these different fields was an identified area of need.

Understanding why climate change impacts are important was recognized as a need for the wine industry and the wider community. There was a feeling some in the industry did not believe in climate change as there were only 130 years of weather history, which they felt too short a time period to rely on the data conclusively.

The group sought education on water uniformity, the effects on high-altitude grape growing, and the effects of increased UVA and UBA rays on the grapes.

### 3.1.6 Research Needs: To Address Barriers

Workshop attendees were asked what research they would like to see within the wine industry and specific to Paso Robles CAB to address their barriers and improve the sustainability of winegrape growing and wine production in Paso Robles. The group identified the following areas needing further research for their specific AVA: water efficiencies, soil health, carbohydrate shunting to roots during extreme stress, pest, disease and virus management, micronutrient deficiencies, smoke taint, and on research extension itself.

## 3.2 Swarm AI

To explore further the barriers and issues raised by attendees at the Powerhouse Workshop with the broader wine industry, this study utilized Swarm AI technology by Unanimous AI. According to Unanimous AI, Swarm is the world's first AI platform to increase the intelligence of networked teams, resulting in more highly accurate forecasts, predictions, decisions, and insights. In a virtual setting, the group participating in the Swarm Session influenced each other by forming a consensus resulting in the best decision for that particular group. In this way, and based on scientific biological principles of Swarm Intelligence, this Swarm platform allowed the group to maximize their combined knowledge, wisdom, insights, and intuitions to reach a conclusion. This same process is used by swarms of bees and flocks of birds to reach optimal decisions with remarkable efficiency. (35)

One of the major benefits of using the Swarm Session process for this study was that it only needed 25 – 50 participants to yield more accurate insights than interviewing focus groups or engaging hundreds or thousands of participants usually required for traditional polls, surveys, or focused groups. (36) Unlike a conventional survey the Swarm Session allowed participants, as active members in a real-time live system, to come together to produce optimal solutions and answers to posed questions formulated from the previous Powerhouse Workshop. By contrast, a traditional survey would have treated participants as passive data points with statistical distribution. The interactive swarming process produced authentic sentiments and enabled the study to process their behaviors as they reacted and interacted with each other. Feedback loops allowed the participating group to explore the options available to them in the carefully formulated questions around climate-smart and sustainable agriculture practices and to converge on solutions that maximized their collective conviction. Traditional polling would have used statistical aggregation to find the average answer across the group, whereas the Swarm enabled the group to interactively weigh the issues presented to find the solution they best agreed upon.

The Swarm Session also gave the study more accurate results based on participants' behavior rather than just reporting. This is particularly relevant when participants reported on questions centered around feelings and sentiments. As noted by Unanimous AI, traditional surveys asking for emotions and sentiments can be unreliable because each individual has a different internal rating scale which can skew and distort answers. By using Swarm technology and its intelligent

algorithms, this study could process and report on how participants were behaving while interacting as part of a real-time system. This behavioral data enabled the Swarm platform to accurately estimate the relative conviction expressed by each individual with respect to the answer options provided.

The Swarm also enabled this study to capture the opinions of the wine industry representatives with an optimal solution rather than an average response. This gave more accurate results than would have been received by working out average responses in terms of percentages, usually derived from traditional surveys.

This study further acknowledges that all data has a bias and there is no perfect data solution and that the results from this survey may have differed if the makeup of the Swarm participants were weighted in favor of one area of the wine industry or particular sizes of operation.



### 3.2.1 Developing the Questions

Members of the PRCC team, Must Writing Services, and Unanimous AI workshopped the key areas of concern for Paso Robles CAB winegrape growers. A final set of 41 targeted questions covering areas included: barriers to sustainable agriculture practices experienced by Paso Robles growers and the wine industry at large, research and data issues, climate-smart practices, water-related concerns, pest and pesticides concerns, carbon sequestration, and other industry issues. The questions targeted understanding the research, education, innovation, regulatory, and financial needs in these areas of focus as well as key areas of sustainable agriculture models.

As the issues of sustainable wine practices in the wine industry are too many to be explored in depth for this study, the Swarm Session questions give a snapshot of the areas most needed for the Paso Robles wine industry, the broader wine industry, and sustainable agriculture as a whole.





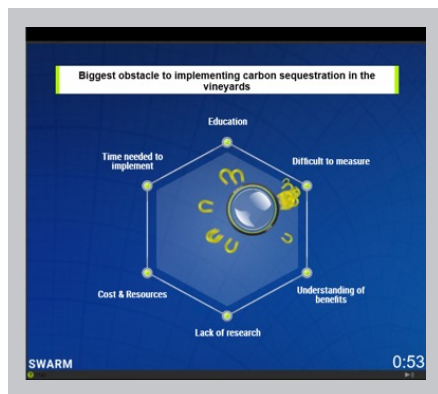
# 4. Swarm AI Survey Results

The Swarm Session was conducted in an interactive AI online format with a moderator providing instructions and presenting questions to the group via a chat feature. A total of 41 questions were asked over a one-hour time period. A total of 75 participants across a variety of industry sectors were invited to take part in the Swarm with a total of 32 participating.

Participants identified themselves as viticulturists, winemakers, educators, proprietors, marketing/PR representatives, sales, or others. They were also identified by size of the operation: under 5000 cases, 5000-50,000 cases, 50,000- 500,000 cases, over 500,000 cases, and others. In this way, the study could determine how each group, by profession or size of operation, answered each question. The study provides data on the thought and convictions of each group segment and the group as a whole. The Swarm takes into consideration differences in opinions and experiences by each group. Eight main categories were discussed:

- Barriers to Sustainability
- Cover Crops and Carbon Sequestration
- Community Engagement
- Climate-Smart Practices Across Wine Industry Sectors
- Pesticides
- Markets, Marketing, and Consumer Perceptions
- Water Issues
- Labor

Paso Robles CAB Collective Swarm Session (32 participants)											
AGE			GENDER			AREA OF WORK			CASE QUANTITY		
25-34	5	16%	Female	9	28%	Education	2	6%	Under 5000	5	16%
35-44	7	22%	Male	23	72%	Marketing/PR	7	22%	5000 - 50,000	6	19%
45-54	8	25%				Other	6	19%	50,000 - 500,000	7	22%
55-64	7	22%				Proprietor	3	9%	Over 500,000	9	28%
65+	5	16%				Sales	1	3%	Other	5	16%
						Viticulture	5	16%			
						Winemaking	8	25%			



During the Swarm process, each participant pulls a magnet puck towards their desired answer and work together to bring the puck to the answer they best agree upon (shown left). An overall conviction score was identified for each question.

The resulting conviction score is a numeric representation of the Swarm’s confidence in its choice. It is derived from an analysis of Swarm members’ behavior during the deliberation of a question and reflects the Swarm’s alignment while answering the question. High conviction scores indicate greater alignment; lower conviction scores reflect answers where there was a longer deliberation with support for multiple options before arriving at the final choice.

## 4.1 Barriers to Sustainability

Understanding barriers to sustainability experienced by the Paso Robles CAB Collective members and the wine industry as a whole was a priority for this study. To identify the top priority for this question into barriers, the Iterative Elimination methodology was applied to order and rank each answer by priority. This methodology was used in the Swarm by eliminating the weakest choice from a set of options and repeating the process until the two strongest choices remained. The final question then identified the best choice by a little or a lot.

### 4.1.1 Most Significant Barriers

Initially, participants were asked to identify the least significant barrier to sustainability, with the question repeated by eliminating the least significant option each time until the final two remained.

The following barriers to sustainability were given as options:

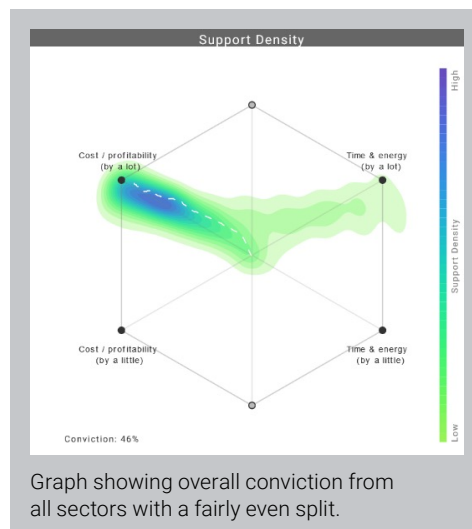
- Implementation of best practice
- Infrastructure/labor/resources/technology
- Cost/profitability
- Data and research sharing
- Time/energy
- Cooperation within the wine industry

Cost/profitability and time/energy were considered to be the greatest barriers facing the CAB-producing industry in Paso Robles. Participants were fairly split between these two final answers with a final conviction score of 46% for cost/profitability, by a lot, making this marginally the most significant barrier facing the wine industry regarding sustainability. Time/Energy was the second highest-ranked concern and was given a significant weighting in this question.

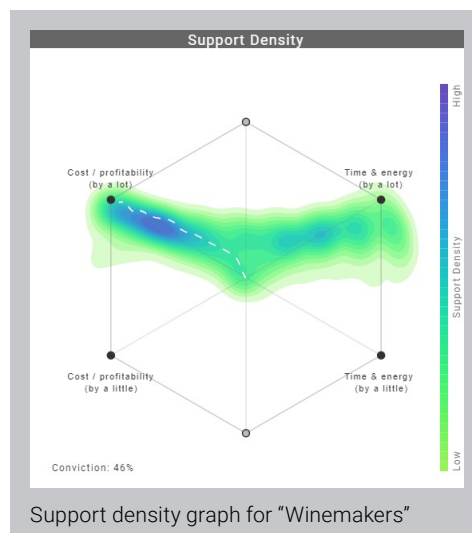
When diving deeper into the demographics of how each sector answered the question, proprietors, and viticulturists were split between cost/profitability and time/energy, while winemakers were decisive on cost/profitability, eventually resulting in the overall conviction score.

Implementation of best practices is well differentiated between the top two and bottom three options. Infrastructure/labor/technology/resources and data and research sharing are similarly perceived but as a lower concern. The Swarm is confident cooperation within the wine community is the least significant barrier to sustainability.

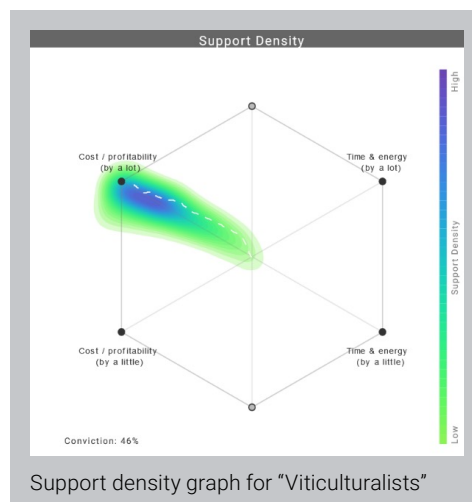
**Conclusion:** PRCC members may be unable to fully implement sustainable practices due to cost and impacts on profitability. The need for financial support and grants for individual and collective wineries and vineyards may be needed to help implement sustainable practices. Although research suggests cooperation in the wine industry is a major barrier to sustainability, PRCC members believe they cooperate well, and this is not a major area of concern. This is supported by information-sharing initiatives they have developed, including a PRCC joint marketing committee and a wine, viticulture, and sustainability committee. Many PRCC members have representations on regional and state industry boards and committees, allowing them to share information and contribute to collective strategies. PRCC members believe information is shared well between local and state certification bodies, which is confirmed by their response and echoed in comments at the Powerhouse Workshop. The study concluded PRCC members do implement best practices, but this is an area of concern. Further research and education could be undertaken to support this need. It is evident different sectors of the wine industry have different barriers to sustainability. Winemakers certainly feel the time and energy plus costs and profitability impact their ability to implement sustainable practices, while viticulturists appear definite that cost and profitability are the major issues for their sector.



Graph showing overall conviction from all sectors with a fairly even split.



Support density graph for "Winemakers"



Support density graph for "Viticulturists"

## 4.1 Barriers to Sustainability

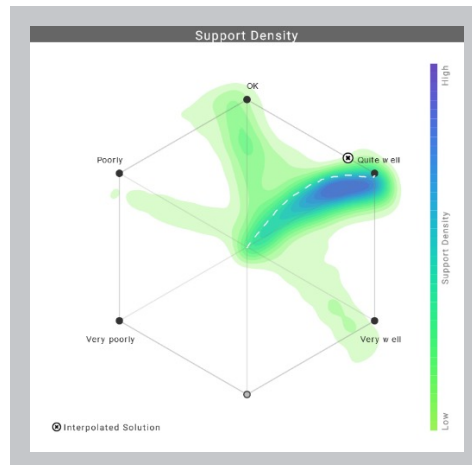
### 4.1.2 Information Sharing and Industry Collaboration

Global research on wine sustainability concludes collaboration within the wine industry is a major barrier to sustainability. Workshop attendees also identified accessing research already in the marketplace as being a major issue. Two further questions on information sharing and industry collaboration were raised to investigate if these concerns held true with PRCC members.

#### How well does our industry share research and collaborate?

- Very poorly
- Poorly
- OK
- Quite well
- Very well

60% of Swarm support was committed to the answer “quite well,” although 34% support was for “OK” or shared “poorly,” indicating there is still room for improvement. All sectors except for education pulled towards “OK” and “poorly.” Educators indicated that the industry shared information “quite well” to “very well.”



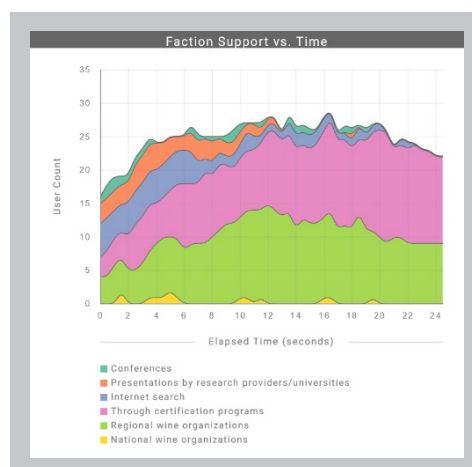
### 4.1.3 Accessing Research

#### Participants were then asked which was the most effective way to access research:

- Conferences
- Presentations by research providers/universities
- Internet search
- Through certification programs
- Regional wine organizations
- National wine organizations

Here the Swarm was split between regional wine organizations and certification programs, with the collective Swarm settling on certifications programs. National bodies and conferences received little to no support. Participants reached the final conclusion on this question in 24 seconds (out of a possible 60-second time limit), and there was a lot of deliberation to reach the final conclusion.

**Conclusion:** The results from 4.1.2 and 4.1.3 indicate there is tremendous emphasis on the importance of certification programs and regional wine organizations to be up to date on industry research and disseminate information on sustainability to the wine industry. More research is needed to understand the importance of these organizations to the wine industry and their ability to disseminate information. If a winery or vineyard is not certified, they may not be accessing this information. The abundance of research papers on sustainability in the wine industry indicates universities may have very valuable information in published studies, but they are not necessarily reaching the target audience. Research on how these published studies are accessed by the wine industry would be beneficial. Better cooperation and outreach between research bodies, certification programs, regional wine organizations, wineries, and producers should be supported. Swarm results indicate the wine industry is either not attending conferences or university lectures that present important information, and/or they are not aware of these events, are not accessing this information, or sustainability information is not presented via these avenues.





## 4.2 Climate-Smart Practices Across Wine Industry Sectors

The next group of questions aimed to investigate the priorities for different sectors of sustainability in the vineyard and winery. Due to the limitation of questions in the overall Swarm Session, ranking from highest to lowest could not be achieved for all questions. In most instances, the top three choices were sought to give an indication of the top priorities of the wine industry in each of these sectors of sustainable agriculture.

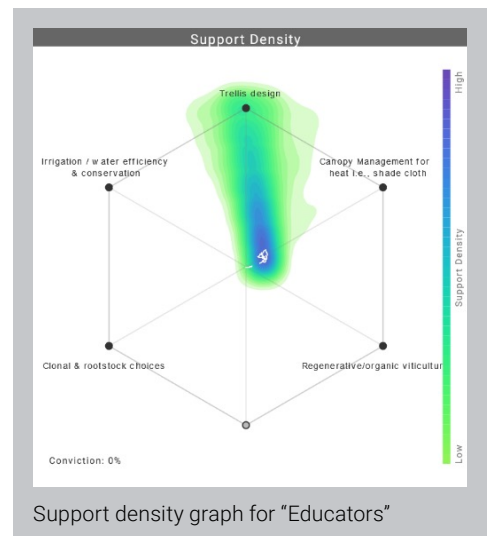
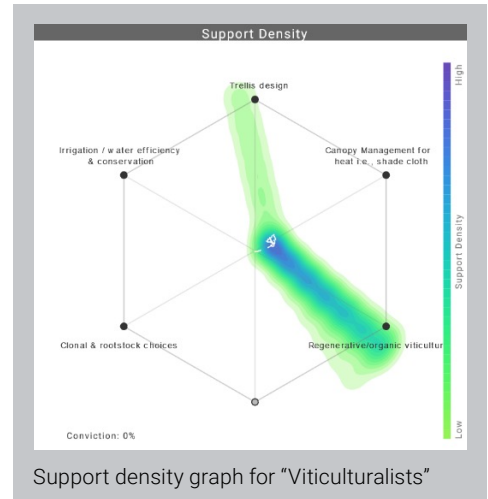
### 4.2.1 Climate-Smart Practices in the Vineyard

Participants were asked to rank their lowest priority for climate-smart practices in the vineyard:

- Clonal and rootstock choices
- Irrigation/water efficiency and conservation
- Trellis design
- Canopy management for heat (i.e shade cloth)
- Regenerative/organic viticulture

After no consensus was met on the first try with a “Brain Freeze” the question was repeated. Although a final consensus again was not met, 53% of participants decided trellis design was the least important while 40% responded with regenerative/organic viticulture. This indicated that the most important issues in vineyard management were clonal and rootstock choices, irrigation/water efficiency, and conservation and canopy management for heat. Those participants who self-identified as in the field of education were unanimous that the lowest priority was trellis design, while the majority of viticulturists saw regenerative/organic viticulture as the lowest priority.

**Conclusion:** Water efficiency and conservation, more tolerant rootstock/clonal choices, and heat effects on grapes remain high areas of concern for Paso Robles CAB winegrape growers. Research into more tolerant rootstock and clonal choices is needed for the Paso Robles terroir. Solutions for water, water efficiencies, and irrigation in the form of research, education, and funding would be beneficial to help support CAB winegrape growers in Paso Robles. The differences in lowest priorities reported by viticulturists versus educators indicate more education around the benefits of regenerative agriculture as a climate-smart practice for those practicing viticulture could be needed.



## 4.2 Climate-Smart Practices Across Wine Industry Sectors

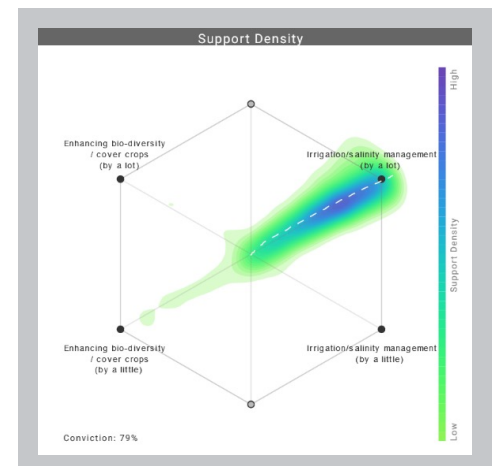
### 4.2.2 Sustainable Practices to Implement Soil Management

Participants were asked to rank from lowest to highest their priorities for implementing sustainable practices to implement soil management. This was a full-ranking question with the elimination of choices with each subsequent question to reach the top two choices. This was followed by a ranking of the top two choices by a little or a lot. Question choices were:

- Enhancing biodiversity/cover crops
- Carbon sequestration practices
- Protecting habitats and ecosystems (pollinators)
- Pest management best practices
- Irrigation/salinity management
- Composting

Participants very quickly and decisively concluded carbon sequestration to be the least important priority relating to soil management with 70% concluding this answer in 11 seconds. Composting was identified as the second least important soil management practice. The study showed pest management best practices, protecting habitats and ecosystems and cover crops were of equal importance. The top priority remained irrigation/salinity management with a conviction score of 79% when compared with the second highest priority cover crops.

**Conclusion:** Water and drought continue to be the highest concern for Paso Robles CAB grapegrowers, echoing the need for more education, research, innovation, and financial assistance in relation to sustainable solutions to assure the viability and sustainability of CAB production in Paso Robles. Research, education, and financial support are also needed to support carbon sequestration practices. As this is a relatively new area for the industry, winegrape growers appear not to fully understand its potential, how to measure carbon sequestration, and even how to implement these practices. Interestingly, protecting habitats and ecosystems is valued as a medium to high priority, indicating the industry is concerned not just with profitability, but also protecting the environment as good stewards of the land. Education and outreach to the consumer, trade, and the community should highlight this point.



## 4.2 Climate-Smart Practices Across Wine Industry Sectors

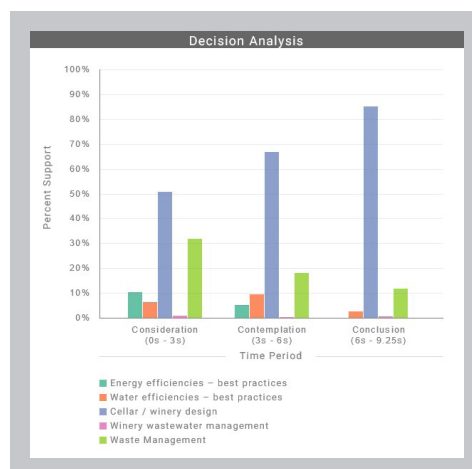
### 4.2.3 Climate-Smart Practices in the Winery

Participants were asked to identify the lowest two priorities for climate-smart practices in the winery:

- Cellar/winery design
- Winery wastewater management
- Waste management
- Energy efficiency – best practices
- Water efficiency – best practices

Participants identified cellar and winery design as the lowest priority very quickly in nine seconds with 75% conviction on this choice. This was followed by waste management as the second lowest priority in eight seconds by 90% of the vote. Winery wastewater management was the third highest priority, with water and energy efficiencies being the highest priorities for the winery.

**Conclusion:** Cellar and winery design can be expensive and time intensive and likely not economically viable for some of the smaller wineries. The major barriers of cost, time and energy are seen here. More research on sustainable changes to cellar and winery design which help reduce water and energy use may be useful as well as grants or financial assistance to make this a reality. Waste management, as the second least important climate-smart practice in the winery, is an interesting choice given the conclusion of the previous question with vineyard management priorities highlighting concerns when it comes to preserving habitats and ecosystems and being overall environmentally friendly. This does not necessarily translate to the winery as being an issue of major concern. The resulting three highest priorities again center around water conservation and efficiency as well as reducing costs for energy efficiency. Educating wineries on the importance of waste management and ensuring staff are trained and following winery procedures for waste management is relevant here. Given the winery is the largest user of water in the wine production process, education and research are needed to support continuing efforts for water and energy best practices.





## 4.2 Climate-Smart Practices Across Wine Industry Sectors

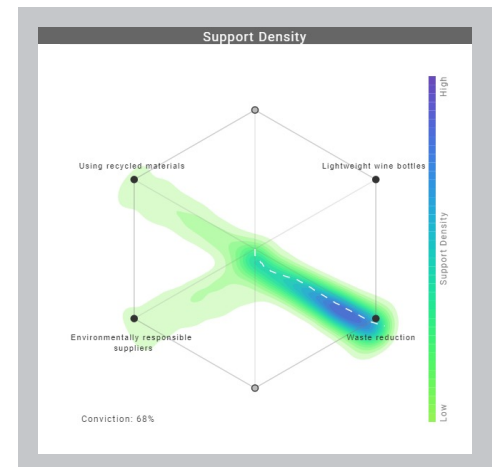
### 4.2.4 Climate-Smart Practices for Wine Packaging

Participants were asked to work together to identify their lowest two priorities for climate-smart practices for wine packaging:

- Environmentally responsible suppliers
- Using recycled materials
- Lightweight wine bottles
- Waste reduction
- Alternative packaging

Alternative packaging was very quickly decided by 81% of the participants in eight seconds as the lowest priority for this sector. Waste reduction was the second least important with 76% of participants choosing this option from the remaining choices in 14 seconds. This left environmentally responsible suppliers and using recycled materials as second and third choices, with lightweight bottles marginally the most important choice for sustainable packaging.

**Conclusion:** Using lightweight wine bottles helps to make shipping wine more environmentally-friendly (heavier wine cases = more fuel usage) and contributes to the overall bottom line if this reduces costs. More research and education are needed for the use of alternative packaging and its effects on the quality of wine, especially for the premium wine sector who is reluctant to place its wine product in cans, bags, onesie pouches, and use screw caps, lightweight bottles, and alternative packaging. They may need more proof premium wine drinkers will purchase Paso Robles CAB in alternative packaging and that it will not damage their brand. Research into how the packaging industry is reaching both the consumer and the wine producer may be needed. Waste reduction, again may not be as important as maintaining branding and image when it relates to quality. There is more acceptance and interest in lightweight bottles, and this sector again would benefit from more research and education, especially in regards to environmental sustainability, cost benefits, and appealing to the under 50 consumer.



### 4.3 Water Issues

In both the Powerhouse Workshop and a workshop held in the summer of 2022, water was by far the top concern for PRCC members. A number of issues were explored in this study as they related to water perceptions, usage, quality, and salinity.

#### 4.3.1 Mitigating the Negative Perception of Vineyards as Heavy Users of Water

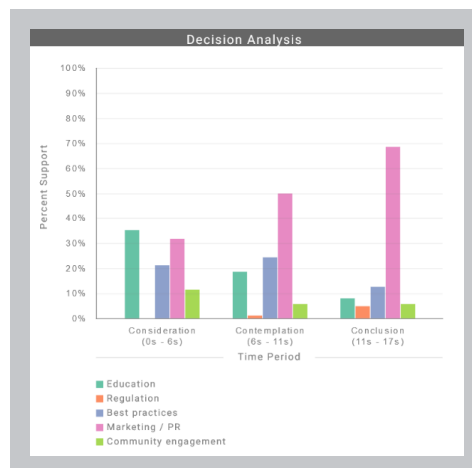
The workshop results highlighted concern regarding community and local government perception of vineyards, in particular, as heavy users of water. This negative perception was resulting in waning support for the Paso Robles wine industry. Media articles published in 2022 at the height of the drought did not always paint the sustainability of the wine industry in Paso Robles favorably.

The following question sought to understand what the wine industry thought was the most effective way to mitigate this perception with the following options:

- Best practices
- Marketing/PR
- Community engagement
- Education
- Regulation

Although initially drawn to education, most participant support (69%) was committed to Marketing/PR as the best way to mitigate this perception. It is possible the participants felt Marketing/PR could also serve as a way to educate and engage the community, local government and the consumer. Education and best practice were also considered by participants as ways to help mitigate this perception.

**Conclusion:** The results of this question could help shape PR and Marketing campaigns for the PRCC in the future, but also highlights a need for funding and grants specific to the PR and Marketing of sustainable agriculture practices as an important and urgent piece to sustainability. It is significant participants did not see regulation as a way to mitigate this image, and this is consistent with their reluctance to support the regulation of water for their continued sustainability. The industry clearly would like to explore other ways, such as technology, innovation, and support for lowering water usage as more viable options. Community engagement overall is still a low priority when it comes to the wine industry but was recognized by proprietors as important when answering this question. More education and support strategies perhaps from regional wine organizations and certification bodies could be helpful regarding how the wine industry can better engage with its community as part of its sustainability model.



## 4.3 Water Issues

### 4.3.2 Water Quality and Salinity

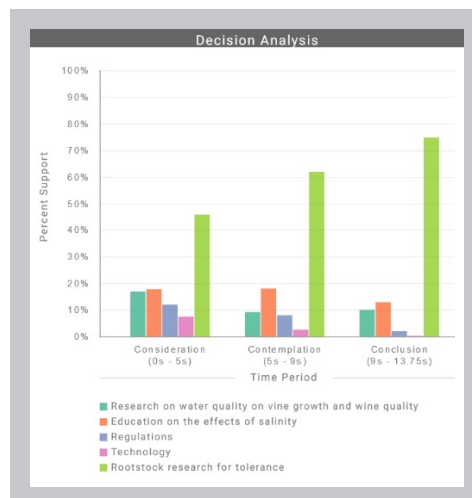
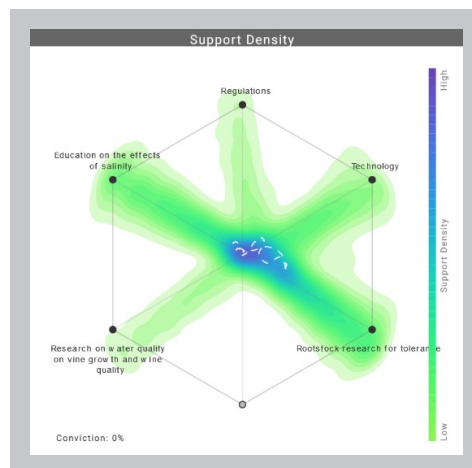
The next question explored the wine industry's needs regarding water quality and salinity, which is becoming an increasing issue for winegrape growers and quality wine production in Paso Robles.

Participants were asked to identify their most important need relating to the water salinity issue from the following choices:

- Regulations
- Technology
- Rootstock research for tolerance
- Research on water quality on vine growth and wine quality
- Education on the effects of salinity

When initially posed with this question, participants in the Swarm were torn between options offered and showed patterns of changing their minds ending in a "Brain Freeze" for the first round. The study concludes all issues were of a high priority, with a slight bias towards needing more education on the effects of salinity and rootstock research for tolerance. When asked again to pick their most important need in this area, the group finally settled on rootstock research for tolerance with a 68% conviction score. It is noted that regulating groundwater use was concluded to be the least needed to address this issue.

**Conclusion:** The industry is clearly calling for research to identify the best possible rootstock for Cabernet Sauvignon which will be more tolerant to the current and future salinity of the Paso Robles water supply. Specific research on adaptations and mitigations as well as the effects of the water quality and salinity on the vine growth and the quality of wine the vines are producing is called for. Subsequent education on the results would benefit winegrape growers. With the advent of new water regulations being imposed on growers in the very near term via the Sustainable Groundwater Management Act (SGMA), it is important to note the disconnect with the wine industry's readiness to accept this as an acceptable way forward, perhaps because they have little to no adaptative solutions and such regulations could be harmful to their business and sustainability. Education in this area is needed as well as research and funding into technology and innovation to provide timely solutions.



## 4.3 Water Issues

### 4.3.3 Access to Water

The next question sought to understand what the industry would see as its highest priority if they did not have the same access to water.

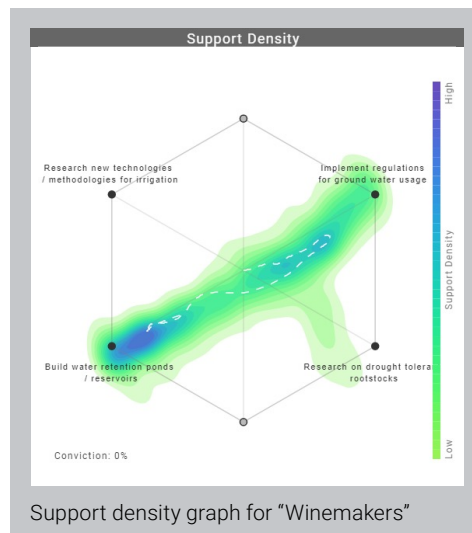
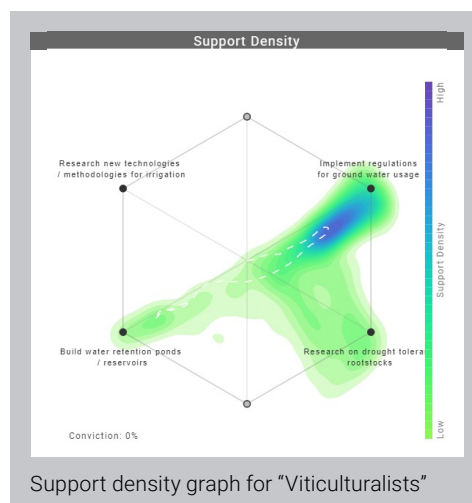
The study asked what the lowest priority for water initiatives for the wine industry with the following options would be:

- Research new technologies/methodologies for irrigation
- Implement regulations for groundwater usage
- Research on drought-tolerant rootstocks
- Build water retention ponds/reservoirs
- Desalinate water

The Swarm was relatively quick to decide the lowest priority would be desalinated water (68% conviction score). The Swarm was then asked to decide on the next lowest priority which caused a tug-of-war between building retention ponds/reservoirs and implementing regulations for groundwater usage. The Swarm appeared to be deadlocked. The moderator removed these two options and then turned the question into which would be their priority between researching new technology/methodologies and research on drought-tolerant rootstocks. New technologies/methodologies by a lot were then decided to be the highest priority for water initiatives.

When looking at what caused the “Brain Freeze” and analyzing the results by “area of work”, the answers given by the viticulturists suggest they understand more regulation on water usage is coming, whether they like it or not, but it was the winemaker group who was “driving the bus” away from regulations and to water retention ponds/reservoirs as a more palatable solution.

**Conclusion:** The Paso Robles CAB wine industry certainly believes desalination of water was not a high priority or perhaps even an option, either on the farm or by the county, in the event they did not have access to the same water supplies. The way the Swarm was torn between regulation (water regulations) and infrastructure needs (reservoirs/retention ponds) could mean the industry understands the potential impacts of implementing regulations, such as increased costs, more regulations in other areas, and overall effects on their sustainability. The group then considered building water retention ponds/reservoirs. After contemplating this answer, perhaps seeing logistical and expenses issues, they then pulled in the opposite direction. One conclusion could be there is overall concern regarding regulation and what it means for the winegrape growers in Paso Robles. There is a need for education, infrastructure support, and innovation/research into technologies that will help the industry adapt to their drought conditions and impact of climate change. The second highest priority was again research into rootstock tolerance, indicating consistency in the industry’s message that they need this vital research to help sustain their sustainability under current changing climatic conditions.





## 4.3 Water Issues

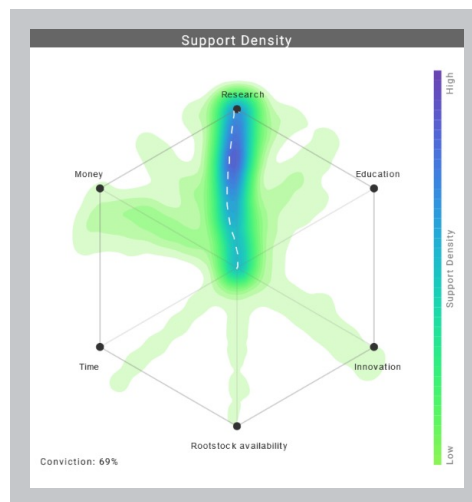
### 4.3.4 Top Need for Drought-Tolerant Rootstock Selections

Following on from this question, rootstock selections were explored in further depth and participants were asked about their top need in relation to drought-tolerant rootstock selections with the following options:

- Research
- Money
- Education
- Innovation
- Rootstock availability
- Time

Research, with a 69% conviction score, was rated the top need for rootstock selections in eight seconds. This was followed by money and education. There was some relevance for innovation, with education, time, and rootstock availability not as important as the other factors. When segmenting this by "area of work", viticulturist were unanimous in their support for research, whereas winemakers also considered time, rootstock availability, and innovation to be factors. Proprietors unanimously ranked money as the top need when considering implementing drought-tolerant rootstock selection.

**Conclusion:** Again, the industry indicates that research into rootstock selections that are more drought tolerant is important to their continued sustainability of adapting Cabernet Sauvignon and other CAB varieties to the current and changing conditions. Accessing financial support, such as grants and other subsidies, will be important to realize this important research. Innovation, time, and rootstock availability were also important considerations.



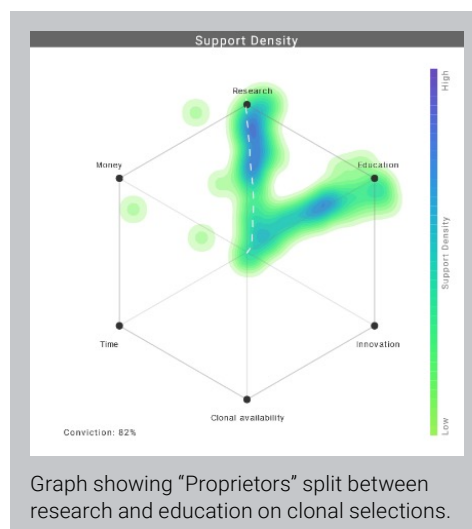
### 4.3.5 Top Need for Clonal Selections

This question was also repeated for clonal selections. Participants were asked what their top need for clonal selections would be:

- Research
- Money
- Education
- Innovation
- Clonal availability
- Time

Research, with a conviction score of 82% was reached by the group in seven seconds. Innovation was the second highest, but only with an end result of seven percent of the support. When looking at the area of work segments, viticulturists and winemakers overwhelmingly agreed research was needed, whereas proprietors were relatively evenly split between research and education. Marketing/PR was split between research and innovation.

**Conclusion:** Research is needed to understand what Cabernet Sauvignon clones would be best suited to the hotter and dryer conditions of Paso Robles and the impacts of climate change. Education and innovation are also highlighted as areas of need.



Graph showing "Proprietors" split between research and education on clonal selections.

## 4.3 Water Issues

### 4.3.6 Greatest Barrier to Dry Farming

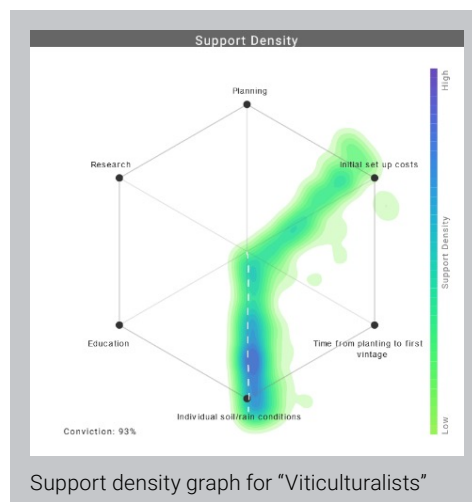
Dry farming is considered by many winegrape growers to be aspirational but not an option for all vineyards. Certification bodies argue this may not necessarily be the case and that better education is needed around dry farming as some vineyards may be able to dry farm with the correct supports.

The Swarm was asked to identify the greatest barrier to dry farming:

- Individual soil/rain conditions
- Education
- Research
- Planning
- Initial set-up costs
- Time from planting to the first vintage

Overwhelming, with a 93% conviction, the industry believes not every vineyard in Paso Robles could dry farm due to their individual soil and rain conditions. Only viticulturalists believed initial set-up costs could be more of a barrier than individual soil and rain conditions.

**Conclusion:** The result of this question indicates the belief by most in the wine industry that the biggest barrier to dry farming is their individual soil and rain conditions, with many in Paso Robles maintaining it would not be a possible due to their unique situation. This means some type of water and irrigation would be needed to ensure the viability of these vineyards. If this is not the case, then more research and education is needed to help these farmers understand the alternatives available to them. However, with some viticulturalists answering that this is possible with the initial setup being the main barrier, viticulturalists may either have a more educated perspective or those who answered in this direction may have soil and rain conditions favorable to dry farming.



## 4.3 Water Issues

### 4.3.7 Addressing Rising Temperatures and Reduced Water Availability

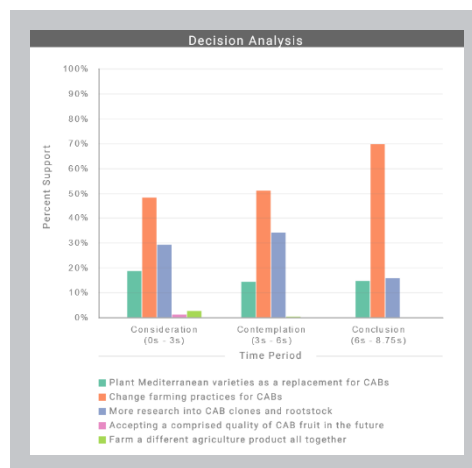
Researchers have indicated with rising temperatures in AVAs globally, a necessity to change the grape variety to one better suited to warmer and dryer conditions for that particular AVA may be needed.

**With the context of rising temperatures and less water availability in Paso Robles, the study asked what the priority should be to address this issue with the following options:**

- Plant Mediterranean varieties as a replacement for CABs
- Changing farming practices for CABs
- More research into CAB clones and rootstocks
- Accepting a compromised quality of CAB fruit in the future
- Farm a different agriculture product altogether

Here the main priorities were identified as changing farming practices for CABs and more research into CAB rootstocks and clones, with those identifying as viticulturists pulling predominantly for these answers. Although most winemakers also concurred with the viticulturists on this question, some were open to planting other varieties as were those who identified as others.

**Conclusion:** It is apparent, given the millions of dollars of investment in CAB varieties in Paso Robles and that CAB varieties represent over 60% of overall plantings, that the Paso Robles wine industry is reluctant to see this varietal fail under the changing climatic conditions. The need for research and education on options available to them for changing their practices to adapt to these conditions and find ways to mitigate the impacts is paramount. Giving up on CABs and replacing them with other varieties or another crop altogether is simply not an option for them at this time. The need for research into adaptive CAB clones and tolerant rootstocks is again highlighted as a priority in this question. Interestingly, even those participants who represent themselves as educators (university professors and researchers) agreed with the major position on this question.



## 4.4 Cover Crops and Carbon Sequestration

### 4.4.1 Cover Crops

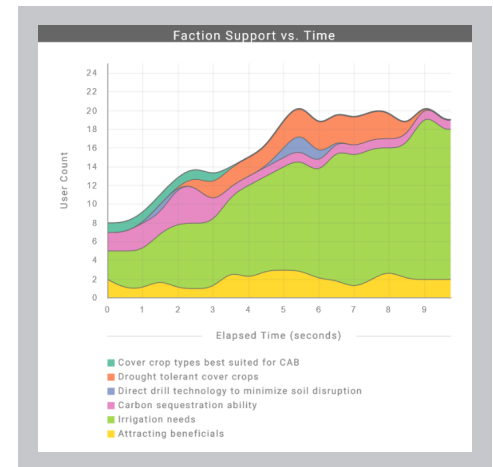
The study explored the group's priorities with cover crops as a sustainable agriculture practice in the vineyards.

Participants were asked to identify what was most needed to understand which cover crops were best suited to the Paso Robles terroir with the following options:

- Cover crops best suited for CAB
- Drought-tolerant cover crops
- Direct drill technology to minimize soil disruption
- Carbon sequestration ability
- Irrigation needs
- Attracting beneficials

Following the concerns of water, the group concluded with a 71% conviction score that irrigation needs were the highest need in this area. The ability of cover crops to reduce irrigation means the specific type of cover crop which helps mitigate the water issues is seen as important. Attracting beneficials and carbon sequestration were also of importance when choosing cover crops, as well as weed control.

**Conclusion:** More research into the most effective cover crop for the specific soil type and terroir is needed for this wine industry, especially pertaining to reducing water use in vineyards. Education on the benefits and measuring of carbon sequestration would also be beneficial as would be the availability of selections for attracting beneficials for pest control and pollinator habitats.





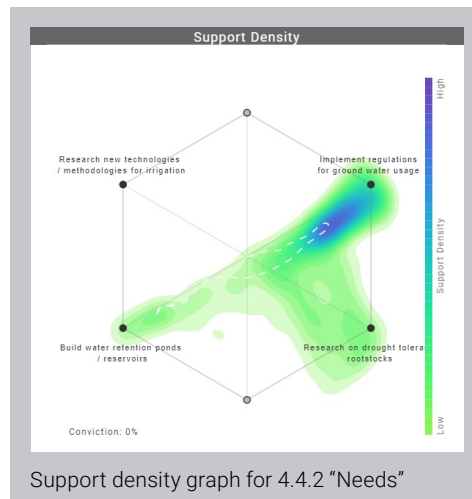
## 4.4 Cover Crops and Carbon Sequestration

### 4.4.2 Needs for Carbon Sequestration

With carbon sequestration being a relatively new climate-smart practice, the industry Swarm were asked what type of research was needed to better understand carbon sequestration with the following options:

- Cover crops
- Composting
- Regenerative viticulture
- Technology to measure
- Other companion plants

Initially, some participants considered composting and to some degree cover crops. Technology to measure was settled as being the area they needed to better understand carbon sequestration, with an 84% conviction score.



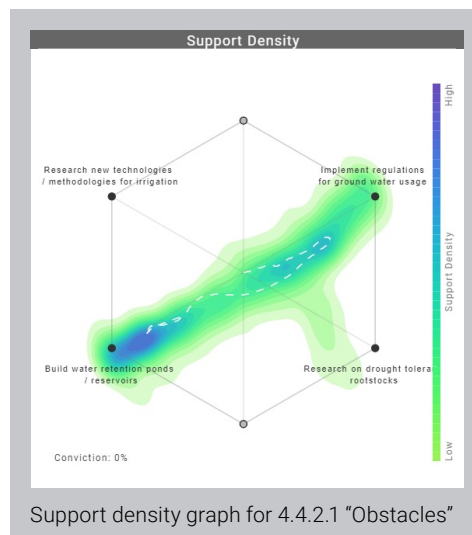
#### 4.4.2.1 Obstacles of Implementing Carbon Sequestration

This was echoed again with the follow-up question which asked what the biggest obstacle was to implementing carbon sequestration in the vineyards with the following options:

- Cost and resources
- Time needed to implement
- Education
- Difficult to measure
- Understanding the benefits

Again, the Swarm concluded with 67% conviction that carbon sequestration was difficult to measure. This was followed by education and a need to understand the benefits of other obstacles to implementing carbon sequestration.

**Conclusion:** These results clearly indicate more research and education are needed on how to measure carbon sequestration and the development of affordable, and accurate technology to do this. Education is further needed on exactly what is carbon sequestration, how difficult or easy it is to measure, and how it is beneficial to sustainability and climate-smart practices. It could also be concluded more research on cover crops and education on the benefits of regenerative agriculture could be beneficial to help winegrape growers understand how this overall system of farming increases the ability to sequester carbon from the soil. Costs and resources should not be discounted, as these may become future barriers as vineyards investigate implementing this practice.



## 4.5 Pesticides

The workshop highlighted the use of pesticides as an issue for those seeking sustainability in the Paso Robles AVA and that the European Union was increasingly regulating pesticide content in wines. This would become an important issue if Paso Robles CAB producers were looking for international markets.

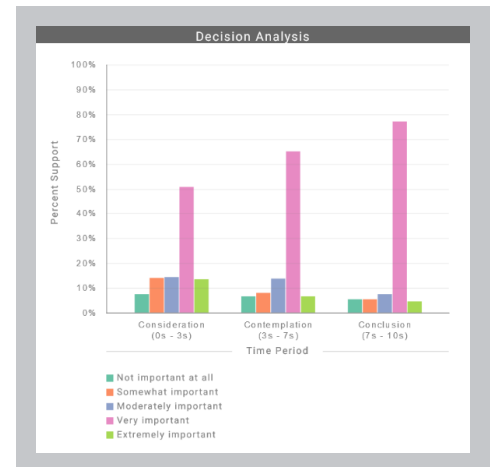
### 4.5.1 Importance of Pesticides

Participants were asked to fill in the blank to gauge how important they felt this was an issue:

- Not important at all
- Somewhat important
- Moderately important
- Very important
- Extremely important

The Swarm expressed that this was moderate to very important, with many switching from moderately to very important the more time they had to think about this answer. The Swarm ultimately converged on “very important” as its answer.

**Conclusion:** This answer is more relevant for those wineries that have larger distribution and the ability to enter the export market. Pesticide levels in wine would become more of a concern should there be an oversupply of wine versus the market demand in the future. According to the 2022 Silicon Valley report, the shrinking wine-drinking market is becoming a reality as the Baby Boomers (the highest wine-drinking market) ages out, and the younger under 50 market is choosing alternatives to wine. More education about the overall effects of the continual use of pesticides in the wine industry is needed, as well as education on future wine-drinking markets. Regulation and industry cooperation on pesticides may be needed to protect those who are wanting to export but are being affected by their neighbors who are not. Industry standards may be needed and appear to be a priority for the wine industry.



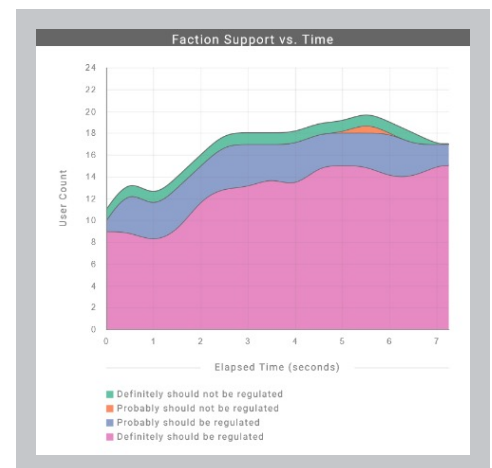
### 4.5.2 Regulation of Pesticides

The next question probes deeper into the issue of pesticides by asking the group should pesticides be regulated with the following options:

- Definitely should not be regulated
- Probably should not be regulated
- Probably should be regulated
- Definitely should be regulated

The Swarm concluded in seven seconds that pesticides should be regulated with a high conviction score of 89%.

**Conclusion:** With a high need for regulations of pesticides, the question of who will regulate this and how will it be regulated should be raised. Questions such as: will certification bodies regulate pesticides as part of their certification programs, will winegrape growers self-regulate and can self-regulation be trusted, should the industry set forth targets or should there be government regulations, will need to be explored.



## 4.5 Pesticides

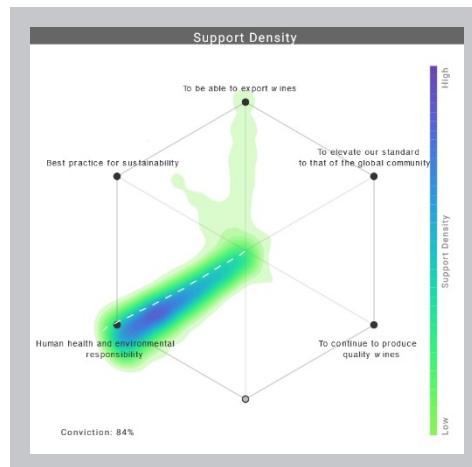
### 4.5.3 Reducing Pesticides

The study then explored why the wine industry felt reducing pesticides was important with the following options:

- Human health and environmental responsibility
- Best practice for sustainability
- To be able to export wines
- To elevate our standard to that of the global community
- To continue to produce quality wines

The overwhelming response to this question was human health and environmental responsibility with an 84% conviction score in seven seconds. Winemakers and viticulturists also cited the ability to export wines, while proprietors were the only ones to register the effect of pesticides on the quality of the wine.

**Conclusion:** The Paso Robles CAB Collective members and the wine industry are highly concerned about the environmental and health impacts caused by the continued use of pesticides. More research and education are needed on the importance this issue could also play in future markets. Paso Robles CAB Collective members appear not to be concerned about their standard in the global community while there is some concern about pesticides affecting the quality of their wines. Further research on consumer importance regarding this issue would be valuable, as would the issue of marketing the wine as pesticide-free (healthier), which could spotlight other wines as being less healthy if they were not pesticide-free.



## 4.5 Pesticides

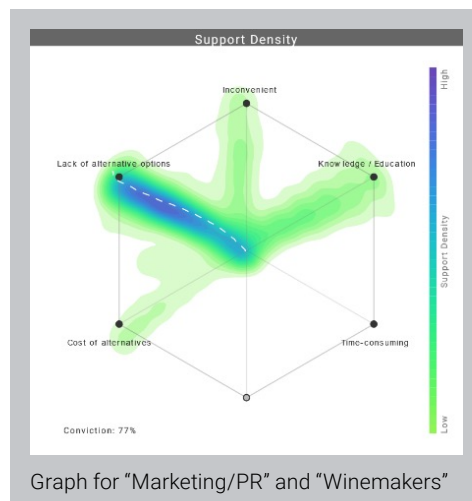
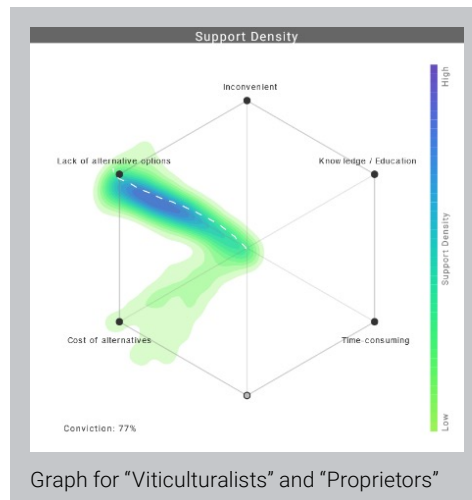
### 4.5.4 Greatest Barrier to Reducing Pesticides

To complete the questions on pesticides, participants were asked to identify the biggest barrier to reducing pesticides considering the following options:

- Cost of alternatives
- Lack of alternative options
- Knowledge/Education
- Time-consuming

The lack of alternatives with a conviction score of 77% was clearly identified as the greatest barrier to being able to produce wines without pesticides. Knowledge and education were the second biggest barriers to reducing pesticides, with the cost of alternatives having minimal pull. In addition to the lack of alternatives, viticulturists and proprietors claimed costs of alternatives were also an issue, while marketing/PR and winemakers did not see cost as much as knowledge/education and time consuming as barriers.

**Conclusion:** It would appear the industry has a huge need and desire to reduce, regulate and perhaps even eliminate pesticide use altogether, however lack of alternative options weighs heavily on them. There seems to be some belief there is a lack of knowledge and education on this issue, which is hindering them rather than alternatives, and if this is true, then this education and knowledge is not reaching them. If regional organizations and certification bodies are the main way the industry is receiving this information, then this issue should be a focus for them. If relevant information on alternatives to pesticides is readily available, it is clearly not being communicated to them or is simply not known about. More research on effective alternatives is either needed or needed to be accessed. Cost is also a barrier to using alternatives to pesticides, which could involve the cost of becoming organic or biodynamic. Grants and subsidies may be needed to help the industry become pesticide free





## 4.6 Labor

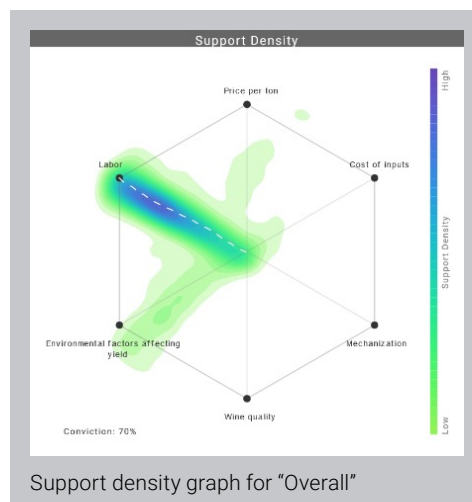
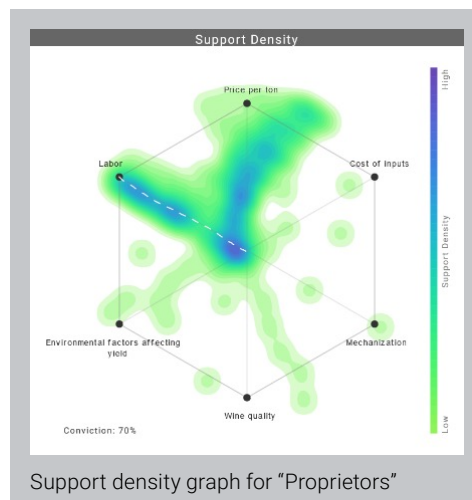
Labor is identified as a key area of concern in both the workshop held in the summer and the Powerhouse Workshop prior to the Swarm Session.

### 4.6.1 Biggest Restriction of Vineyard Profitability

This question investigated the biggest issue restricting vineyard profitability with the following options:

- Price per ton
- Cost of inputs
- Mechanization
- Wine quality
- Environmental factors affecting yield
- Labor

Labor was identified as the biggest issue restricting vineyard profitability with a 70% conviction score. Environmental factors affecting yield were also a concern, followed by price per ton. Those who described themselves as “proprietors” in this question were the group who showed the most concern with price per ton, relating to their concern with profitability and economic sustainability of the entire business, especially when there is an oversupply of grape juice. Grants and financial support are needed to develop new markets and maintain competitiveness in current markets (marketing). This is key to ensuring there is not an oversupply of wine and maintaining price per ton. An oversupply of wine affects the price per ton and causes wine to be discounted, cheapening the brand, and can trigger competition between wine producers. Fruit is also often dropped rather than harvested when there is oversupply and some farmers are forced to replace winegrapes with other agriculture due to the lack of sustainability.



## 4.6 Labor

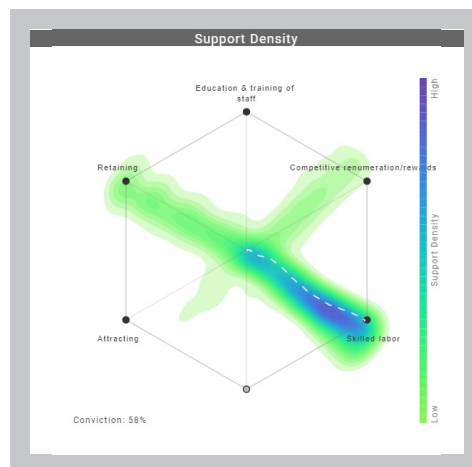
### 4.6.1.2 Most Important Labor Issues

Exploring the labor issue was followed with a question that explored the most important labor issue impacting the wine industry in Paso Robles with the following options:

- Attracting
- Retaining
- Education and training staff
- Competitive remuneration/rewards
- Skilled labor

Three answers received significant support on this question. Ultimately, skilled labor was the Swarm's choice, but with only 58% conviction. Retaining, and competitive remuneration/rewards were also highlighted as areas impacting the wine industry.

**Conclusion:** All answers seem to revolve around the idea of having skilled employees. However, keeping employees and paying them competitively appeared preferable to the costs incurred by attracting and educating (and gaining experience on the job) for new employees. The seasonality of employing workers in the wine industry could be an issue here. Hiring and housing season workers in the wine industry and vineyards are often faced with competing for the same workers at the same time, under pressure to harvest grapes at the most optimal time for producing the best quality wine. Providing living wages versus minimum wages are also a consideration. A key difference between sustainable and regenerative agriculture models is that regenerative agriculture assures a living wage as part of a commitment to holistic farming, sustainability models may pay only minimum wages. Education on the cost benefits of educating and maintaining a workforce may be beneficial for winegrape growers and producers, as opposed to the cost of attracting, rehiring, and retraining the workforce. Mechanization research and technology to replace traditional labor in the vineyard would be of interest, as this could help solve the issue of skilled labor being hard to come by.



## 4.7 Community Engagement

Community engagement was discussed at the Powerhouse Workshop as part of the overall sustainability model. Feedback on this issue reflected a lack of understanding of the value of community engagement or the industry's ability to connect with the local community and local government to shape perceptions and garner support. It is apparent that many producers and vineyards are practicing sustainable and environmental practices, but their story is not being told to the wider community. This was explored further in the Swarm with the following questions.

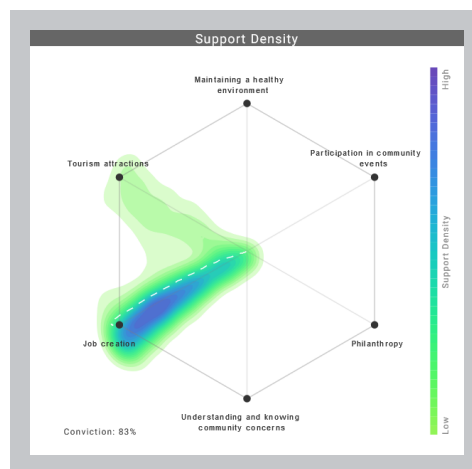
### 4.7.1 Wine Industry's Importance for the Community

Participants were first asked what the most important thing the wine industry does for the community, with the following options:

- Job creation
- Tourism attraction
- Maintaining a healthy environment
- Participation in community events
- Philanthropy
- Understanding and knowing community concerns

Considering the wine industry in Paso Robles employs over 10,000 people, it is not surprising the wine industry felt their contribution by creating jobs for the local community was the most important thing they did for the local community. Their role in creating tourism was also significant, adding to further job creation and economic impact for the region. Philanthropy and understanding/knowing community concerns were low priorities compared to other options given.

**Conclusion:** Exploring more ways of connecting with the local community is important in creating and shaping community perceptions. Educating the workforce and the tourism industry on sustainable practices and the positive impacts on the community will go a long way to helping community perceptions and encouraging support from both the community and the local government. Considering recent media, this could be important in sustaining the industry. The wine industry firmly believes in its role as environmental stewards of the land and preserving and maintaining a healthy environment to the benefit of the wider community, and this message needs to resonate with the community. The industry needs to work on ways it can better understand community concerns, especially relating to water use and environmental standards. More research into community perceptions is needed, as is educating the wine industry that their role is not just economic return to a community. Having representation on boards, committees, and other community groups could be helpful as well as education from regional bodies and certification programs.



## 4.8 Markets, Marketing, and Consumer Perceptions

Marketing is an important pillar of economic viability in the sustainability model. This study touched on a few issues relating to developing markets for sustainable wine, marketing, and consumer perceptions.

The Silicon Valley Bank's recent State of the Wine Industry report stated the younger consumer (the under 50) values sustainability, and the wine industry is not effectively marketing to this sector (they are the wine drinkers of the future with Baby Boomers declining in numbers).

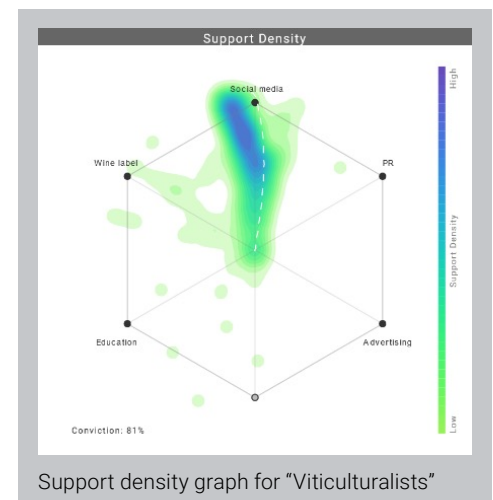
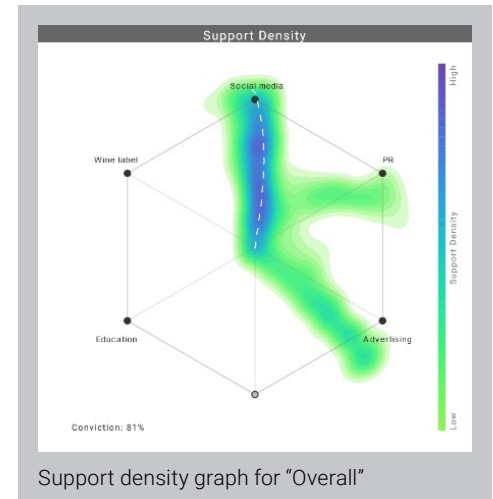
### 4.8.1 Reaching Younger Consumers

The following questions aimed to understand how PRCC members (as a snapshot of the wine industry) would reach out to this market with the following options:

- Education
- Wine label
- Social media
- PR
- Advertising

The overwhelming response was for social media to carry this message effectively with a conviction score of 81%. This correlates with the belief that the under 50 market heavily uses social media as a communication and information channel. Interestingly, those who identified themselves as marketing/PR professionals (and perhaps most qualified to answer this question) pulled towards PR and advertising as effective mediums for communicating to this market, which indicates the under 50 market may also receive information from these channels in addition to social media or that these channels can better relay their sustainability messages. Proprietors overwhelmingly believed PR to be the most effective channel. Viticulturists initially went for the wine label and then changed their minds to the group conclusion of social media.

**Conclusion:** Social media, as a marketing channel, may be the most effective way to market to the under 50 market, probably due to its scalability and propensity for this demographic to use this channel, but other channels such as PR and advertising should also be considered. More research into the importance of this market to the wine industry is needed as well as educating the wine industry and what and how this market sector needs to convert more alcohol-age drinkers to wine drinking and in particular Paso Robles CABs. More grants to support the wine industry relating to market development and marketing programs aimed at educating and not necessarily sales conversations should be made available.





## 4.8 Markets, Marketing, and Consumer Perceptions

### 4.8.2 Support in Finding New Markets

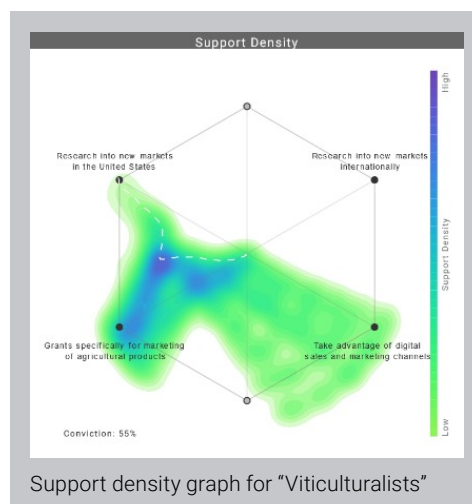
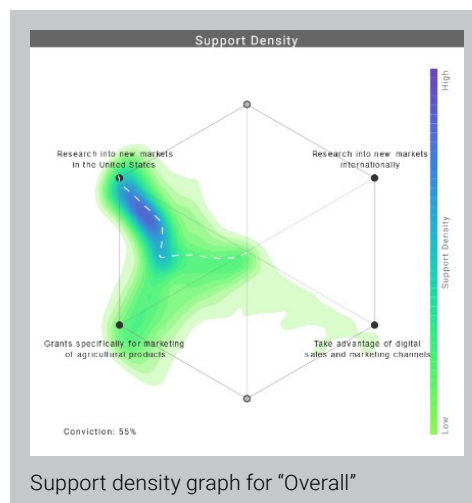
A follow-up question was presented to determine where Paso Robles CAB producers felt they needed support to find new markets to ensure economic viability and continued sustainability.

They were offered the following options:

- Research into new markets in the US
- Research into new markets internationally
- Take advantage of digital sales and marketing channels
- Grants specifically for marketing agricultural products

The Swarm was split fairly evenly on research into new markets in the United States and grants specifically for marketing of agriculture products. Of all participating groups, those who were industry stakeholders and represented themselves as “other” pulled towards grants and take advantage of digital sales and marketing channels over research into new markets in the United States.

**Conclusion:** PRCC producers firmly believe there are potentially more markets in the US for their wine than those they currently service. Research would be valuable to them in understanding where to direct sales and marketing efforts in the future. Such research could be by state or demographic, with information about the potential new market’s wine-drinking profiles. More grants specifically targeting the marketing of wine as an agricultural product are called out as important to the industry, especially by industry stakeholders, given the limited number of grants accessible for pure marketing. Those grants which do include market development and marketing for agricultural products, tend to be extremely competitive. Factors such as cost, access, and ability to distribute given size of operation, may have been reasons why there was no interest in researching international markets. If there is an oversupply of wine in the US compared to the wine-drinking market as a whole, the wine industry will either be forced to look for international markets or start to compete amongst themselves for a smaller market share, which in turn could have devastating effects on smaller producers who may not be able to compete and remain sustainable. In this scenario, cheaper wine will be dumped on the market, affecting premium wine brands and sales, and some farmers would be forced to drop fruit rather than harvest. The complexity of selling wine digitally in the US market may also be a reason why this sector did not receive as much collective support.



## 4.8 Markets, Marketing, and Consumer Perceptions

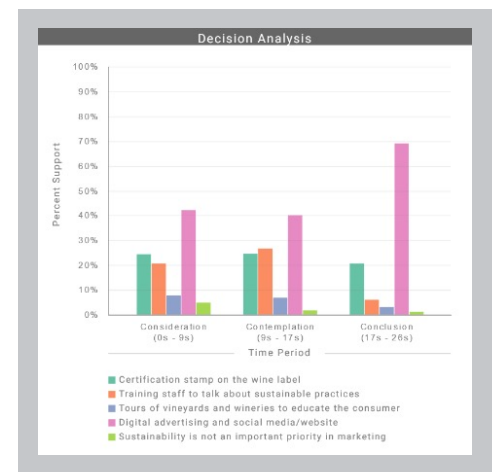
### 4.8.3 Method of Marketing Sustainability to the Consumer

This was followed by a question on the best way to message sustainable practices to the consumer with the following options:

- Certification stamp on the wine label
- Training staff to talk about sustainable practices
- Digital advertising and social media/website
- Tours of vineyards and wineries to educate the consumer
- Sustainability is not an important priority in marketing

The Swarm gave equal consideration to digital advertising and social media/website, certification stamp on the wine label, training staff to talk about sustainable practices, and finally settled on digital advertising and social media/website with a 56% conviction score. Interestingly, those who associated themselves as Marketing/PR professionals were split between certification stamp on the wine label, training staff to talk about sustainable practices and digital advertising, and social media/website. Viticulturalists were the most collective group to agree on digital advertising and social media/website and it was only winemakers who considered briefly that sustainable practices were of little interest to the consumer.

**Conclusion:** Digital advertising and social media/websites appear to be the industry's preferred method of marketing sustainability to the wine consumer, probably due to its scalability. More research should be conducted on the current level of knowledge of the consumer about sustainability in the wine industry and how this impacts their decision to buy wine. This would help properly inform the wine industry on how to educate the consumer and how to market to them. Educating all who are engaged in the production of wine on the importance of the consumer's expectations and desires for sustainability is important. Without a consumer, there is no industry. A deeper dive into the issue of the consumer and marketing for sustainability would be beneficial.



## 4.8 Markets, Marketing, and Consumer Perceptions

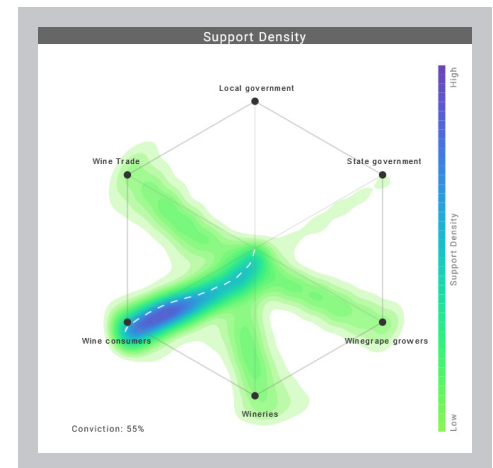
### 4.8.4 Who Would Benefit from Sustainability Education

Participants were then asked who would benefit from education on current sustainable practices:

- Wine Trade
- Wine Consumers
- Winegrape growers
- Wineries
- State government
- Local government

Participants were also equally spread on this question with wine trade, wine consumers, wineries, and winegrape growers all needing education. Wine consumers appeared to be the favored answer with a conviction score of 55%. Viticulture participants were the only ones who felt the wine trade and state government in addition to consumers needed education. Winemakers were divided between wine trade, consumers, wineries, and winegrape growers. Educators believed it was the winegrape growers, wineries, and wine consumers who needed educating, whereas marketing/PR professionals were almost unanimous in their conclusion on the wine consumer.

**Conclusion:** Clearly the wine industry feels it would benefit if the wine consumer and wine trade were educated on sustainable practices. Their knowledge and understanding could translate into sales and more positive perceptions of the industry's genuine attempts to be good stewards of the land. However, all sectors would also benefit from updated and continued education on sustainability practices. This education may have to be broader than just certification bodies and regional wine organizations, but also among themselves as an industry. The industry may also consider educating local and state governments on the sustainability efforts of the wine industry, especially if they feel regulations on the water are not favorable for Paso Robles winegrape growing and wine production.





# 5. Summary of Recommendations Table

■ The following table is a summary of recommendations from the Powerhouse Workshop, Swarm Session, and individual interviews. The table is broken down into seven main categories:

- Barriers to Sustainability for the Wine Industry
- Other Major Areas of Concern/Need for Paso Robles CAB Producers
- Research Needs
- Education Needs
- Infrastructure/Equipment/Innovation Needs
- Financial Needs
- Regulations

Summary of Recommendations Table	
<b>1. Barriers to Sustainability for the Wine Industry</b>	
1	Cost and profitability were the highest-ranked barriers to accessing and implementing sustainable agriculture, particularly for winegrape growers
2	Time and energy were the second-highest-ranked barriers and a major concern for winemakers
3	Infrastructure, labor, resources, and technology are other barriers that have a significant impact on implementing sustainable agriculture practices by the wine industry
4	Accessing data and research is an issue and barrier for the wine industry
<b>2. Other Major Areas of Concern/Need for Paso Robles CAB Producers</b>	
1	Water efficiency and conservation were of the highest concern, including irrigation techniques and issues of water salinity affecting grapes
2	More tolerant rootstock and clonal choices specific to the Paso Robles AVA and Cabernet varietals are needed for sustainability in changing climatic conditions
3	The ability to change farming practices specifically for CAB winegrape growing to suit the ever-changing climate and weather conditions are issues of concern
4	The use of pesticides in the vineyards, how this is being managed by the industry, and implications for health, environmental stewardship, as well as export market/market regulations and the lack of options are issues
5	Labor, including attracting, retaining, educating, rewarding, and obtaining skilled labor is a key issue
6	Possible wildfires and the effect of smoke taint are issues of concern

## Summary of Recommendations Table

### 2. Other Major Areas of Concern/Need for Paso Robles CAB Producers (CONTINUED)

7	Extreme weather events caused by climate change including prolonged periods of increased temperatures, frost, and flooding rains and crop adaptability
8	Compressed harvest conditions caused by changing climate conditions, and the impact on flavor formulation are industry concerns
9	Possible future pandemic and how to remain economically viable if this was to occur is an issue of concern
10	Cost of goods and being able to afford to implement sustainable practices and maintain viability are industry issues
11	Adaptations are too slow to be effective and are seen as an issue and a barrier

### 3. Research Needs

1	Research on how the wine industry implements best practices and what best practices are actually being implemented by different wine grapegrowers and producers in the Paso Robles region and the greater wine industry as a whole
2	Research on how universities are outreaching to the wine industry regarding recent and relevant published research papers and ongoing demonstration projects in relation to sustainable wine agriculture
3	Research into the role of certification bodies and regional organizations as platforms for providing research and support for sustainable practices in the wine industry and how they disseminate this information
4	Research those winegrowers and wine producers who are not certified or aligned with regional organizations and how they receive information on how to implement and what to implement in relation to sustainable agriculture practices
5	Research into how the wine industry is accessing current and/or relevant research papers and information regarding ongoing research so efforts are not duplicated
6	Research into more drought-resistant and tolerant rootstocks relevant for the Paso Robles AVA and different soil types in the sub AVAs
7	Research into what inputs and practices will be needed by the Paso Robles CAB growers and producers to continue producing quality Cabernet and Red Bordeaux varieties in the face of changing climate conditions
8	Research into more drought-resistant and tolerant CAB variety clones relevant for the Paso Robles AVA and different soil types in the sub AVAs
9	Research water efficiencies specific to the Paso Robles AVA, soil type, and typography for individual farmers
10	Research into the best possible irrigation choices for farmers based on AVA, soil type, and typography of individual vineyards
11	Research into the effects of water salinity on grape growing and wine quality
12	Research into subsurface irrigation and better ability to identify possible leaks
13	Research into organic solutions to water salinity
14	Research into carbon sequestration abilities of different soil types within the Paso Robles AVA and the best and most cost-effective tools for measuring
15	Research into technologies for water-efficient practices in the winery



## Summary of Recommendations Table

### 3. Research Needs (CONTINUED)

16	Research the effects of lightweight bottles, screw caps, pouches, and cans, on wine quality
17	Research the effects of lightweight bottles, screw caps, pouches, and cans on consumer perception of premium wine
18	Research into how the packing industry is reaching the wine industry with innovation and alternative packaging which aids in sustainability
19	Research into new technologies for the irrigation of vineyards
20	Research on dry farming alternatives for CAB winegrape growers
21	Research into the most effective cover crops for specific soil types and terroir in the Paso Robles AVA
22	Research into cover crops that can help reduce water usage in the vineyard
23	Research into cover crops for weed reduction
24	Research into the use of and effects of continued use of pesticides in the vineyards
25	Research into how regulating pesticides in the vineyards would be managed – self-regulation, government regulation, or through certification bodies
26	Research into alternatives to pesticides in the vineyard with pest growth in the vineyard due to hotter conditions becoming an increasing issue
27	Research into local community perceptions of the wine industry and how this can affect sustainability
28	Research into consumer markets for sustainable wine is needed, including their current understanding of wine sustainability, their buying habits, and the best marketing channels to reach them
29	Research into consumer understanding of wine certification on wine labels and how this affects buying choices and if this differs depending on wine market segmentation
30	Research into redefining sustainable agriculture for the wine industry to incorporate a time range, such as five generations
31	Research into vine architecture and trellis design, row orientation best suited to heat and climate conditions
32	Research into grape resilience to UVA and UVB light, shade cloth techniques, and sunscreens
33	Ongoing research into the effects of smoke taint on wine grapes, precursors, and sensors, and with testing and washing fruit
34	Research into the timeliness of agriculture grants in fast-changing climatic conditions so that adaptations can be quicker and more effective
35	Comparative research to see if wine industry participants by specific area of practice and size of vineyard/winery operation and size of research group would yield different results.

## Summary of Recommendations Table

### 4. Education Needs

1	Education on how to implement best practices for winegrape growers and wineries
2	Education on conferences featuring information on sustainable practices
3	Education and outreach by universities to advertise and make accessible any presentation of relevant research
4	Outreach by universities to certification bodies, and regional organizations as a means to reach the broader wine industry on their research and published papers
5	Educate certification and regional organizations on their importance as an information source on sustainable agriculture and how their information can be accessed by those outside their membership
6	Education on water efficiencies specific to the Paso Robles AVA, soil type, and typography for individual farmers
7	Education into best possible irrigation choices for farmers based on AVA, soil type, and typography of individual vineyards
8	Educating winegrape growers, wineries, and proprietors on the value of regenerative agriculture as an extension of their sustainable agriculture practices
9	Education on carbon sequestration and its importance in the vineyard to the wine industry
10	Education on how carbon sequestration rates can vary in the different soil types within the Paso Robles AVA and the best and most cost-effective tools for measuring.
11	Education on cover crops which increase carbon sequestration abilities
12	Education of consumers, trade, and community on Paso Robles wine industry's value of the environment and being good stewards of the land
13	Education for wineries on the value of waste management as an important aspect of sustainability and educating their workforce on waste management best practices and creating sustainable policies
14	Education for wineries on available alternative packaging
15	Education on the effects of lightweight bottles, screw caps, pouches, and cans, on wine quality
16	Education on the effects of lightweight bottles, screw caps, pouches, and cans on consumer perception for premium wine
17	Education for the wine industry on the importance of community engagement and strategies to help with this engagement
18	Education on water regulations affecting the Paso Robles AVA
19	Education on ways to desalinate water in the vineyard
20	Education on ways to desalinate water in the winery
21	Education on dry farming options to CAB winegrape growers
22	Education on changing farming practices for CAB winegrapes specifically due to climate changes
23	Education on the best cover crops for the different soil types within the subregions of the Paso Robles AVA

## Summary of Recommendations Table

### 4. Education Needs (CONTINUED)

24	Education on the best cover crops for pest control
25	Education on the best cover crops for pollinators
26	Education on regenerative agriculture and biodiversity as extensions to sustainability
27	Education on the overall effects of the continual use of pesticides in the wine industry
28	Education on the use of pesticides affecting marketing and sales to under 50 market and global export markets
29	Education on effective alternatives to pesticides
30	Education on the cost/benefits of investing in educating and skills investment in employees, rather than attracting and retaining staff
31	Educating the wine industry on the importance of community engagement in creating and shaping perceptions
32	Educating the local community on the efforts of the Paso Robles wine industry on its sustainability efforts and concern for the environment
33	Educating trade on the importance of the sustainability efforts by Paso Robles CAB Collective members and the wider wine industry
34	Educating the consumer on what sustainability means in the wine industry
35	Educating the wine industry on new markets, particularly the under 50 market and their values of environmental stewardship and health when selecting products
36	Educating all sectors on the current sustainable agriculture practices in the wine industry including wine trade, wine consumers, winegrape growers, wineries, state, and local government
37	Shared access to shade cloth research, advancements, and efficiencies
38	Education on any innovation to deal with grapes which have suffered from smoke taint, precursors, and sensors, and with testing and washing fruit
39	Educating trade and consumers on smoke taint is not dangerous and not necessarily detectible in the wine
40	Educating the broader wine industry on the sustainability efforts of the Paso Robles wine region and CAB winegrape growers with opportunities to present at conferences, industry podcasts, and outreach opportunities

### 5. Infrastructure/Equipment/Innovation Needs

1	Innovation in irrigation techniques to maximize water efficiency
2	Innovation and technology for carbon sequestration measuring equipment
3	Innovation in cellar design aimed at reducing energy and water usage
4	Innovation into water-efficient technologies in the winery
5	Innovation into energy-efficient technologies in the winery

## Summary of Recommendations Table

### 5. Infrastructure/Equipment/Innovation Needs (CONTINUED)

6	Innovation for vine irrigation
7	Support for building reservoirs/water retention ponds and infrastructure support using this water for the vineyard and winery
8	Innovation to predict climate and weather changes that affect farming practices, and harvest dates due to unpredictable weather and constant climate changes
9	Innovation and technology for mechanization within the vineyard and winery to reduce the need for hard-to-come-by skilled labor
10	The ability to have battery storage for renewable energy for both vineyards and winery
11	Innovation into cost-effective shade cloth methods to protect the grapes from the intense heat
12	Innovation to deal with grapes which have suffered from smoke taint, precursors and sensors, and with testing and washing fruit

### 6. Financial Needs

1	Grants and financial support for individual and collective winegrape growers and wine production businesses to implement sustainable agriculture practices. Grants need to be simplified and easily accessible to all
2	Grants and financial support aimed at supporting certification bodies and regional organizations in their ability to help grow and support sustainable agricultural practices in the wine industry
3	Grants for demonstration and research projects for drought-tolerant rootstocks for CAB grown specifically in the Paso Robles AVA and for different soils types within sub AVAs
4	Grants and financial assistance for planning and implementation of irrigation techniques aimed at conserving water
5	Grants for demonstration and research projects for carbon sequestration practices for CAB grown specifically in the Paso Robles AVA and for different soils types within sub AVAs
6	Grants and financial assistance for wine growers to measure carbon sequestration
7	Grants for sustainable practices plans in the winery addressing waste and wastewater management, water and energy efficiencies
8	Grants and financial assistance for wineries to implement water-saving efficient technologies
9	Grants and financial assistance for wineries to implement water energy-efficient technologies
10	Grants specific to PR and marketing campaigns for sustainable agriculture crops and products
11	Grants and financial assistance for building reservoirs and water retention ponds
12	Grants and financial assistance for those winegrape growers wanting to convert to dry farming
13	Grants and financial assistance for changing CAB farming practices due to changing climate conditions
14	Grants and financial assistance for investigating the best cover crops for CAB grape growing in Paso Robles AVA, including trials and demonstration projects
15	Grants and financial assistance for wine grapegrowers who need to rouge vines to control pests rather than use pesticides

## Summary of Recommendations Table

### 6. Financial Needs (CONTINUED)

16	Financial assistance for farmers to become organic or biodynamic
17	Grants for regional organizations to make available training for skilled labor
18	Grants for scholarships and training for individual wineries and vineyards
19	Grants for market development, marketing, and PR programs aimed at educating the consumer about the sustainable efforts of the wine industry, and developing new markets for their wine, particularly in the US
20	Grants and financial assistance to help the Paso Robles wine industry to attend state, national, and international wine sustainability conferences and events, as both speakers and event attendees

### 7. Regulations

1	Regulations on the use of pesticides in the vineyards
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# 6. References

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