Climate change mitigation in the wine sector: sustainable practices in vineyard and winery

Deliverable D5.2

Guideline: Addressing climate change in winery companies

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Executive summary

This guideline provides a practical roadmap for how the wine sector can address climate change, integrating scientific evidence, European and national policy initiatives, and lessons from industry practice. It combines mitigation and adaptation measures with prioritisation tools and governance frameworks, offering wineries and cooperatives an operational reference for sustainable viticulture.

Climate change is already reshaping wine production. Rising temperatures, water scarcity and more frequent extreme events are altering yields, grape quality and the viability of traditional regions. At the same time, greenhouse gas emissions occur throughout the value chain, with major contributions from fertiliser use, energy consumption in wineries, glass packaging and international transport. The sector therefore faces a dual challenge: reducing emissions while ensuring resilience.

To respond, a catalogue of 69 mitigation and adaptation measures has been developed as an independent document. Each measure has been evaluated in terms of technical feasibility, economic viability and climate impact. The catalogue includes both low-cost, high-return options, such as lighter packaging or improved irrigation, and more transformative measures that require long-term investment. A prioritisation exercise shows that combining different actions can deliver significant environmental benefits with reasonable payback times.

Beyond technical solutions, progress depends on the role of institutions, knowledge platforms and collaborative projects. EU-funded initiatives such as LIFE and Horizon have demonstrated how digital technologies, genetic research and regional cooperation can enhance vineyard resilience and lower emissions. In parallel, a review of sustainability schemes and certifications reveals growing convergence on environmental principles, but also fragmentation in metrics and verification, which creates confusion and highlights the need for harmonisation.

The overall conclusion is that achieving sustainable viticulture requires more than technology adoption. Coordinated action is needed to align farm-level practices with enabling conditions, including access to finance, coherent policy incentives, credible certification systems and consumer engagement. Accelerating the uptake of cost-effective measures, harmonising standards and strengthening advisory and collaborative structures will be decisive in ensuring that the sector adapts effectively to climate change while contributing to the objectives of the European Green Deal.

List of abbreviations

CAP – Common Agricultural Policy
CEEV – European Committee of Wine Companies
CSDDD – Corporate Sustainability Due Diligence Directive
DOCa – Qualified Designation of Origin
DO / PDO – Protected Designation of Origin
ESG – Environmental, Social and Governance
FEV – Spanish Wine Federation
FIVS – International Federation of Wines and Spirits
HVE – Haute Valeur Environnementale (France)
IPW – Integrated Production of Wine (South Africa)
ISO – International Organization for Standardization
IWCA – International Wineries for Climate Action
KPI – Key Performance Indicator
LCA – Life Cycle Analysis
LkSG – Lieferkettensorgfaltspflichtengesetz (German Supply Chain Due Diligence Act)
MAPA – Spanish Ministry of Agriculture, Fisheries and Food
OEMV – Spanish Wine Market Observatory
OIV – International Organisation of Vine and Wine
OIVE – Spanish Wine Interprofessional Organisation
PTV – Spanish Wine Technology Platform
RVA – Regenerative Viticulture Alliance
SME – Small and Medium-sized Enterprise
SWNZ – Sustainable Winegrowing New Zealand
SWA – Sustainable Winegrowing Australia
SWfCP – Sustainable Wineries for Climate Protection (Spain)
SWGB – Sustainable Wines of Great Britain
SWR – Sustainable Wine Roundtable
USDA Organic (NOP) – United States Department of Agriculture, National Organic Program
WASP – Wines of Alentejo Sustainability Program (Portugal)

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1. INTRODUCTION

Climate change represents one of the most pressing challenges for the European wine sector, with impacts ranging from grape yield and quality to the economic viability and competitiveness of winegrowing regions. Rising average temperatures, shifting precipitation patterns, the increasing frequency of extreme weather events, and the spread of pests and diseases are altering the historical agro-climatic conditions of production areas. These changes threaten not only the viticultural heritage of Europe but also the socio-economic fabric closely linked to wine, a sector of high cultural, environmental and commercial significance.

Against this backdrop, there is an urgent need for practical tools to support wineries, vineyards and other stakeholders in the transition towards more resilient and low-carbon production models. This guideline has been developed within the framework of the LIFE CLIMAWIN project, which seeks to assist the wine sector in reducing greenhouse gas emissions and adapting to the impacts of climate change, in alignment with the European Green Deal and the Farm to Fork Strategy. The document aims to provide a robust and operational reference framework that integrates scientific and technical evidence, sectoral experience and examples of good practice, thereby facilitating informed decision-making and promoting the adoption of effective and verifiable measures.

The preparation of this guideline followed a combined methodology. First, an extensive review was undertaken of scientific, regulatory and technical literature addressing climate change and sustainability in the wine sector at both European and international levels. In parallel, practical experiences and case studies were compiled from wineries and vineyards across diverse regions, together with outputs from previous EU-funded projects. The project partners actively contributed to the identification and assessment of measures through technical workshops and consultation processes, enabling the prioritisation of the most relevant and adaptable strategies. This participatory approach ensures that the contents are not only technically sound but also applicable to the realities of the sector.

The guideline is organised into several interconnected chapters. Chapter 1 outlines the context and key impacts of climate change on the wine industry. Chapters 2 and 3 examine mitigation and adaptation measures implemented by wineries and vineyards, as well as the main barriers encountered. As an outcome of this work, a Catalogue of 69 mitigation and adaptation measures has been developed; due to its length and format, it is presented as an independent document. Each measure is accompanied by a detailed technical factsheet and an assessment by the project partners. Chapter 4 provides a prioritisation of

measures based on technical and strategic criteria. Chapter 5 explores the broader sustainability ecosystem of the wine sector, including a description of relevant organisations, an overview of EU projects addressing sustainability, and an in-depth analysis of 40 existing sustainability certification schemes, followed by a technical comparison. Finally, the document concludes with key findings and future perspectives, synthesising the main insights and outlining potential pathways for advancing towards a more resilient and sustainable wine industry.

2. CLIMATE CHANGE CONTEXT IN THE WINE SECTOR

2.1. The double face of the wine sector: Wholesome tradition and environmental footprint

Wine has long been associated with culture, heritage, rural tourism and even a healthy lifestyle. Yet behind this wholesome image lies a production system with significant environmental repercussions across the value chain.
In the vineyard, intensive use of fertilisers and pesticides risks contaminating soil and water, while mechanisation and irrigation increase both greenhouse gas emissions and water demand. Winemaking itself generates by-products and effluents that require careful management to prevent ecological damage. Downstream, packaging and distribution add further pressure, particularly through the high energy intensity of glass bottle production and the waste it generates.

Another dimension often overlooked is wine tourism. Sun and Drakeman (2022) estimate that it accounts for more than one-third of the total carbon footprint of the Australian wine sector, providing the first large-scale assessment of this contribution through an environmentally extended input–output model.
Thus, despite its positive connotations, the wine sector must address the challenge of reducing its ecological footprint and embedding sustainability across all stages of production and consumption.

2.2. Current Impacts of Climate Change on Viticulture

Over recent decades, many traditional wine regions have experienced significant climatic shifts, including temperature increases of between 2 °C and 5 °C in parts of Europe, greater rainfall variability and more frequent extreme events such as heatwaves, frosts, droughts and floods. These phenomena directly affect both yields and grape composition, typically leading to higher sugar levels, lower acidity and reduced aromatic complexity. Such changes compromise typicity and the overall quality profile of wines. The geography of wine production is consequently being redrawn. Southern Spain, Italy, Greece and Southern California are projected to become increasingly unsuitable before the end of the

century, with up to 90% of low-altitude coastal vineyards exposed to severe heat and water stress. Conversely, cooler regions such as Oregon, Washington, northern France and southern England are emerging as viable production areas (Sgubin et al., 2023).

Biotic pressures are intensifying in parallel. Warmer conditions facilitate the spread of pathogens such as Xylella fastidiosa and increase the number of generations of pests such as the grape berry moth (Lobesia botrana). In Spain, episodes of heavy rainfall have also raised the prevalence of fungal diseases, further threatening yields and wine quality.At the physiological level, vines are ripening more rapidly, shortening phenological stages and disturbing the balance between sugars, acids and phenolic compounds. Prolonged droughts and growing water scarcity compound these stresses, increasing yield losses and in some cases threatening vineyard survival, particularly in non-irrigated systems (Fraga, 2020).

These combined pressures extend beyond the vineyard itself, destabilising wine markets and creating significant risks for producers and consumers alike. In this context, climate change must be recognised as both an environmental and an economic challenge with far-reaching implications for the global wine sector.

2.3. Regulatory Framework and Market Requirements

In the current global trade environment, both consumer preferences and regulatory frameworks are reshaping business practices. Environmental transparency is increasingly valued: carbon footprint labelling and recyclable packaging are in strong demand. In Spain, surveys indicate that most consumers consider environmental impact when making purchasing decisions, with many rejecting products that lack clear sustainability information.

At the regulatory level, international supply chains are under growing legal and social pressure to embed sustainability clauses. The EU Corporate Sustainability Due Diligence Directive (CSDDD) and Germany's Supply Chain Act (LkSG) require large firms to guarantee compliance with environmental and human rights standards across their value chains, signalling a structural shift towards more responsible production and trade (World Economic Forum, 2024; BAFA, 2023).

The European Union is leading this transition through its 'Fit for 55' package, which sets the objective of reducing emissions by 55% by 2030 (Council of the EU, 2023). Within this framework, the UTCUTS Regulation establishes CO_2

absorption targets for vineyards, while the Sectoral Wine Intervention (ISV) reserves 5% of its budget for climate adaptation. Spain has reinforced these provisions through Royal Decree 250/2024, making public support conditional upon environmentally sustainable practices (MAPA, 2024).

Financial instruments are being mobilised to implement these commitments. The ISV allocates €202 million annually (2023–2027) to vineyard conversion projects aligned with sustainability objectives (MAPA, 2022). At the regional level, Aragón has earmarked €2.7 million for varietal adaptation and the reduction of agrochemical use (Government of Aragón, 2025), while Castilla-La Mancha has launched large-scale programmes to promote low-impact technologies.

2.4. Need for an Integrated Response

Addressing climate change in viticulture requires a systemic strategy that integrates mitigation and adaptation, supported by innovation and efficient resource management. This is particularly critical in Europe, which accounts for almost half of the world's vineyard surface.

Agronomic practices such as cover cropping, optimised irrigation and controlled water stress improve both resilience and grape quality. These approaches are actively supported under the CAP 2023–2027 eco-schemes, with €280 million allocated in Spain alone (MAPA, 2023).

Regulatory and certification frameworks are also evolving. Regulation (EU) 2018/848 on organic production strengthens traceability requirements, while ongoing initiatives at the OIV (2023) aim to harmonise sustainability standards and prevent market fragmentation.

Integrated adaptation approaches in viticulture can provide relevant economic and agronomic co-benefits. In Spanish mountain vineyards, pilot studies under the LIFE MIDMACC project show that combining innovative practices—such as the introduction of IoT sensors and the optimization of cover crops—improves climate resilience while supporting local economies. The economic evaluation in these pilot sites indicates that combined measures accelerate the return on investment and promote both resource efficiency and long-term sustainability. Furthermore, the share of organic vineyards in Spain increased from 13.8% in 2020 to around 18% in 2023, reflecting broader sectoral transitions supported by national and European policy instruments (MAPA, 2024b)

Recent innovations further illustrate this potential. The CMAViT deep-learning model for yield forecasting (Kamangir et al., 2024) and precision viticulture projects in Galicia (USC, 2024) show how science, digitalisation and regional collaboration can underpin a more resilient and diversified European wine sector.

2.5. Identified Gaps in the Wine Sector

The absence of a unified international standard for sustainability measurement and certification continues to undermine transparency and trust. Fragmented schemes with varying criteria hinder both communication with consumers and the adoption of best practices (Catchpole, 2020).

Structural inequalities reinforce this problem. Larger wineries are better placed to invest in innovation, precision technologies and certification, while most smallholdings—the sector's majority—lack capital, expertise and staff. Family wineries in particular struggle with prohibitive costs and regulatory complexity, reducing their adaptive capacity and risking exclusion from the ecological transition (Moisello, 2024).

Another gap lies in the scarcity of precise, localised climate data and viticulture-specific indicators. Limited monitoring restricts evidence-based decision-making, especially in southern and eastern Europe, where exposure to accelerated warming is greatest (Tscholl et al., 2024).

Regulatory and institutional constraints add to the challenge. The diversity of sustainability protocols across Europe perpetuates fragmentation, while rigid systems such as PDOs can restrict adaptation by limiting authorised varieties and yields (European Commission, 2024). Europe's highly fragmented vineyard structure—over two million holdings, many under one hectare—further exacerbates inequalities (Šajn, 2023).

In Spain, these structural issues are evident. Despite growth in organic production and cooperatives, the absence of a cohesive national sustainability strategy weakens competitiveness abroad. Smaller holdings remain disadvantaged compared with larger wineries dominating premium exports, while the lack of robust climate indicators and early warning systems leaves southern regions particularly vulnerable. Stronger collaboration with universities and research centres is therefore essential.

Recognising these gaps—regulatory, economic and technical—sets the stage for action. The following section outlines emission sources and presents a catalogue

of mitigation and adaptation strategies aimed at addressing urgent environmental pressures while safeguarding the resilience and competitiveness of the wine sector.

3. MITIGATION AND ADAPTATION MEASURES FOR WINERIES AND VINEYARDS

3.1. Emission Sources in the Wine Sector

The wine industry generates greenhouse gas (GHG) emissions throughout the entire value chain, from vineyard operations to distribution. Although viticulture is less emission-intensive than many other agricultural activities, it nonetheless presents considerable opportunities for reduction (Longbottom & Petrie, 2015).

In the vineyard, emissions arise predominantly from the use of fossil fuels in machinery and irrigation, and from the application of nitrogen fertilisers. Nitrous oxide linked to fertiliser use has a global warming potential far higher than that of carbon dioxide and may account for up to 40% of total emissions in certain systems, particularly under humid or irrigated conditions (Ponstein et al., 2019). Additional contributions stem from soil management practices and the burning or decomposition of organic residues such as prunings and pomace, while regional variations in water and energy practices further shape the overall footprint (Longbottom & Petrie, 2015; Ponstein et al., 2019).

Within wineries, the production and use of packaging represents the dominant factor, with glass bottles alone accounting for up to 57% of the emissions associated with a typical bottle of wine. Energy consumption for cooling, bottling and climate control constitutes a further 10–30% of winery-related emissions, depending on efficiency levels and the composition of the local energy mix (Ponstein et al., 2019; Matos & Pirra, 2022). Transport also represents a significant share of emissions. When international trade is considered, logistics can amount to as much as 30% of the life-cycle footprint, particularly in distant importing countries such as Finland, where long shipping routes markedly increase the carbon intensity per bottle (Ponstein et al., 2019).

3.2. Illustrative Mitigation and Adaptation Measures

Research has identified a wide variety of measures with strong potential to reduce emissions and enhance resilience in the wine sector. Previous studies have highlighted interventions in packaging, such as lighter glass bottles, reuse systems or alternative formats (Ponstein et al., 2019; Massaglia et al., 2023), as well as improvements in winery energy management through the integration of renewable sources (Matos & Pirra, 2022). In the vineyard, practices like drip

irrigation, cover cropping and other soil management techniques contribute both to efficiency and to biodiversity protection, while waste valorisation strategies, including composting and biochar production, offer further opportunities to close material cycles and reduce emissions (Provenzano et al., 2024).

These examples demonstrate the range of possible interventions and their potential to address multiple environmental pressures at once. A comprehensive catalogue of mitigation and adaptation measures, assessed in terms of technical feasibility, economic viability and overall impact, is presented in section 3.4.

3.3. Barriers to Adoption

Despite the availability of effective solutions, the adoption of mitigation and adaptation measures in the wine sector is often constrained by financial, regulatory, cultural and technical obstacles. From a financial perspective, clean technologies, renewable energy systems and reusable packaging require high upfront investment, which many small and medium-sized wineries cannot afford without subsidies or favourable financing mechanisms (de Castro et al., 2024; Brito et al., 2024). Regulatory inconsistencies further complicate implementation. Sustainability certification remains fragmented across jurisdictions, and the lack of fiscal tools such as carbon pricing or targeted incentives for circular economy practices discourages innovation (SWR, 2024).

Cultural and market-related barriers also play an important role. In traditional regions, heavy glass bottles continue to be perceived as symbols of premium quality, which reduces willingness to adopt lighter or alternative packaging formats and reinforces the prestige associated with established practices (Ponstein et al., 2019; Mura et al., 2023). Finally, technical and knowledge gaps affect the capacity of many wineries to take action. Training in regenerative viticulture and energy-efficient methods is often limited, infrastructure is outdated, and the size of vineyard areas makes monitoring and emissions control challenging. These problems are particularly acute in regions where data and expertise are scarce (O'brien et al., 2025). Taken together, these barriers confirm that decarbonisation of the wine sector cannot rely solely on technological innovation. Progress will depend on systemic change, underpinned by coherent regulation, adequate financial instruments and stronger collaboration between producers, policymakers and consumers.

3.4. Catalogue of Measures for Wineries and Vineyards

To support effective decision-making in the wine sector, this project has developed a structured catalogue of mitigation and adaptation measures intended to serve as a practical tool for decision-making in the wine sector. The catalogue covers both direct emissions, corresponding to Scopes 1 and 2, and indirect effects across the value chain (Scope 3). To ensure usability, the catalogue has been prepared as a standalone document of approximately 70 pages, where each measure is presented in the form of a technical factsheet. This format facilitates consultation and practical application by wineries, cooperatives and policymakers, making it more accessible than if it were integrated in full within the present guideline.

The measures are organised by intervention area, including soil management, water use, energy, packaging, mobility and waste valorisation. Each has been assessed in terms of technical feasibility, economic viability and mitigation potential, using a harmonised set of criteria. This classification ensures comparability and allows each winery or vineyard to identify those measures most relevant to its specific circumstances.

The preparation of the catalogue followed a rigorous methodology. First, an exhaustive review of scientific and technical literature was undertaken to identify measures already studied or implemented in the wine sector. In parallel, practical knowledge and insights were gathered through technical sessions with project partners, who contributed their expertise and field experience. This participatory process made it possible to validate the measures identified, adapt them to the realities of the sector, and include innovative approaches tested in different contexts.

The resulting catalogue combines established best practices with novel solutions, balancing technological innovation with nature-based approaches. It has been designed for adaptability, allowing gradual adoption across diverse production models and geographical conditions. Above all, it provides a coherent and evidence-based framework to guide the transition towards low-carbon and climate-resilient viticulture.

The full Catalogue of Measures can be consulted here
https://unizares-my.sharepoint.com/:b:/g/personal/aapolo_unizar_es/EQTdlPNb-GhGsPwszBZjWZEBMng19ppXQehynBPNtJCqvA?e=IOE8B2

4. PRIORITIZATION OF MITIGATION AND ADAPTATION MEASURES IN WINERIES AND VINEYARDS

Based on an initial brainstorming process and expert knowledge from project partners, a wide range of climate change mitigation and adaptation measures relevant to the wine sector was identified. This list was subsequently supported and complemented through an extensive literature review, resulting in the development of the measure catalogue presented in the previous section. Following this, a prioritisation exercise was carried out, grounded in in-depth interviews with the project's expert partners. These experts were asked to assess each measure in terms of its implementation cost and mitigation potential, based on their field experience and technical expertise within the specific context of the project.

4.1. Classification of Measures

Measures were grouped into ten categories: (A) soil health, (B) synthetic input reduction, (C) cover crops, (D) water management, (E) energy efficiency, (F) decarbonisation and energy transition, (G) mobility, (H) input reduction, (I) redesign, and (J) waste revalorisation. Each category reflects a key intervention area for sustainability in the wine sector.

4.2. Expert Pretest

The evaluation was carried out by specialists in agronomy, precision agriculture and renewable energy, who rated the suitability, costs and mitigation potential of each measure. Experts also indicated whether measures contributed to adaptation.

For the assessment of implementation cost and mitigation potential, a qualitative five-level scale was used: Very Low, Low, Moderate, High, and Very High. Additionally, experts were asked to identify the specific emission sources directly affected by each measure, and to indicate whether the measure was solely aimed at mitigation or also contributed to climate change adaptation. These emission sources, along with the corresponding classification of each measure, are detailed in the catalogue of mitigation and adaptation measures.

It is therefore essential not only to identify and technically prioritise measures for climate change mitigation and adaptation in the wine sector, but also to provide robust mechanisms for their implementation and verification. The subsequent

analysis presents the results of the expert assessment, offering a strategic framework for evidence-based action in vineyards and wineries.

4.3. Preliminary Results and Perspectives

Based on the expert assessment conducted by project partners within the LIFE CLIMAWIN initiative, a prioritisation exercise was carried out to evaluate the proposed climate mitigation measures using a bi-criteria evaluation matrix. This matrix considers two key dimensions: the greenhouse gas mitigation potential (vertical axis) and the estimated cost of implementation (horizontal axis). The resulting prioritisation matrix allows for the strategic positioning of each measure according to its relative effectiveness and economic feasibility, supporting evidence-based decision-making in the viticulture sector.

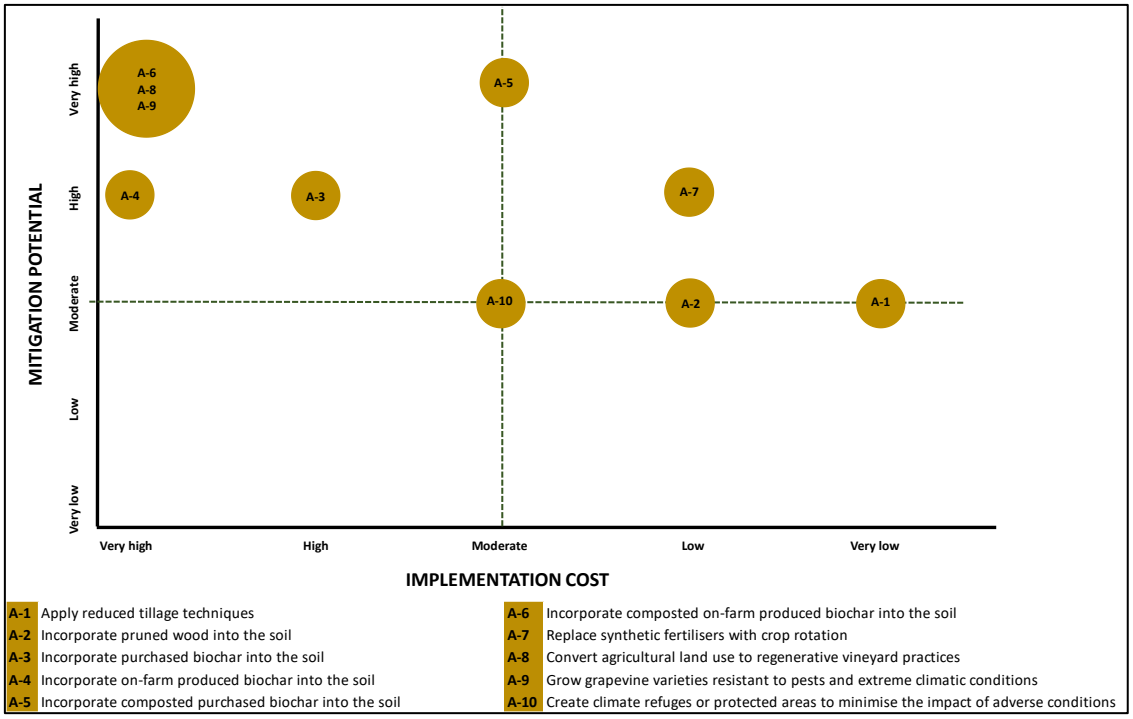

Figure 1. Sustainable strategies: Soil Health (A)

Figure 1 presents the prioritisation of soil-related measures. It shows that reduced tillage, incorporation of pruned wood and crop rotations provide low-cost, high-return options, while compost and biochar applications require more investment but enhance resilience. More transformative practices such as regenerative systems and resistant varieties have very high potential but demand long-term planning and significant resources.

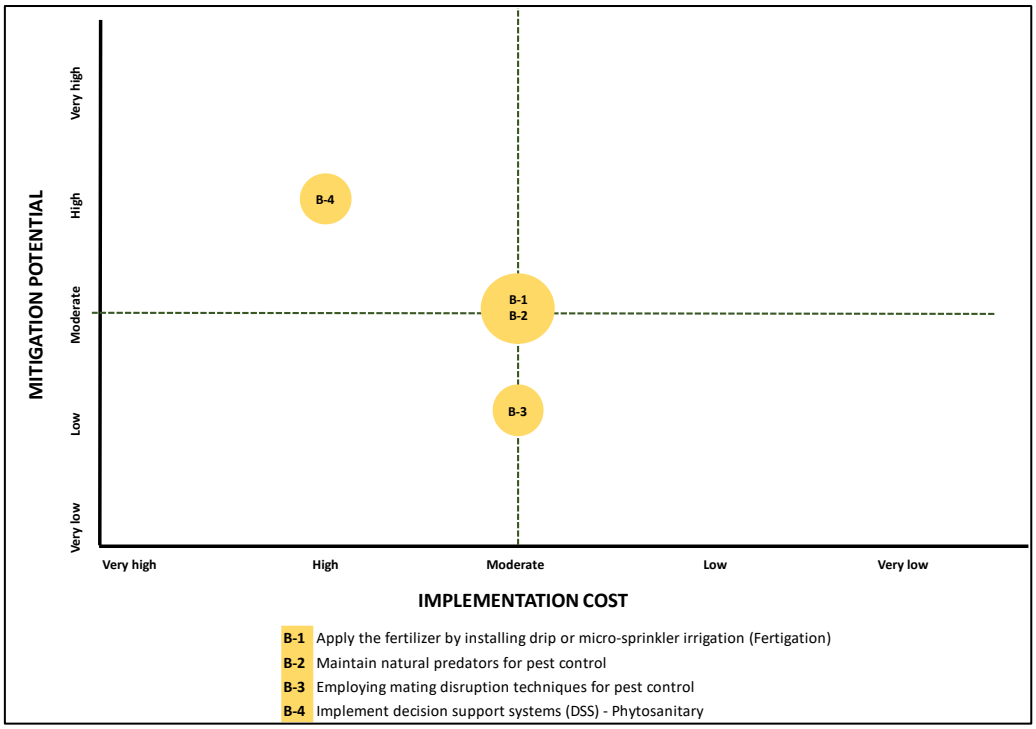

Figure 2. Sustainable strategies: Reduce synthetics inputs (B)

Figure 2 illustrates measures to reduce synthetic inputs. Options such as fertigation and conservation of natural enemies represent balanced pathways with moderate costs and benefits. Decision-support systems show higher potential but require technological capacity, whereas mating disruption is more specific, suitable mainly in areas with high pest pressure.

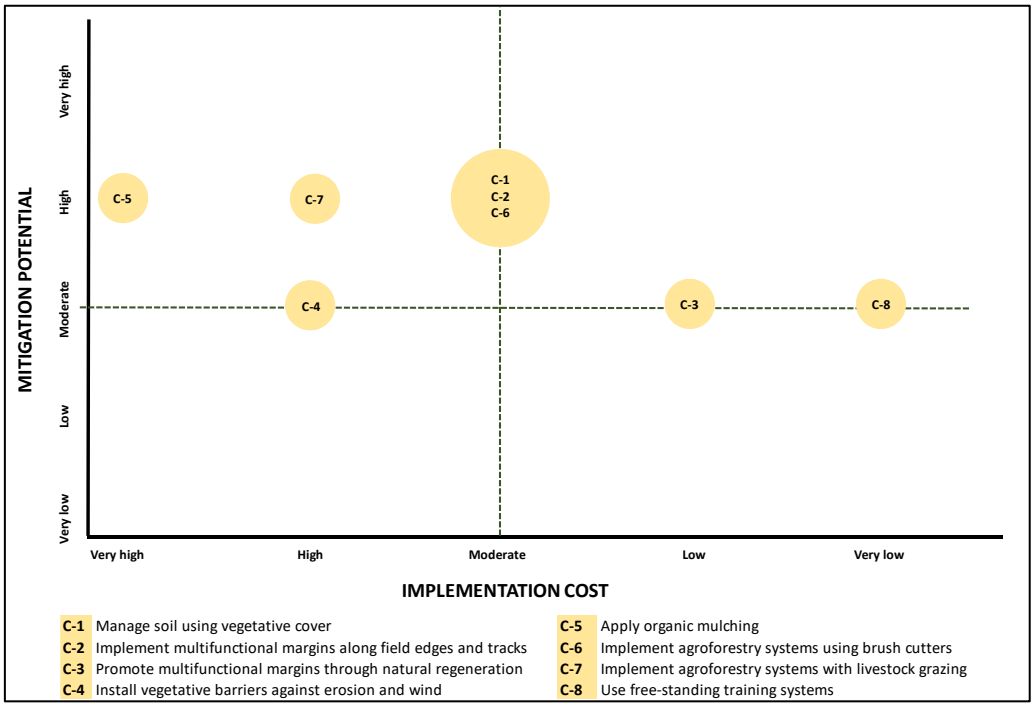

Figure 3. Sustainable strategies: Implementation of cover crops in the vineyard (C)

Figure 3 shows the role of cover crops. Managed cover, multifunctional margins and agroforestry deliver substantial benefits at moderate cost, while organic mulching and animal integration increase resilience but demand greater resources. Simpler approaches, such as natural regeneration or alternative vine training systems, are low-cost entry points that bring incremental gains.

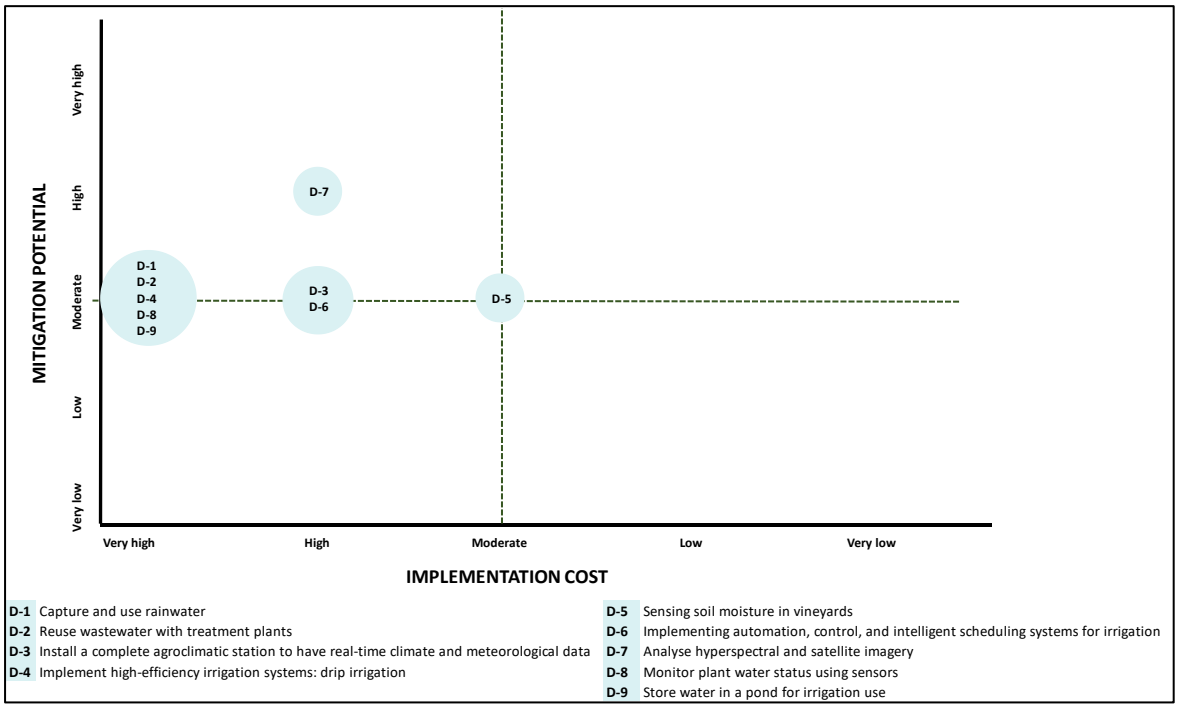

Figure 4. Sustainable strategies: Water management (D)

Figure 4 presents water management measures, which generally involve structural investment. Rainwater harvesting, wastewater reuse, drip irrigation and sensor-based monitoring provide strong benefits but require major resources. More accessible solutions include soil moisture sensing or automated irrigation, while advanced tools like hyperspectral imagery are most suited to technically advanced wineries.

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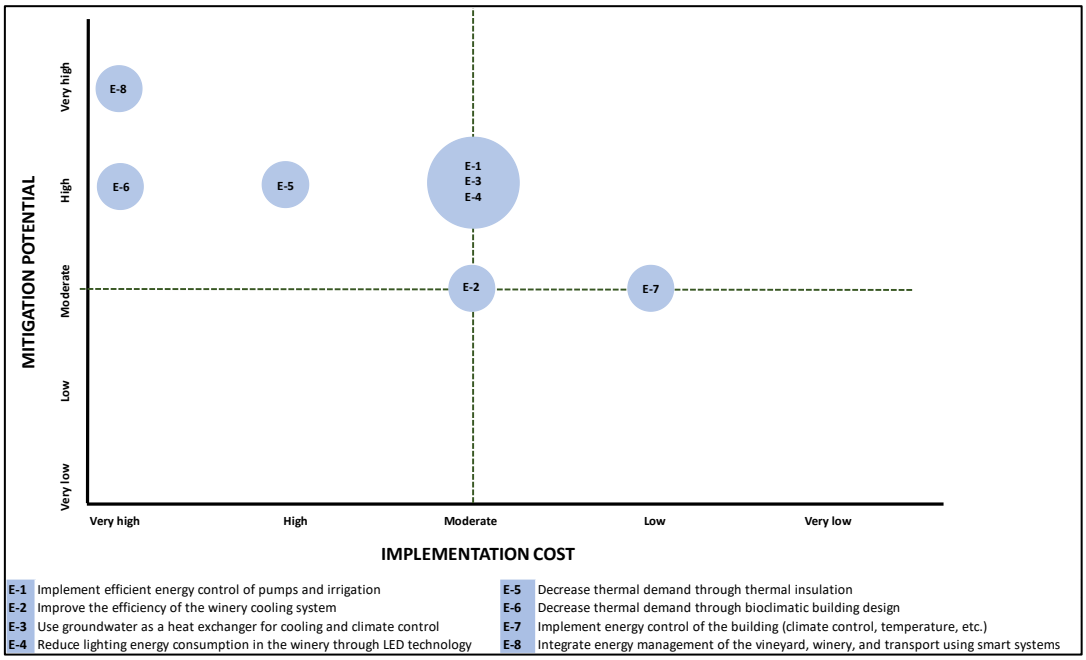

Figure 5. Sustainable strategies: Energy Efficiency(E)

Figure 5 illustrates energy efficiency strategies. High-cost infrastructural measures, such as insulation, bioclimatic construction and efficient pumps, achieve very high potential, while options like LED lighting, energy control systems and groundwater-based heat exchange offer good performance at moderate cost. Optimising cooling processes is a practical first step requiring limited resources.

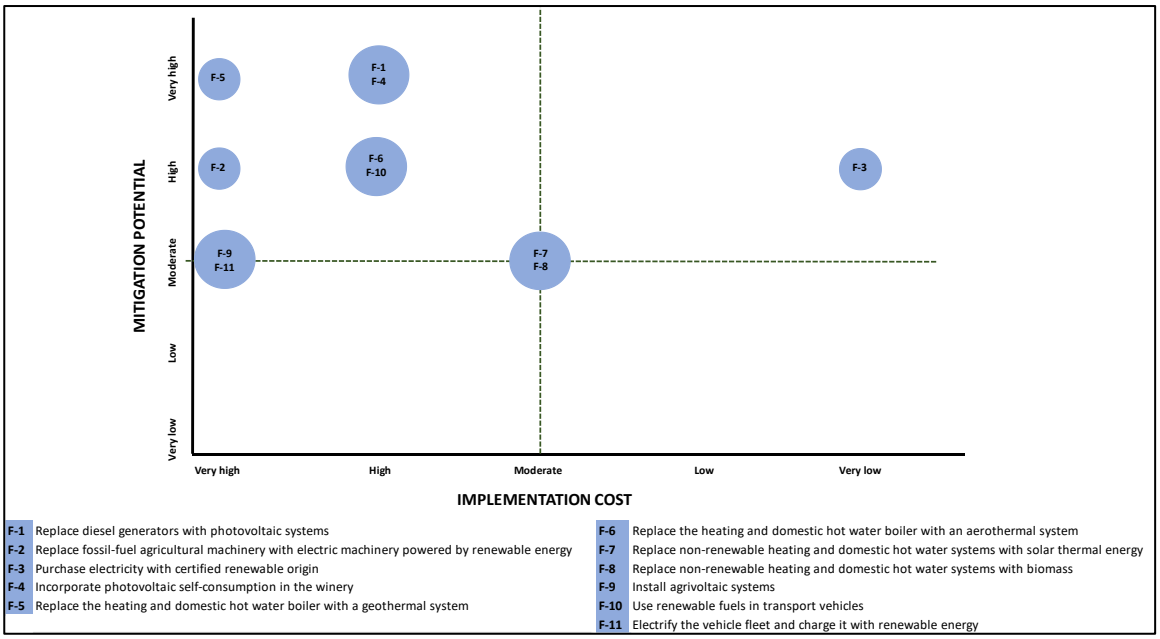

Figure 6. Sustainable strategies: decarbonization and energy transition (F)

Figure 6 shows the prioritisation of decarbonisation and energy transition measures. Contracting renewable electricity arises as a highly effective, low-cost strategy. Photovoltaics and aerothermal systems balance cost and benefit, whereas geothermal, renewable fuels and fleet electrification offer deep decarbonisation but require substantial investment and long-term commitment.

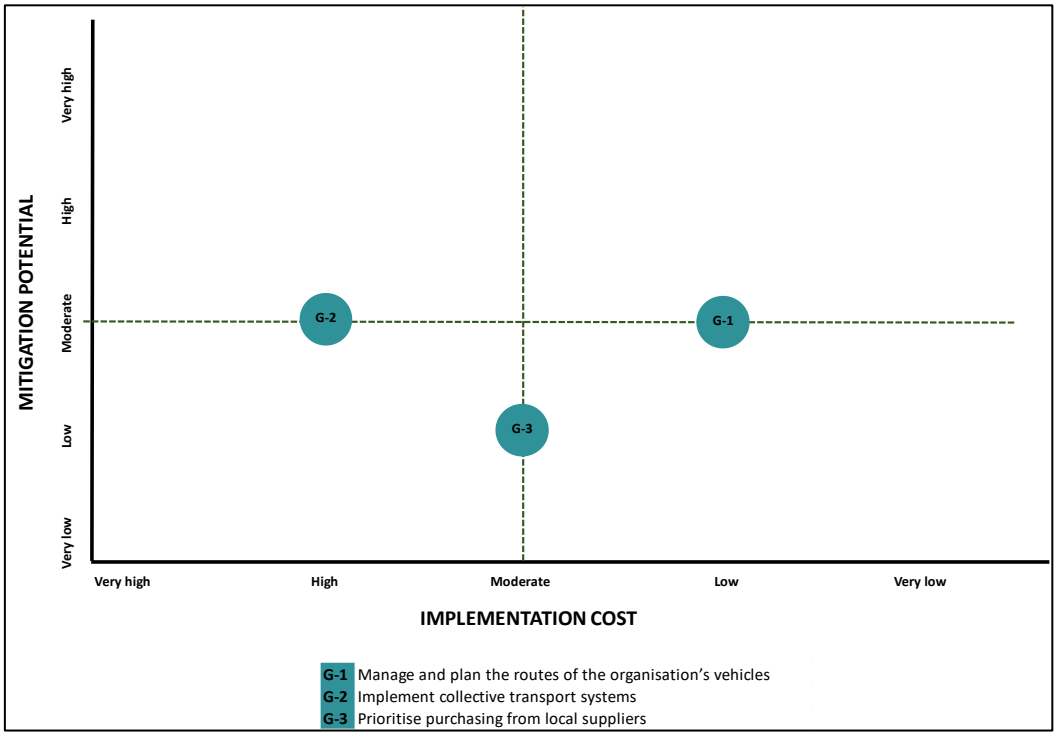

Figure 7. Sustainable strategies: Sustainable mobility (G)

Figure 7 presents strategies for sustainable mobility. Route management and logistics optimisation provide a straightforward, low-cost starting point. Collective transport systems have higher mitigation potential but depend on coordination and financial support, while sourcing from nearby suppliers adds value mainly through shorter supply chains and local economic benefits.

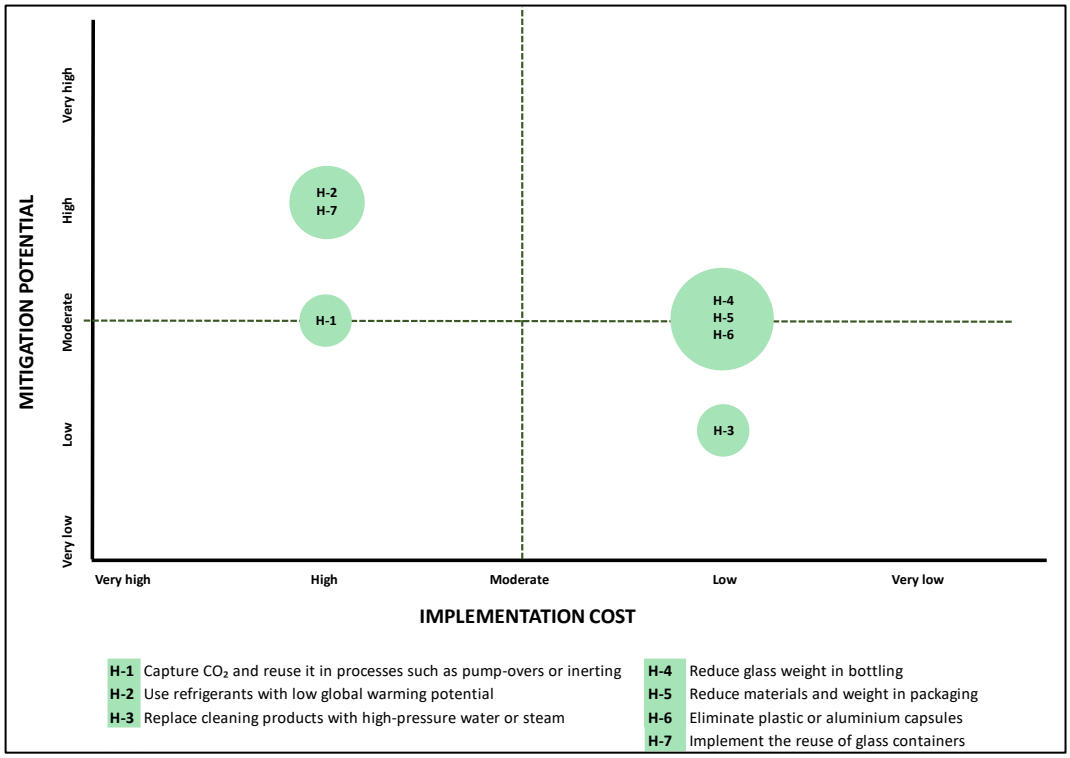

Figure 8. Sustainable strategies: Reducing inputs (H)

Figure 8 illustrates input reduction strategies. Lightweight bottles, reduced packaging and removal of capsules represent low-cost, broadly applicable improvements. Glass container reuse and low- Global Warming Potential refrigerants achieve greater impact but require structural adaptation and higher investment, making them more suitable for larger or more advanced wineries.

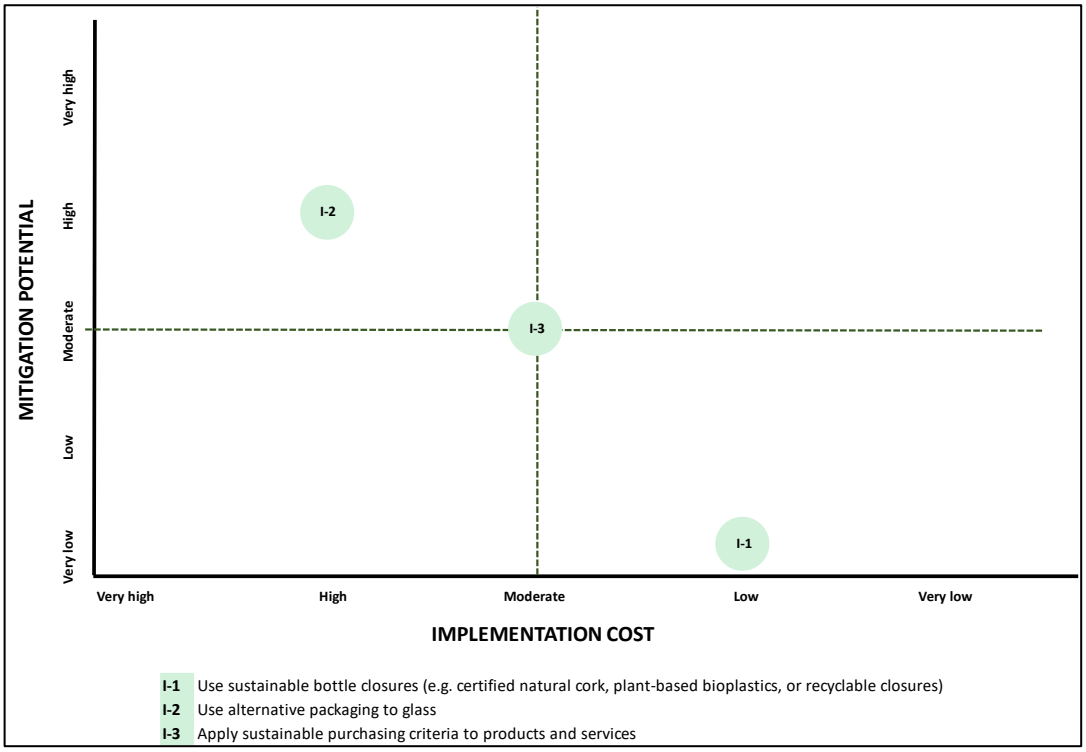

Figure 9. Sustainable strategies: Redesign (I)

Figure 9 shows redesign options for winery operations. Alternative packaging to glass offers significant mitigation but requires major investment. Sustainable purchasing and eco-friendly closures are more accessible, providing moderate or incremental benefits and allowing gradual adoption across different scales of wineries.

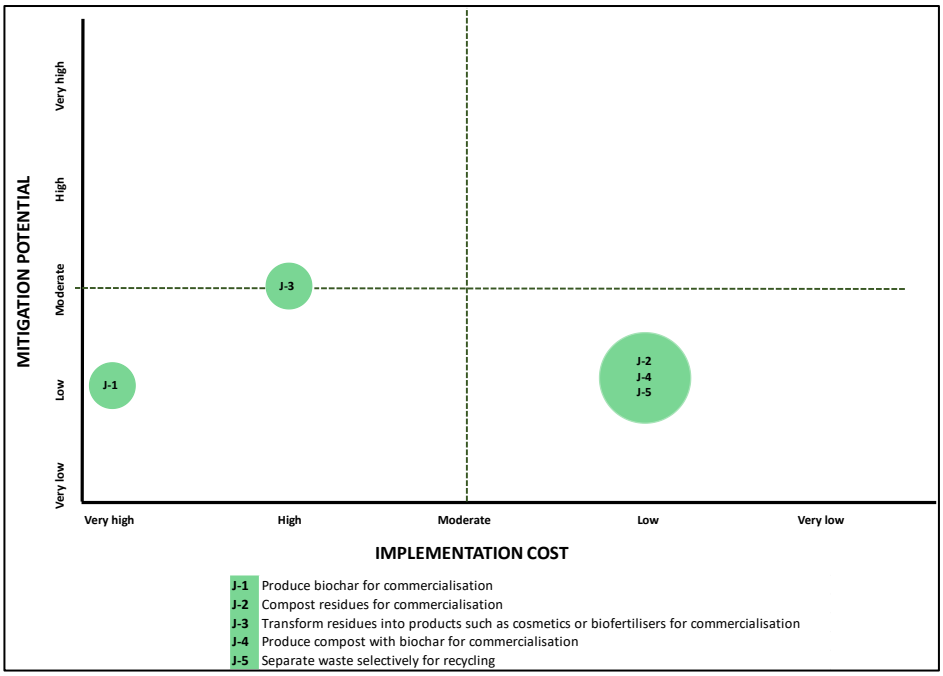

Figure 10. Sustainable strategies: Revalorisation of residues (J)

Figure 10 presents residue revalorisation strategies. Composting and selective recycling are low-cost and simple to implement, while producing bio-based products such as fertilisers or cosmetics offers moderate environmental and economic benefits but requires investment and compliance. Biochar production has limited standalone potential but can add value when integrated into broader waste and soil management systems.

The effective implementation of mitigation and adaptation measures requires not only a rigorous process of technical and economic prioritization, but also mechanisms to verify, communicate, and consolidate progress in sustainability to the market and society. In this context, sustainability schemes and certifications play a crucial role by enabling the objective evaluation of efforts undertaken, providing international recognition, and granting access to increasingly demanding consumer segments and markets. The following chapter analyzes the principal certification frameworks in force, comparing their approach, requirements, and relevance for both the European and global wine sector

5. SUSTAINABILITY SCHEMES AND CERTIFICATIONS IN THE WINE SECTOR

5.1. Introduction

Viticulture, one of the most emblematic agricultural sectors, is confronted with pressing environmental, social, and economic challenges. Conventional practices have been associated with intensive water use, soil degradation, and greenhouse gas (GHG) emissions, while concerns also persist regarding labour conditions and the economic vulnerability of small producers in global markets. This has intensified demand from regulators and consumers for more responsible and transparent production (Montalvo-Falcón et al., 2023).

In response, sector-specific sustainability certifications have been developed to address the triple dimension of sustainability—environmental, social, and economic—across the entire value chain (Baiano, 2021). These schemes encourage practices such as efficient use of water and energy, biodiversity conservation, soil protection, and improved labour standards (Maicas & Mateo, 2020). Furthermore, wine appellations of origin contribute to sustainable rural development, particularly through their role in wine tourism and regional identity (Juste Carrión & Aleixandre Mendizábal, 2022). Despite minimal differences in sensory quality, evidence shows that consumers are willing to pay more for wines produced under certified sustainable practices (Baiano, 2021).
Several internationally recognised schemes illustrate the sector's diverse approaches. USDA Organic sets strict limits on synthetic chemical use, Demeter certification applies biodynamic principles by viewing the vineyard as a self-sustaining ecosystem, and SIP Certified emphasises water stewardship and renewable energy (Moscovici & Reed, 2018).

Spain, with the world's largest vineyard area and as the third-largest global producer, reflects both the potential and the challenges of sustainable winegrowing. The sector is highly fragmented and remains vulnerable to climate change, while also facing difficulties in positioning Spanish wines internationally as sustainable products. In this context, the Sustainable Wineries for Climate Protection (SWfCP) certification was introduced in 2015 by the Spanish Wine Federation (FEV). It is noteworthy as the only Spanish scheme specifically designed for wineries, covering environmental, social, economic, and governance dimensions, and aligned with the UN Sustainable Development Goals (OIVE, 2025).

Sustainability certifications not only help address structural challenges in viticulture but also generate tangible benefits, including access to differentiated markets, strengthened competitiveness, and reduced environmental impacts.
This chapter is organised into six subsections. Subsection 2 explores the conceptual basis of sustainability in viticulture and recent regulatory trends within the EU. Subsection 3 examines the main organisations driving sustainability standards. Subsection 4 reviews key European projects applying mitigation and adaptation practices. Subsection 5 surveys leading schemes and certifications at both international and European levels, including designations of origin in relation to sustainability. Subsection 6 provides a comparative classification of schemes according to their dominant focus, summarised in a criteria table.

5.2. Sustainability in the wine sector

5.2.1. Sustainability and Its Dimensions in the Wine Sector

Sustainability has become a strategic priority for viticulture, essential to both the sector's resilience and competitiveness. It entails responsible practices across the entire production chain, aiming to balance environmental stewardship, social equity, and economic viability. Far from being a passing trend, sustainability is a necessity to safeguard natural resources, adapt to climate change, and respond to more conscious and demanding consumers (OIV, 2025).
A sustainable approach to winemaking embraces three main dimensions. Environmentally, it promotes efficient water and energy use, soil conservation, reduced greenhouse gas emissions, and biodiversity protection through organic and biodynamic practices (Fragoso & Figueira, 2021; Baiano, 2021). These measures not only protect ecosystems but can also enhance product quality. Socially, it supports fair labour conditions, the empowerment of rural communities, and the active involvement of stakeholders to build a culture of shared responsibility and innovation (Pucci et al., 2020). Economically, sustainable practices can optimise resource use, lower costs, and open premium markets, while driving innovation and supporting long-term value creation (Montalvo-Falcón et al., 2023; Ferrer et al., 2022; Broccardo et al., 2020).
A key driver of this model is certification, which validates commitments and facilitates market recognition. Nonetheless, barriers persist, particularly for small producers who face high upfront costs for sustainable technologies and certification. Stronger cooperation between governments, international organisations, and local stakeholders is needed to make sustainability broadly accessible and effective (Moscovici & Reed, 2018).
Integrating sustainable principles is thus not only an answer to regulatory and consumer pressures but a strategic pathway to ensuring the long-term viability of the wine industry in the face of accelerating environmental and social challenges.

5.2.2. Differences between schemes and certifications in the wine sector

In sustainability governance, a scheme is a structured framework of principles, standards, and guidelines designed to guide the implementation of sustainable practices. These schemes, usually developed by governments, technical bodies, or independent organisations, establish requirements for areas such as resource efficiency, emissions reduction, and product traceability. They provide the foundation for certification programmes and act as a reference for managing sustainability objectives (MAPA, 2021).

A certification, by contrast, is the formal process through which an independent body verifies compliance with a given scheme. It typically involves external audits, document reviews, and on-site assessments. Although generally voluntary, certifications provide proof of adherence to defined standards, enabling access to differentiated markets, strengthening consumer trust, and offering internationally recognised credentials (Merli et al., 2018).
In this sense, schemes outline the technical criteria and sustainability objectives, while certifications confirm their effective application. Both are indispensable for advancing responsible practices, ensuring credibility, and supporting the transition of productive sectors such as viticulture. Within the wine sector, this distinction is illustrated by instruments such as ISO 14001, which defines environmental management principles, and certifications such as Sustainable Wineries for Climate Protection (SWfCP) in Spain or Certified California Sustainable Winegrowing (CCSW) in the United States, which validate compliance against environmental, social, and economic benchmarks. These tools not only strengthen sustainability across the value chain but also help wineries differentiate themselves in highly competitive global markets.

5.2.3. European trends and regulations

The transformation of the European wine sector is being accelerated by both market forces and regulatory frameworks. On the demand side, consumers are increasingly seeking wines that align with environmental and ethical values, fuelling the expansion of organic and biodynamic markets and strengthening the role of sustainability-focused certifications as instruments of market differentiation (European Commission, 2024). In parallel, sustainability has become a competitive strategy for wineries, enabling access to premium segments and enhancing international positioning in an increasingly conscious marketplace.

At the regulatory level, the European Union has embedded sustainability objectives at the core of its agricultural policies. The Common Agricultural Policy (CAP 2023–2027) provides financial incentives for practices that minimise environmental impact, including rational use of inputs, biodiversity protection, and improvements in water and energy efficiency (MAPA, 2023). Complementary directives and programmes address carbon footprint reduction, waste management, and the promotion of circular economy approaches at winery level. Legal frameworks for organic and biodynamic production, alongside initiatives such as the EU Ecolabel and the forthcoming Corporate Sustainability Due Diligence Directive (CSDDD), reinforce transparency, traceability, and compliance with social and environmental standards across the wine value chain (Council of the EU, 2025; BAFA, 2023).
In addition to regulation, the EU has mobilised substantial support mechanisms—ranging from subsidies to innovation programmes such as LIFE or Horizon Europe—to foster the adoption of clean technologies, renewable energy, and sustainable vineyard management. Together, these measures build the structural conditions for a wine sector aligned with the European Green Deal and long-term climate neutrality objectives.

5.3. Main organizations and entities related to sustainability in the vitivinicultural sector

In order to address the increasing challenges related to sustainability, there are various organizations and entities—both national and international—that provide the necessary tools, standards, and support to foster sustainable practices in wine production. These institutions not only establish standards and certifications, but also promote research, drive technological innovation, and facilitate the implementation of sustainable policies throughout the entire production process, from the vineyard to commercialization.
The following section presents some of the key actors that play a crucial role in integrating sustainability into the vitivinicultural sector, highlighting their core functions and most relevant programs.

5.3.1 International organizations

5.3.1.1. International Organisation of Vine and Wine (OIV)

The International Organisation of Vine and Wine (OIV) has evolved since 1924 into the central intergovernmental authority shaping scientific, technical, and regulatory convergence within the global wine sector. Beyond its formal mandate of providing expertise and coordinating standards, it has become a decisive

forum where international policy and sustainability concerns are incorporated into vitivinicultural practices (OIV, 2024).

Its resolutions—ranging from biodiversity protection to organic viticulture and climate change mitigation—have progressively configured a comprehensive framework that integrates environmental efficiency with social responsibility. A benchmark in this respect is Resolution OIV-VITI 641-2020, which codifies guiding principles of sustainable vitiviniculture, explicitly linking ecological performance with respect for human rights in wine-producing communities (OIV, 2020).

5.3.1.2. International Federation of Wines and Spirits (FIVS)

Since its foundation in 1951, the International Federation of Wines and Spirits (FIVS) has established itself as the principal global industry platform where wine, spirits, and beer producers coordinate their positions on sustainability and regulatory issues. Operating within the framework of the "triple bottom line", it has created globally recognised instruments such as the Greenhouse Gas Accounting Protocol and the Global Sustainability Principles for Wine, both of which contribute directly to harmonising practices across producing nations and aligning them with international sustainability agendas (FIVS, 2024).

FIVS plays a pivotal role in lowering technical trade barriers while simultaneously safeguarding environmental and social objectives. Its active engagement with intergovernmental organisations—including the OIV, the World Trade Organization, and Codex Alimentarius—ensures that its standards and recommendations carry political legitimacy and scientific credibility. This ability to mediate between private sector imperatives and multilateral governance has reinforced its influence in shaping a level playing field for the international wine trade (FIVS, 2024).

5.3.1.3. Wine Institute

Founded in 1934, the Wine Institute has consolidated its position as the institutional anchor of the Californian wine sector, articulating both regulatory advocacy and international market expansion (Wine Institute, 2025). Its strategic importance lies in its dual agenda: safeguarding the economic competitiveness of wineries while embedding sustainability into policy, certification, and promotional frameworks.

In partnership with the California Association of Winegrape Growers, it has been instrumental in shaping the California Sustainable Winegrowing Alliance (CSWA), the body responsible for implementing the Certified California Sustainable Winegrowing (CCSW) scheme. This programme, regarded as one of the most advanced sustainability systems in viticulture, operationalises environmental efficiency, biodiversity preservation, and social equity into rigorous, third-party verified criteria (CSWA, 2023). Its replicable model has influenced similar initiatives beyond the United States, reinforcing the perception of California as a normative reference point in sustainable wine production.

5.3.1.4. Regenerative Viticulture Alliance (RVA)

Created in 2021, the Regenerative Viticulture Alliance (RVA) has rapidly positioned itself as the primary institutional reference for framing vineyards as catalysts of ecosystem restoration rather than mere agricultural systems (RVA, 2024). Its purpose extends beyond incremental sustainability: it seeks to reconfigure vineyard management so that viticulture actively regenerates soils, restores ecological balance, and contributes to carbon sequestration.

Through its certification scheme, developed jointly with scientific institutions and practitioners, the RVA operationalises regenerative principles into measurable performance indicators. Producers that adopt practices such as cover cropping, minimal tillage, or managed grazing are assessed according to tangible improvements in soil organic carbon and biodiversity restoration. This approach adds scientific precision and credibility to what is often perceived as a niche movement within sustainable agriculture (RVA, 2024).

5.3.1.5. International Wineries for Climate Action (IWCA)

Since its foundation in 2019 by Familia Torres and Jackson Family Wines, the International Wineries for Climate Action (IWCA) has established itself as the leading coalition driving science-based decarbonisation in the global wine sector (IWCA, 2025). Unlike broader sustainability platforms, IWCA translates climate targets into enforceable technical requirements, thereby setting a benchmark for credibility in agricultural climate governance.

Formally integrated into the United Nations' Race to Zero initiative, IWCA commits its members to a 50% emissions reduction by 2030 and carbon neutrality by 2050, covering Scope 1, 2, and 3 emissions. Membership eligibility requires independently verified baselines, a minimum adoption of renewable energy, and

a full transition plan incorporating sustainable vineyard management. This ensures not only ambitious goals but also operational accountability (IWCA, 2025).

5.3.1.6. Sustainable Wine Roundtable (SWR)

Established in 2021, the Sustainable Wine Roundtable (SWR) has emerged as the principal global forum where diverse stakeholders—ranging from producers and distributors to NGOs and retailers—coordinate efforts towards a unified sustainability agenda in wine (SWR, 2025). Its institutional value lies in bridging fragmented certification schemes and national standards, offering a common reference framework capable of aligning the sector with international climate and biodiversity goals.

In practice, the SWR combines policy harmonisation with pragmatic interventions that address major emission sources and efficiency gaps. The Bottle Weight Accord exemplifies this approach, setting a binding target for reduced glass bottle weight to lower the sector's carbon footprint, coupled with parallel measures to tackle transport impacts through instruments like the Bottle Miles Calculator. Initiatives on water efficiency and the integration of regenerative viticulture further consolidate its multidimensional strategy (SWR, 2025).

5.3.1.7. Fairtrade International

Since its establishment in 1997, Fairtrade International has become the leading institution embedding social justice and equitable value distribution within global agri-food supply chains, including the wine sector (Fairtrade International, 2025). Its governance system—spanning producer networks and national organisations—enables it to operationalise standards that go beyond compliance, enshrining minimum prices and community premiums as structural protections for vulnerable producers.

Fairtrade's impact within wine-producing countries such as Chile and Argentina demonstrates its dual function as both a certifier and an enabler of socio-economic transformation. By ring-fencing Fairtrade premiums for local investment in education, health, and sustainable agricultural practices, the organisation consolidates a model where empowerment and resilience are tied directly to certification and transparent trade practices (Fairtrade International, 2025).

5.3.2. National Organizations (Spain)

5.3.2.1. Spanish Wine Federation (FEV)

Since its inception in 1978, the Spanish Wine Federation (FEV) has evolved into the pre-eminent governance body for Spain's wine industry, marshalling collective action across more than 950 wineries through a robust network of regional associations (FEV, 2025). Its institutional strength resides in its capacity to represent the sector's interests both domestically and within European and international fora—where it influences policy, trade negotiations, and technical standards as an active participant in the Comité Européen des Entreprises Vins (CEEV) and OIV.

The FEV's agenda increasingly prioritises sustainability and international competitiveness. Through initiatives such as the Sustainable Wineries for Climate Protection (SWfCP) certification and robust participation in the Wine in Moderation programme, the federation functions not merely as a representative entity, but as the primary driver of sectoral adaptation to climate, regulatory, and market challenges. It delivers technical guidance on regulation, export logistics, and sustainability reporting, supported by intelligence from the Spanish Wine Market Observatory (OEMV) (FEV, 2025).

5.3.2.2. Spanish Wine Interprofessional Organisation (OIVE)

Established in 2014, the OIVE provides institutional cohesion for Spain's wine sector by uniting production, processing, and marketing stakeholders within a formalised governance structure (OIVE, 2025). Endorsed by the Ministry of Agriculture, the OIVE operates as a critical intermediary, building consensus and facilitating the adoption of binding decisions that underpin long-term sectoral stability and competitiveness.

Core to the OIVE's approach is its deployment of economic intelligence, sector coordination, R&D&I, and responsible consumption programmes. Through robust data analytics and market insight, it enhances transparency and equips operators to navigate shifting regulatory and market environments both domestically and globally. Its educational initiatives and marketing campaigns—such as "Take Things with Wine" and "Wine School"—address not only sectoral image but also consumer trust and engagement (OIVE, 2025).

5.3.2.3. Spanish Wine Market Observatory (OEMV)

The Spanish Wine Market Observatory (OEMV) was a private foundation established in 2008 with the support of the Spanish Wine Federation and the Ministry of Agriculture, Fisheries and Food. Its main mission was to analyze, collect, and disseminate strategic information about domestic and international wine markets, aiming to boost the competitiveness of Spain's wine sector (OEMV, 2025).

OEMV's core activities included economic intelligence applied to wine, such as conducting market studies, statistical analyses of exports and imports, tracking consumption trends, and evaluating distribution channels. It also organized seminars and training courses to share information with industry operators, facilitating their adaptation to market changes. Notable projects addressed topics like the effects of climate change on international markets and consumer behavior post-pandemic.

One of OEMV's key strengths was providing timely and detailed information about the wine trade, such as deep analyses of exports by region, identification of leading world importers, and evaluation of trends in key markets like the US, China, and Germany. These insights helped Spanish wineries identify business opportunities and optimize international strategies. The Observatory also compiled sector data on production, domestic consumption, and vineyard surface area, providing a comprehensive overview.

5.3.2.4. Wine Technology Platform (PTV)

Founded in 2013, the Wine Technology Platform (PTV) has become the leading institution orchestrating research, development, and innovation (R&D&I) in Spain's wine sector (PTV, 2025). Operating as a connector between wineries, research institutes, technology developers, and auxiliary industry firms, the PTV translates sectoral challenges—ranging from climate adaptation to digitalisation—into actionable collaborative projects.

The platform's Strategic Innovation Agenda defines priority research trajectories, encompassing sustainable viticulture, advanced production processes, and new technology integration. By leveraging cross-sectoral partnerships and facilitating access to both national and European funding sources, the PTV has channelled resources into over 100 multidisciplinary R&D&I projects. Its activities generate practical tools—from drone-enabled vineyard management to environmental impact metrics—that provide Spanish wineries with competitive and sustainable solutions (Tecnovino, 2017; Vinetur, 2023; PTV, 2024).

Table 1.Summary table of wine organisations and their main characteristic

Organisation	Scope / Nature	Year	Focus	Main Functions	Members / Beneficiaries
OIV Dijon-Francia	International / Public	1924	Environmental, social, economic, consumer safety	Standard harmonisation, technical advisory, research	51 member countries across Africa, the Americas, Asia, Europe, and Oceania
FIVS Paris, France	International / Private	1951	Environment, Social, Economic	Global standards, coordination	Companies and associations from: Australia, USA, France, Portugal, UK, EU (European Container Glass Federation)
Wine Institute California, USA	USA / California Private	1934	Sustainability, promotion, economic, environmental	Certification/CCSW, Representation	Wineries and companies Over 1,000 companies (California)
RVA	International / Private	2021	Environmental (soil regeneration and biodiversity)	Certification (in partnership with Ecocert)	Vineyards, wineries, scientists (including some Spanish wineries)
IWCA	International / Private	2019	Environmental (carbon emissions reduction)	Establishes schemes, metrics, and climate action	Wineries (45+ members across 11 countries) (including 10 Spanish wineries)
SWR	International / Private	2022	Triple focus (environmental, social, economic)	Establishes standards and best practices	Companies, distributors, retailers, NGOs (130+ members)
Fairtrade International Headquarters: Germany	International / Private	1997	Social and economic (fair trade)	Certification	Producers and companies in 25 countries
FEV	Spain / Private	1978	Environmental and social	Representation, sector interests	950 wineries and regional associations
	Spain / Private	2014	Responsible consumption, economic intelligence, R&D	Represent and coordinate stakeholders across the Spanish wine value chain	Members: grape growers, wineries, marketers in production/processing organizations.
OeMv por Vino de España	Spain / Foundation	2008	Market, Analysis, Intelligence	Market research, dissemination	All Spanish wine sector actors
PTV	National / Association	2010	Genetic improvement, production optimisation, innovation, climate change mitigation.	Promotes wine sector R&D and technology.	450 members: wineries, research centres, companies, cooperatives, institutes.

5.4. European projects focused on mitigation and sustainability measures

Within the framework of the LIFE CLIMAWIN project (2023–2026, ongoing), which aims to demonstrate that sustainability and climate change mitigation in wineries and vineyards can become the new industry standard, it is considered essential to analyse and draw lessons from other European initiatives that have addressed similar challenges in the wine sector. This comparative analysis strengthens the methodology and adds rigour to sustainability certification reports by enabling the identification of validated practices, the transfer of knowledge, and the assessment of the real impact of actions implemented in the field (LIFE CLIMAWIN, 2024).

5.4.1. LIFE Programme projects

The LIFE Programme is the European Union's principal financial mechanism for environment and climate action. Since 1992, it has supported over 6,000 initiatives, many of them aimed at climate change mitigation, biodiversity protection, and the circular economy (European Commission, 2025). In the wine sector, LIFE has enabled the development of experimental and replicable models that demonstrate how sustainability, resource efficiency, and innovation can coexist with competitiveness.

Projects funded under LIFE address critical aspects such as water and energy use, waste reduction, biodiversity enhancement, and climate-smart vineyard management. They frequently test digital tools for monitoring greenhouse gas emissions, promote regenerative and circular production practices, and integrate certification frameworks into their outputs. These initiatives have lowered environmental pressures in viticulture, enhanced resilience to climate risks, and generated transferable knowledge that supports the uptake of sustainability certifications (European Commission, 2025)

By combining collaborative governance, scientific rigour, and applicability at vineyard and winery level, LIFE projects function as experimental laboratories where innovative solutions are tested, validated, and mainstreamed across European wine regions. The capacity of certain projects to influence certification schemes and provide practical tools—such as carbon footprint calculators, water reuse systems, or biodiversity-based vineyard management—illustrates their strategic role in accelerating the transition of wineries towards certified sustainable practices.

5.4.2. Other European projects

Beyond the LIFE framework, several other European funding instruments have driven sustainability-oriented innovation in viticulture. Interreg Sudoe, POCTEFA, Horizon Europe, Erasmus+, and national ERDF schemes have financed research and demonstration actions that strengthen resilience, promote circular economy principles, and digitalise vineyard and winery processes (Interreg Sudoe, 2024; ICVV, 2023).

These projects expand the thematic scope by incorporating renewable energy integration, green infrastructure networks, and biotechnological advances. They have focused not only on tangible environmental results—such as optimised irrigation, carbon footprint reduction, or the substitution of synthetic pesticides—but also on capacity building through training, best-practice catalogues, and continuous professional development. In parallel, several initiatives have tested tools for assessing vineyard emissions, validated clean technologies for winemaking, or promoted the development of sustainability labelling schemes

Through these programmes, the European wine sector has gained access to new methodologies, decision-support systems, and digital innovations that complement LIFE-funded outcomes. Their contribution lies in bridging applied research with operational adoption, providing both technical results and governance frameworks that facilitate compliance with certification standards, while enhancing the sector's ability to adapt to climate, environmental, and market pressures

The projects reviewed illustrate diverse approaches to environmental, social, and technological innovation in the wine sector. While the narrative sections have emphasised their strategic orientation, drivers, and broader relevance to certification, Table 2 provides a structured overview of their operational characteristics. It allows a comparative reading of geographical scope, project status, timeframe, objectives, and concrete results.

This synthesis highlights the heterogeneity of European initiatives—from regenerative viticulture and biodiversity-oriented management to digital decision-support tools, eco-innovation in bottle reuse, and renewable energy integration—showing how multi-scale actions converge towards shared sustainability targets. By presenting their key outputs side by side, Table 2

functions as a complementary reference point that facilitates cross-comparison between completed and ongoing experiences, supporting knowledge transfer and replication within the wine industry (European Commission, 2024; EU CAP Network, 2024; Regenerative Viticulture Association, 2025).

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Table 2. European projects related to wine sustainability

Project	Countries	Status	Period	Main objective	Key results
LIFE ADVICLIM	France, Germany, Italy, Spain	Completed	2014-2019	Tools to assess climate impact in vineyards	Carbon footprint tools, online platform, professional network
LIFE ReWINE	Spain	Completed	2016-2020	Bottle reuse system to cut waste & CO_2	82k bottles reused, 34 t waste avoided, 171 t CO_2 saved
LIFE PRIORAT +MONTSANT	Spain	Completed	2016-2021	Sustainable, replicable wine model	−22–29% water use, natural pest control, model replicability
Life Vine Adapt	Austria, France, Germany, Hungary	Ongoing	2020-2024	Biodiversity & climate resilience in vineyards	Sustainable practices, emission reduction in 31 vineyards
rewind **LIFE REWIND**	Spain	Completed	2021-2024	Reuse wastewater for irrigation	Reduced potable water use, safe wastewater reuse
LIFE VitiCaSe	Italy	Ongoing	2023-2026	Regenerative viticulture & carbon credits	Soil carbon tool, climate-smart replicable model
SUSTAVINO	Various EU countries	Completed	2008-2012	Environmental strategy for wineries (waste & SMEs)	Waste tech, SME training, quality label
WatEnerWine WATENERWINE	España, Francia, Italia	Ongoing	2024-2027	Water & energy efficiency, renewables	Lower emissions/costs, renewables, advisory networks
vid expert	Spain	Completed	2021-2024	Digital tool for vineyard/winery carbon footprint	ML-based model, tailored mitigation measures
Interreg POCTEFA OENOPROT	Spain, France, Andorra	Ongoing	2022-2027	Biotech & AI winemaking innovations	Smart fermentation, protein tech, cross-border pilots.
Interreg Sudoe Co-funded by the European Union ECOSPHEREWINES	Spain, France, Portugal	Ongoing	2024-2026	Enhance ecosystem services & green infrastructure	Green networks, ecosystem mapping tools
Interreg POCTEFA VITISAD	Spain, France	Completed	2020-2022	Climate adaptation practices in vineyards	Genetic diversity, optimised irrigation, wine typicity
HarvRESt	Spain	Ongoing	2024-2027	Renewable energy & clean tech in vineyards	Electric tractors, robots, agrivoltaics
Green Vineyards	Spain, France, Italy, North Macedonia, Germanya	Ongoing	2022-2024	Training in sustainable practices & adaptation	Courses, best practices, self-assessment tools
Novaterra NOVATERRA	Spain, Portugal, France, Italy, Greece	Completed	2020 - 2024	Reduce/eliminate synthetic pesticides	Pesticide-free farming, soil biodiversity,
LifeisLight	Italy	Ongoing	2021-2025	Organic fertilisers from residues for viticulture	Improved soil health
Smart Managing Sustainable Wine smart	Spain	Completed	2022-2024	Smart tech to cut wine sector footprint	Data-driven tools, reduced carbon/water footprint

5.5. Main existing sustainability schemes and certifications in the wine sector

5.5.1 Key certifications in Europe

5.5.1.1. EU Organic Certification

The EU Organic Certification is administered by the European Commission, establishing a harmonised framework for organic production, labelling, and marketing across all Member States. Since its inception with Regulation (EEC) No. 2092/91 in 1991 and subsequent refinements through Regulation (EC) No. 834/2007—and most recently Regulation (EU) No. 2018/848 (in force since 1 January 2022)—the system has evolved to align with the European Green Deal and the Farm to Fork strategy, specifically aiming to convert at least 25% of EU agricultural land to organic by 2030 (European Commission, 2025b).

This certification encompasses the entire supply chain, covering primary agricultural products, processed foods, and certain non-food items. The standards prohibit synthetic pesticides, chemical fertilisers, and genetically modified organisms, while requiring high standards in animal welfare and sustainable soil management. Certification demands annual inspections by accredited bodies; for processed goods, a minimum of 95% of agricultural ingredients must be organic. Imported products must satisfy identical requirements.

The scheme incentivises sustainable practices, fosters biodiversity, and reduces carbon emissions. It delivers economic benefits through market premiums and supports rural development, with the EU organic logo guaranteeing transparency and consumer trust. Currently, over 8.5% of farmland in the EU is managed organically, propelled by supportive public policies and robust global demand. By harmonising standards, the certification facilitates international trade and enhances the competitiveness of Europe's agricultural sector. (European Commision,2025c)

5.5.1.2 Sustainable Wineries for Climate Protection (SWfCP)

The Sustainable Wineries for Climate Protection (SWfCP) certification, established in 2015 by the Spanish Wine Federation (FEV), is the only Spanish scheme exclusively focused on sustainability within the wine sector. Specifically tailored to wineries and vineyards, it addresses four central pillars: environmental, social, economic, and governance. The standard is aligned with the United Nations Sustainable Development Goals (UN SDGs), reaffirming its

holistic commitment to social progress, environmental mitigation, and economic resilience (FEV, 2025b).

Environmentally, SWfCP standards target reductions in greenhouse gas emissions, efficient and renewable energy usage, sustainable water management, and the preservation of soil and biodiversity. Socially, the certification advocates for fair labour conditions, protection of local culture, community development, and consumer health and safety. Economically, it emphasises resource optimisation and enhanced resilience to global market fluctuations. Governance requirements demand corporate transparency, ethical conduct, and effective stakeholder communication

Certification entails a thorough external audit, performed by entities such as Applus+, with verification against SWfCP's criteria. Achieved certification remains valid for two years and mandates ongoing improvement plans in each area assessed. Wineries may also register with the Spanish Ministry of Agriculture's National Carbon Footprint Register, reinforcing official recognition of their sustainability credentials (Applus, 2025).

5.5.1.3. Sustwine (ECO-PROWINE)

The ECO-PROWINE certification, launched in 2012 within the framework of a European Commission-funded project managed by CIRCE, provides a rigorous, transparent, and internationally recognised reference for sustainability in the wine sector. Its primary aim is to offer wineries a comprehensive Life Cycle Assessment (LCA) methodology specifically tailored to wine production, coupled with an online tool facilitating self-assessment and improvement across the entire value chain, from vineyard to bottle.

Following the successful pilot phase—validated in more than 90 European wineries—ECO-PROWINE was relaunched in Spain in 2020 by CIRCE to address evolving sector and consumer demands. Updates included enhanced requirements, carbon and water footprint accounting, and greater consumer transparency via QR-coded wine labels. The certification, endorsed by the European Commission, is accessible to wineries across Europe, but holds particular significance in Spain, where, by late 2024, 20 wineries held certification across 12 Designations of Origin and seven autonomous communities

ECO-PROWINE/SUSTWINE employs an integrated LCA-based approach, evaluating environmental impacts, production costs, and the social and economic performance of wine activities. Certification is granted only to wineries

demonstrating environmental impact below the European average and compliance with established social and economic criteria, after a thorough benchmarking process. Continuous improvement is mandatory: recertification every two years requires at least a 10% improvement in overall sustainability indicators (CIRCE Technologic Center, 2025).

5.5.1.4. Certificación ZERYA Residuo Cero

ZERYA Residuo Cero is a Spanish private standard established in 2009, promoting agricultural production— including vineyards—free from detectable pesticide residues, setting a threshold below 0.01 ppm as per EU Regulation (EC) 396/2005 (ZERYA, 2025). Although not exclusive to the wine sector, it has been adopted by pioneering producers such as Casa Américo Wines in Portugal and Viñedos del Contino in Spain, who have certified their vineyards with ZERYA, marking a significant step for sustainability in viticulture.

The certification attests that grapes are free from detectable pesticide residues at harvest, although the seal traditionally applies to grapes rather than to bottled wine. Achieving this certification requires stringent agronomic practices, independent audits, and multi-residue testing for each harvest, and is open to both conventional and organic farming. ZERYA certification is increasingly recognised as offering both environmental advantages—such as reduced chemical input, greater efficiency, and biodiversity support—and competitive benefits for producers facing more demanding markets.

Currently, only a limited number of wineries and vineyards in Spain and Portugal hold ZERYA certification, with Viñedos del Contino being the first Spanish winery recognised, and Casa Américo Wines pioneering the model in Portugal. Efforts are underway to extend this standard from grapes to finished wines.

5.5.1.5. VIVA Sustainability

VIVA Sustainability is a program of the Italian Ministry of Environment and Energy Security aimed at evaluating and certifying sustainability in wine production (Opera Research, 2020; Viticoltura Sostenibile, 2022). It uses four key indicators—AIR (GHG emissions), WATER (freshwater use and pollution), VINEYARD (agricultural practices and agrochemical use), and TERRITORY (socio-economic and biodiversity impacts)—to drive continuous improvement (Viticoltura Sostenibile, 2022).

Certification involves a voluntary agreement with the Ministry, an independent assessment of the indicators by trained staff or consultants, and third-party validation, renewed biennially. Main costs are linked to technical assessment and certification (Viticoltura Sostenibile, 2022). Adoption is mostly Italian, with examples such as Il Borro and Principe Corsini, and integration into regional projects like SOStain Sicilia. While there are no certified Spanish wineries, the methodology is a potential model for other countries. VIVA's strength lies in its holistic approach and consumer transparency through digital labels enabling verification of results

5.5.1.6. Equalitas

Equalitas is an Italian national certification scheme dedicated to sustainable wine production, applicable across the full value chain at company, product, and territorial levels (CSQA, 2025; Equalitas, 2025). It adopts a holistic ESG framework aligned with international sustainability standards, using measurable indicators such as biodiversity, carbon footprint, and water footprint to promote continuous improvement and transparency through independent audits and annual sustainability reporting.

The standard covers environmental, social, and economic dimensions: soil and fertility management, integrated pest management (excluding hazardous pesticides), efficient water and energy use, biodiversity preservation, sustainable packaging, labor conditions, corporate governance, and stakeholder engagement Certification follows a progressive three-year implementation timeline and is verified by accredited auditors (e.g., CSQA, Valoritalia) under the latest SOPD v5 standard (CSQA, 2025).

Equalitas is widely adopted in Italy and increasingly abroad. As of 2025, over 14,500 wine labels—representing 8.8 million hectoliters—are certified under the scheme. Regional and territorial projects, such as those of the Consorzio Vino Nobile di Montepulciano, illustrate its role in embedding sustainability within designations of origin. Certified wineries report benefits including improved environmental performance, enhanced internal monitoring, and stronger market recognition (Equalitas, 2025).

5.5.1.7. SQNPI (Sistema Qualità Nazionale Produzione Integrata)

The SQNPI (Sistema di Qualità Nazionale Produzione Integrata) is Italy's official national standard for integrated agricultural production, recognized by the EU and regulated by the Italian Ministry of Agriculture since 2011, with application

to viticulture since 2016 (CSQA, 2025; MIPAAF, 2023). Its aim is to ensure that agricultural products, including wine, are obtained using techniques that minimize chemical inputs, optimize fertilization, and respect ecological principles within a traceable and verifiable framework.

Participation is voluntary and open to producers, wineries, and distributors individually or through associations. Compliance requires adherence to national guidelines and regional production protocols (disciplinari) covering phytosanitary defense, soil management, biodiversity protection, and rational fertilizer use. Internal self-monitoring is complemented by annual third-party audits by accredited certification bodies, which include document reviews, soil and product analysis, and full traceability from vineyard to bottle (CSQA, 2025; MIPAAF, 2023). Certified products carry the official bee logo in a green circle, the SQNPI visual mark recognized at national and EU levels.

SQNPI certification is generally less costly than international sustainability schemes, as many requirements align with existing Italian and EU agricultural regulations. Costs vary depending on company size, individual or group participation, and documentation management, with cooperative approaches offering significant savings for small producers (CSQA, 2025).

5.5.1.8. SOStain

SOStain is a regional sustainability certification scheme developed specifically for the Sicilian wine sector. Formally established in 2010, it is managed by the Fondazione SOStain Sicilia in collaboration with the Consorzio di Tutela Vini DOC Sicilia and Assovini Sicilia (SOStain Sicilia Foundation, 2025). The program applies exclusively to wineries and vineyards in Sicily and certifies environmental, social, and economic sustainability across the entire production cycle. Wines that meet its standards can display the SOStain label, guaranteeing consumers that strict sustainability criteria are respected throughout production.

The certification requires sustainable vineyard management under recognized schemes such as SQNPI or organic production, the complete elimination of chemical herbicides, active protection of biodiversity, and the use of eco-friendly materials, as well as exclusive sourcing of Sicilian grapes. Wineries must also calculate annually their carbon and water footprints using the Italian Ministry of Environment's VIVA methodology, adopt renewable energy sources, implement measures to reduce glass bottle weight to lower transport-related emissions, ensure transparency of information towards consumers, and provide continuous training for operators (SOStain Sicilia Foundation, 2025).

The certification process begins with a formal application and technical training, followed by the analysis of sustainability indicators, external audits by accredited independent bodies, and final approval. Compliance is monitored annually and entails corrective actions aimed at continuous improvement. As of 2025, more than thirty Sicilian wineries are certified under SOStain, and the number continues to grow as regional commitment to sustainability strengthens (SOStain Sicilia Foundation, 2025).

5.5.1.9. Haute Valeur Environnementale (HVE)

The Haute Valeur Environnementale (HVE), or High Environmental Value, is a voluntary certification scheme established in 2012 by the French Ministry of Agriculture as part of the national agro-ecological project (Ministère de l'Agriculture et de la Souveraineté Alimentaire, 2025). It promotes sustainable farming practices that reduce environmental impacts, preserve biodiversity, and encourage responsible management of natural resources such as water and fertilizers. HVE takes a holistic approach, assessing the overall farm rather than individual plots, and is achieved through three progressive levels of environmental commitment.

At Level 1, farmers demonstrate compliance with basic environmental regulations and complete a self-assessment reviewed by an accredited body. Level 2 requires the implementation of best practices grouped into four areas: biodiversity conservation, rational use of plant protection products, efficient fertiliser management, and sustainable water use. Level 3 grants HVE certification and authorises the use of the official logo on products, provided that at least 95% of raw materials are sourced from certified farms. This highest level is based on measurable environmental performance indicators defined by the Ministry of Agriculture (Ministère de l'Agriculture, 2025).

HVE has gained significant traction among French winegrowers. According to official ministry data, by January 2022 there were over 24,800 HVE-certified farms, representing around 6.4% of all farms in France, with vineyards accounting for approximately 80% of certifications. This strong adoption underscores the relevance of HVE to the wine sector, and certified products benefit from recognition of the HVE label in national and export markets.

5.5.1.10. Terra Vitis

Terra Vitis is a French certification scheme formally recognised by the Ministry of Agriculture and Food Sovereignty as the only national standard dedicated

exclusively to sustainable viticulture (Ministère de l'Agriculture et de la Souveraineté Alimentaire, 2024). It applies across the entire production chain, from vineyard management through to winemaking, and is designed to promote a holistic balance between environmental protection, social responsibility and economic viability.

Its technical specifications establish strict requirements, including the rational use of plant protection products with an explicit prohibition of substances classified as carcinogenic, mutagenic or toxic to reproduction, efficient management of water and energy resources, and concrete measures to conserve biodiversity. Certified producers must also demonstrate compliance with social and labour standards, ensuring fair working conditions and a positive contribution to local communities (Terra Vitis, 2024).

Compliance is assessed through annual audits carried out by accredited independent bodies such as AFNOR and Certipaq. Wines that meet the standard are entitled to bear the Terra Vitis logo, which guarantees consumers full traceability and transparency regarding sustainable production practices (Terra Vitis, 2024).

5.5.1.11. Vignerons Engagés (Sustainable Winegrowing)

Vignerons Engagés, formerly known as Vignerons en Développement Durable (VDD), is a French certification scheme that combines sustainability with corporate social responsibility (CSR) in the wine sector. It is coordinated by the Vignerons Engagés association in collaboration with industry organisations, and its requirements are aligned with the ISO 26000 international standard, with audits conducted by AFNOR, the French national standardisation authority (Vignerons Engagés, 2024).

Unlike most certifications, which focus primarily on vineyard and winery practices, Vignerons Engagés places equal emphasis on the social dimension of sustainability. The scheme involves both winegrowers and employees across different French wine regions, underscoring its commitment to human capital, fair working conditions, continuous training and employee participation (Vignerons Engagés, 2024).

Its framework is structured around four core pillars—environmental stewardship, social responsibility, sound governance and economic resilience—and operationalised through twelve mandatory commitments. These include reducing chemical inputs, managing water and energy responsibly, eco-design

of packaging, transparent governance, respect for labour rights and active engagement with local communities.

5.5.1.12. Biodyvin

Biodyvin is a European certification dedicated exclusively to biodynamic viticulture and winemaking. It is managed by the Syndicat International des Vignerons en Culture Bio-Dynamique (SIVCBD), a non-profit organisation created and directed by winegrowers themselves (SIVCBD, 2012).

The certification requires producers to hold prior EU organic certification and to complete a minimum three-year conversion period before being recognised as biodynamic. Its requirements apply to the entire estate and to all wines produced, ensuring full consistency between vineyard practices and cellar management. Compliance is verified through annual independent audits, and certified producers are authorised to display the Biodyvin logo on their wines, providing assurance of both ecological integrity and traceability (SIVCBD, 2012).

Biodyvin distinguishes itself from other biodynamic schemes by demanding a whole-estate commitment, reinforced by continuous documentary and sensory checks. This comprehensive approach places emphasis not only on ecological performance but also on transparency and integrity across the full production cycle.

5.5.1.13. Fair and Green

Fair'n Green is a German sustainability certification established by the non-profit organisation Fair and Green e.V., with the objective of embedding environmental, social and economic responsibility within the wine sector. Its framework is based on a holistic model structured around three traditional sustainability pillars and a fourth dedicated specifically to the particularities of viticulture (Fair and Green e.V., 2024).

The certification requires wineries to meet an extensive set of criteria covering vineyard management, winemaking practices and organisational governance. A minimum threshold must be achieved at the outset, and certified members are obliged to demonstrate at least a three per cent annual improvement in their overall performance. Areas assessed include resource efficiency, soil and biodiversity management, carbon emission reduction, labour conditions and social contribution to local communities. Conformity is verified through periodic audits undertaken by accredited independent bodies such as GUTcert (Fair and Green e.V., 2024).

The scheme has been widely adopted in German-speaking regions and neighbouring European countries, and it has also begun to expand into Spain, where wineries such as Granbazán and Baigorri have implemented the system. Its success derives from its progressive approach, enabling producers to integrate sustainability step by step while maintaining competitiveness.

5.5.1.14. Respekt-BIODYN

The respekt-BIODYN certification, established in Austria in 2007, is among the most influential biodynamic winegrowing standards in Central Europe. The association currently comprises 36 members and 39 wineries across Austria, Germany, Italy, Hungary and Slovenia, covering approximately 1,160 hectares of certified vineyards (respekt-BIODYN, 2025).

The scheme is governed by its own regulatory framework, exceeding both EU organic legislation and other biodynamic certifications. It applies comprehensively to vineyard and winery: only wines produced entirely from respekt-BIODYN grapes and in accordance with its vinification rules may carry the label, ensuring consistency, authenticity and traceability.

Conversion requirements vary according to the starting point of the holding: three years for conventional vineyards, two years for organic holdings, and one year for wineries already certified biodynamic. Certification also requires annual audits, organoleptic wine assessments, and active participation in community activities, including training and mentoring (respekt-BIODYN, 2025).

5.5.1.15. FairChoice

The FairChoice certification was created in Germany by the Deutsches Institut für nachhaltige Entwicklung (DINE e. V.) at Heilbronn University, as a sustainability label specifically designed for the European wine sector. Its framework draws on internationally recognised references, including the United Nations Global Compact, the International Labour Organization and the Global Reporting Initiative (FairChoice, 2024).

FairChoice distinguishes itself through its comprehensive scope, which extends beyond ecological aspects to encompass social and economic dimensions of wine production. The certification applies both in the vineyard and in the winery, ensuring that environmental, labour and business practices are aligned with

sustainability principles. Products that fulfil the established requirements may carry the FairChoice seal on the label, thereby signalling compliance with a wide set of verifiable sustainability criteria (FairChoice, 2024).
The system integrates environmental protection, including the avoidance of synthetic agrochemicals, efficiency in energy and water use, and biodiversity conservation, together with social responsibility measures such as safe working conditions, fair wages and respect for international labour standards. It also emphasises responsible long-term business management, full traceability and transparency towards consumers.

5.5.1.16. EcoStep-Wein

EcoStep-Wein is a German certification developed specifically for the wine sector, with a focus on integrated sustainability management. It originated in Rhineland-Palatinate, one of Germany's leading wine regions, with the support of the Umweltallianz Hessen (Environmental Alliance of Hesse), the KATALYSE Institute and Geisenheim University. The scheme was first implemented in 2005 under the European LIFE project EcoStep-Wein, as an adaptation of the EcoStep system for small and medium-sized enterprises to the specific context of wineries and vineyards (EcoStep-Wein, 2019).

The certification is designed for small and medium-sized wineries, helping them to establish structured management systems that incorporate international standards such as ISO 9001, ISO 14001, ISO 22000 and ISO 45001. Unlike organic or biodynamic schemes, EcoStep-Wein does not prescribe specific agricultural practices. Instead, it focuses on continuous improvement in resource efficiency, environmental protection, occupational safety, waste management and regulatory compliance. Although the reduction of greenhouse gas emissions is not explicitly required, the environmental management principles inherited from ISO 14001 encourage actions aimed at lowering emissions

EcoStep-Wein is nationally restricted to Germany, with particular relevance in Rhineland-Palatinate and Hesse, where institutional and financial support has been provided for its implementation. Wineries adopting the certification must undergo an initial technical implementation phase lasting six to twelve months, supported by external consultancy. Certification is subject to internal annual audits and external verification every three years, with financial support schemes covering part of the implementation costs in some cases

5.5.1.17. Portugal's Sustainable Winegrowing Certification

The Portugal Sustainable Winegrowing Certification was formally launched in 2023 by ViniPortugal in collaboration with the Instituto da Vinha e do Vinho (IVV, I.P.). The system is managed by accredited certification bodies such as CERTIS, authorised under ISO 17021 by the Instituto Português de Acreditação (IPAC) (ViniPortugal, 2025). It applies to the entire Portuguese wine sector, covering grape growers, wineries, distillers, bottlers and vinegar producers, and is specifically designed as an integrated sustainability framework for viticulture.

The certification is structured around 86 indicators grouped into four domains: management and continuous improvement, environmental, social and economic. Within this framework, 28 "knock-out" indicators are compulsory for certification, ensuring that the baseline requirements for sustainable production are met (ViniPortugal, 2025). To be eligible, at least 50% of grapes must come from sustainable production, and the overall compliance level is graded A, B or C according to the score achieved.

Applicants complete an internal self-assessment, register with ViniPortugal and undergo an external audit carried out by an accredited body such as CERTIS or LRQA. Successful operators are authorised to display the certification seal on their products. The scheme follows an annual monitoring cycle and the certificate is valid for three years, renewable subject to re-audit.

5.5.1.18. Wines of Alentejo Sustainability Programme (WASP)

The Wines of Alentejo Sustainability Programme (WASP) was created in 2015 by the Comissão Vitivinícola Regional Alentejana (CVRA) as the first certification scheme for sustainable winegrowing in Portugal. Designed specifically for the Alentejo region, the programme seeks to improve the environmental, social and economic performance of viticultural and winemaking activities, with a focus on protecting natural resources, promoting biodiversity and strengthening rural communities. Since its inception, it has become a reference model for regional sustainability initiatives worldwide (Interreg Europe, 2021).

The certification is structured around 18 thematic chapters, covering both primary domains—such as water and waste management, vineyard practices and grape production—and secondary domains, including energy efficiency, packaging and circular economy measures. Members are required to complete an annual self-assessment against 171 criteria, achieving a minimum score of 86% in order to obtain certification. Compliance is verified through independent audits conducted by bodies accredited by the Portuguese Accreditation Institute

(IPAC). Certified operators must also demonstrate a commitment to continuous improvement to maintain their status (Interreg Europe, 2021).

A distinctive feature of WASP is its explicit alignment with the United Nations Sustainable Development Goals (SDGs) and its emphasis on circular economy principles, including the reuse and recycling of by-products and the adoption of climate adaptation measures, such as planting grape varieties tolerant to higher temperatures. The programme also collaborates with international organisations, including the World Wide Fund for Nature (WWF), to strengthen its impact and visibility

5.5.1.19. LEAF Marque

The LEAF Marque certification was established in 1991 by Linking Environment and Farming (LEAF) in the United Kingdom. Its objective is to promote sustainable agricultural practices worldwide by combining agricultural productivity with environmental protection (LEAF Marque, 2023). Originally developed in the UK, the certification has since expanded to other countries, including Australia and New Zealand, and is applicable to a wide range of crops, including vineyards.

The scheme is based on the Integrated Farm Management (IFM) framework, which advocates the responsible use of natural resources, soil conservation, biodiversity enhancement, waste reduction, and the efficient use of water and plant protection products. Certification requires the adoption of practices that minimise environmental impacts while maintaining agricultural viability, and compliance is verified through annual independent audits conducted by accredited bodies (LEAF Marque, 2023).

Although LEAF Marque is not exclusive to viticulture, its framework is increasingly applied to vineyards seeking to demonstrate high environmental standards. It offers producers an internationally recognised sustainability certification that integrates agricultural management, environmental stewardship and continuous improvement, thereby reinforcing transparency and consumer trust in certified products.

5.5.1.20. Sustainable Wines of Great Britain

The Sustainable Wines of Great Britain (SWGB) certification was launched in 2020 by WineGB as the national sustainability scheme for viticulture and winemaking in England and Wales. Its purpose is to foster environmentally and socially responsible practices across vineyards and wineries, with a particular

focus on soil conservation, biodiversity enhancement, efficient water and energy use, carbon footprint reduction and the minimisation of chemical inputs (WineGB, 2024).

Certification begins with an annual self-assessment aligned with the scheme's standards, followed by an independent audit every three years carried out by Ricardo PLC, an accredited verification body. Measurement of the carbon footprint is mandatory and must be undertaken using the official WineGB Carbon Calculator. Performance data are managed through the SWGB Data Hub, which enables the monitoring and benchmarking of sustainability indicators (WineGB, 2025).

Only wines produced from certified vineyards and vinified in certified wineries are eligible to carry the SWGB seal, ensuring traceability and credibility for both domestic consumers and export markets. The scheme also offers an advanced level, SWGB Gold, awarded to producers who demonstrate best practice and excellence in sustainability following an additional audit.

5.5.2. International certifications outside Europe

5.5.2.1. Regenerative Viticulture Alliance (RVA)

The Regenerative Viticulture Alliance (RVA) is an international certification scheme established to promote regenerative agricultural practices in vineyards, with the aim of restoring soil health, enhancing biodiversity, and supporting climate change mitigation (RVA, 2024). The initiative is coordinated by the Regenerative Viticulture Association in partnership with the Regenerative Viticulture Foundation, while third-party certification is conducted by Ecocert, an internationally accredited body specialising in organic and sustainability standards.

RVA distinguishes between two certification levels: RVA Certified, awarded to vineyards where regenerative practices are fully implemented—such as permanent cover crops, minimal or no tillage, application of organic amendments, holistic grazing, and biodiversity conservation—and RVA Transition, a status granted to vineyards that are working towards full compliance within a maximum period of six years (RVA, 2024). Certified wines must also originate from vineyards that have been farmed organically for at least three years.

5.5.2.2. Demeter Biodynamic Certification

The Demeter Biodynamic Certification is the most recognised global standard for biodynamic agriculture, a system introduced by Austrian philosopher Rudolf

Steiner in 1924. It views the farm as a living, self-sustaining organism, integrating ecological balance, soil regeneration, and biodiversity enhancement as core principles (Demeter International, 2024). Created in 1928 by Demeter International, the world's oldest ecological certifier, Demeter now operates in over 50 countries and applies particularly to wine production, where biodynamic wines are highly valued for quality and sustainability.

Demeter certification goes beyond traditional organic standards by requiring whole-farm certification rather than crop-specific compliance. It mandates integration of crops and livestock, humane treatment of animals, minimal reliance on external inputs, and the use of biodynamic preparations derived from plants and minerals to improve soil and ecosystem health. At least 10% of the total farm area must be dedicated to biodiversity conservation, and ethical standards must be upheld for workers and local communities. Demeter International, 2024

The certification process involves regular inspections against international Demeter standards. Applicants must first comply with their country's organic regulations (e.g. USDA Organic in the US or EU Organic in Europe) and subsequently adopt additional biodynamic practices. Among these are requirements that at least 50% of livestock feed be produced on-farm and that all farming practices maintain a regenerative focus. Audits are conducted by accredited Demeter inspectors (Demeter International, 2024)

5.5.2.3 SIP Certified (Sustainability in Practice)

Sustainability in Practice (SIP) Certified is a comprehensive sustainability programme developed for vineyards, wineries, and wines, designed to ensure the implementation of environmentally sound, socially responsible, and economically viable practices across the entire wine value chain. It was created by the non-profit Vineyard Team, which has been promoting sustainable agriculture since 1994. The programme evolved from the Positive Points System (PPS), an internal self-assessment tool launched in 1996, into a third-party verified certification after four years of technical development and review by more than 50 experts. The certification was officially introduced in 2008 with a pilot covering 3,700 acres in California's Monterey and Santa Barbara counties (SIP certified, 2025).

SIP Certified is based on rigorous science-driven standards and independent verification. Participants must comply with over fifty mandatory requirements addressing habitat conservation, water management, energy efficiency, air quality, soil stewardship, waste reduction, and ethical business practices.

Certification requires the implementation of at least 75% of eligible practices and annual audits combining documentation reviews with on-site inspections (SIP Certified, 2025). This structure ensures continuous improvement and transparency, which are core principles of the programme.

SIP Certified is widely regarded as one of the most robust sustainability standards in the wine sector due to its holistic approach, combining environmental protection with social responsibility and economic resilience. Its independent audit process and science-based metrics make it a reliable benchmark for sustainable viticulture and a valuable model for other regions seeking to integrate verified sustainability into wine production (SIP certified, 2025).

5.5.2.4. Salmon-Safe

Salmon-Safe is a multi-sector certification programme established in 1996 by Pacific Rivers and managed by Salmon-Safe Inc. to promote land management practices that protect watersheds and aquatic biodiversity, particularly wild salmon habitats. Although it was not originally designed for the wine industry, it has been applied to vineyards since 1997, beginning in Oregon's Willamette Valley. Early adopters included wineries such as Bethel Heights and Sokol Blosser, which integrated riparian restoration and runoff management into their vineyard operations (Salmon-Safe, 2025).

Today, Salmon-Safe certifies more than 350 vineyards across the Pacific Northwest (Oregon, Washington, northern California) and British Columbia (Salmon-Safe, 2025). The programme requires an external audit every three years, complemented by annual verifications. Certification standards focus on reducing harmful agrochemical use, maintaining vegetative buffers along streams, managing stormwater to prevent erosion and runoff, and ensuring ecological connectivity within watersheds (Salmon-Safe Vineyard Certification, 2025). These practices are designed to enhance aquatic ecosystem health while supporting vineyard productivity.

5.5.2.5. B Corp

The B Corp certification is an international standard created in 2006 by the non-profit organisation B Lab to recognise companies that integrate social and environmental responsibility into their core business models. The certification aims to promote a more equitable and sustainable economy by assessing companies across five key areas: governance, workers, community, environment, and customers

To obtain certification, companies must meet three core requirements: achieve at least 80 out of 200 points in the B Impact Assessment; legally incorporate stakeholder interests into their governance documents; and publish verified performance data for public accountability. Certification is subject to a re-evaluation every three years to ensure continuous compliance with these standards B Lab , 2025). As of 2025, more than 9,000 companies in 95 countries and 162 industries hold B Corp certification.

In the wine sector, adoption remains limited—around 1% of all certified companies—but it is growing as wineries seek to strengthen their sustainability credentials. Raventós Codorníu became B Corp certified in 2025 with a score of 88.5 points, following initiatives such as full organic vineyard conversion (completed in 2023), a 50% reduction in water use since 2015, and biodiversity enhancement programmes across its estates (Vinetur, 2025a). Alma Carraovejas also obtained certification in 2025, becoming the first Spanish wine and gastronomy group to meet B Lab standards; its projects include Pago de Carraovejas (Valladolid), Ossian Vides y Vinos (Segovia), and Viña Meín–Emilio Rojo (Ourense), with actions focusing on biodiversity conservation, GHG emissions reduction, and rural community engagement (Akatavino, 2025).

5. 5.2.6. USDA Organic

The USDA Organic certification is the official U.S. standard for organic production, established under the Organic Foods Production Act (1990) and regulated by the National Organic Program (NOP) of the U.S. Department of Agriculture. Fully implemented in 2002, it governs production, processing, and labelling to ensure the integrity and sustainability of organic products (USDA, 2024; SARE, 2025).

USDA Organic standards prohibit the use of synthetic pesticides, chemical fertilisers, genetically modified organisms (GMOs), sewage sludge, and ionising radiation. They promote practices such as crop rotation, organic soil amendments, biodiversity preservation, and integrated pest management. Agricultural land must undergo a minimum three-year transition without prohibited substances before certification eligibility (USDA, 2024)

While the scheme is primarily adopted in the U.S. and by exporters targeting that market, some Spanish wineries seeking access to American consumers have also obtained USDA Organic certification alongside EU Organic (Foods & Wines from Spain, 2022). Its strategic value lies in its strict verification system and strong consumer recognition in competitive markets like the U.S., although its costs and rigorous requirements can pose challenges for producers (SARE, 2025).

Overall, USDA Organic provides a robust and internationally recognised framework that ensures environmentally responsible viticulture and enhances market access where demand for verified organic products is high.

5.5.2.7. Fair Trade USA

Fair Trade USA is an international certification scheme created in 1998 in California with the goal of fostering more ethical and equitable trade relationships. Originally developed for commodities like coffee and cocoa, its scope later expanded to include wine production, offering wineries a recognised framework for demonstrating social and environmental responsibility (Fair Trade USA, 2025).

The certification requires compliance with rigorous labour and human rights standards. Certified vineyards and wineries must provide fair wages, safe working conditions, respect for freedom of association, and a strict prohibition on child and forced labour. A distinctive feature is the Fair Trade Premium, an additional sum paid per sale that goes directly to producer communities, managed democratically to fund social projects in healthcare, education, housing, or infrastructure (Fair Trade USA Standards, 2025;).

Fair Trade USA operates globally and is widely adopted in emerging wine regions across Latin America, Africa, and parts of Europe. Chile, Argentina, and South Africa host numerous Fair Trade-certified wineries, with verification carried out by accredited independent auditors such as SCS Global Services and FLOCERT to ensure continuous compliance (Fair Trade USA, 2025).

5.5.2.8. Certified California Sustainable Winegrowing (CCSW)

The Certified California Sustainable Winegrowing (CCSW) programme is a sustainability certification developed by the California Sustainable Winegrowing Alliance (CSWA), a non-profit organisation founded in 2003 to promote responsible practices in the state's wine industry. Officially launched in 2010, CCSW provides third-party verification ensuring that participating vineyards and wineries implement sustainable practices and commit to continuous improvement across environmental, social and economic dimensions (CSWA, 2025; Keramida, 2024).

Certification is based on the California Code of Sustainable Winegrowing Practices, which includes 227 assessment criteria covering soil health, water conservation, energy efficiency, biodiversity, waste management and community relations. To obtain CCSW status, producers must meet at least 58

mandatory prerequisites, undergo annual independent audits and demonstrate year-on-year progress through documented action plans (CSWA, 2025; OPC California, 2024).

Although designed for California, CCSW has influenced other sustainability initiatives internationally. In Europe, including Spain, there are no wineries certified under CCSW as regional schemes such as EU Organic, Demeter and SWfCP predominate. Nonetheless, the success of CCSW highlights its value as a reference model for integrating environmental stewardship with social and economic responsibility in viticulture (Keramida, 2024; CSWA, 2025).

5.5.2.9. CCOF (California Certified Organic Farmers)

The California Certified Organic Farmers (CCOF) programme, created in 1973 by Californian growers and accredited under the USDA National Organic Program (NOP), is one of the oldest and most influential organic certification schemes in North America. Initially focused on promoting agriculture free of synthetic chemicals, CCOF today certifies a wide range of products, including vineyards and wineries across the U.S. and Canada (CCOF, 2025; USDA, 2024).

Organic certification under CCOF requires a minimum three-year transition without synthetic pesticides or fertilisers, the submission of a detailed Organic System Plan (OSP), and annual on-site inspections covering vineyard and winery operations. Once certified, producers may use both the CCOF logo and the USDA Organic seal, reinforcing credibility among environmentally conscious consumers (CCOF, 2025).

In the wine sector, CCOF has played a pioneering role since the late 1980s. Family-run vineyards like Redwood Valley Vineyards in Mendocino were among the first to obtain certification in 1989. More recently, Corison Winery certified 19 acres of its Sunbasket and Kronos vineyards in 2023 after decades of organic management, while Gloria Ferrer became, in May 2025, the largest certified organic vineyard in Sonoma with 338 acres and the only fully organic sparkling wine producer in California (CCOF, 2025; Wine Business Monthly, 2025).

5.5.2.10. Napa green

Napa Green is an exclusive sustainability certification programme for Napa Valley, California, managed by the non-profit organisation of the same name. Originally launched as Napa Green Land in 2004 and extended to wineries in

2008, the scheme was further expanded in 2021 with Napa Green Vineyard, which places particular emphasis on climate action, regenerative farming, and social equity (Napa Green, 2025). Both certifications cover the entire wine production chain and align with the United Nations Sustainable Development Goals.

The programme integrates the three pillars of sustainability — environmental, social, and economic — through a rigorous framework comprising over 90 verifiable practices for vineyards (including soil organic matter enhancement, water and energy efficiency, greenhouse gas reduction and carbon sequestration) and more than 100 measures for wineries (covering waste reduction, water and energy management, governance, and fair employment) (Wine Industry Advisor, 2024). To obtain certification, applicants undergo an initial assessment and develop a tailored action plan with the Napa Green technical team, followed by implementation and verification audits conducted by accredited third parties, such as Fish Friendly Farming (vineyards) or SureHarvest and SCS Global (wineries). Certification is valid for three years and requires annual progress reviews.

Benefits for participating wineries include enhanced positioning in premium markets, operational resource optimisation, and strengthened engagement with local communities. Although Napa Green currently applies exclusively to Napa County and does not offer international certification, its methodological robustness has positioned it as a reference model for other regional schemes.

5.5.2.11. Lodi Rules

Lodi Rules for Sustainable Winegrowing is California's pioneering sustainability certification for viticulture. It is managed by the Lodi Winegrape Commission and certified by Protected Harvest. The initiative originated in the 1990s as an integrated pest management project developed by local growers and evolved into the first formally accredited sustainability programme in 2005

The certification is based on more than 150 science-based standards, grouped into six key areas: business management, human resources, ecosystem management, and soil, water and pest management. Each standard is measurable, scientifically validated, economically feasible and linked to one or more pillars of sustainability—environmental, social or economic. A central feature of the programme is the PEAS 2.0 model, a pesticide risk assessment system that produces quantitative indices reflecting potential toxicity to workers, aquatic species, birds and pollinators

To achieve certification, a vineyard must score at least 50% of the available points in each chapter and a minimum of 70% overall, while also meeting mandatory standards and not exceeding pesticide risk thresholds. External audits are carried out annually by accredited bodies. Wineries may use the certification seal on their labels if at least 85% of the grapes originate from certified vineyards, with strict traceability records required throughout (Lodi Growers, 2025).

5.5.2.12. LIVE (Low Input Viticulture & Enology)

The LIVE (Low Input Viticulture & Enology) certification was established in 1997 by a group of winegrowers in Oregon's Willamette Valley and formally incorporated as a non-profit organisation in 1999. Shortly thereafter, it obtained international accreditation from the International Organisation for Biological and Integrated Control (IOBC), providing global recognition of its technical rigour (LIVE, 2025). Designed specifically for the ecological conditions of the Pacific Northwest, the scheme has since been recognised as a model for sustainable viticulture beyond its region of origin.

LIVE promotes agricultural and oenological practices that minimise chemical inputs, conserve biodiversity, manage energy and water efficiently, and safeguard the welfare of workers and local communities. Certification requires compliance with a broad checklist of sustainability standards, covering soil management, integrated pest control, water use, biodiversity, plant nutrition and labour conditions. Vineyards must eliminate herbicides entirely and may only apply active substances approved by the Organic Materials Review Institute (OMRI), as listed on the LIVE Yellow List. In addition, producers are required to maintain detailed records of inputs, resource use and labour conditions, and to conduct greenhouse gas inventories (scopes 1, 2 and 3), supported by a third-party reviewed plan to achieve carbon neutrality by 2030 and net zero by 2050 (LIVE, 2024).

Certification extends to both vineyard and winery. For a wine to carry the LIVE seal, at least 97% of the grapes must be certified, and vinification must take place in a LIVE-certified winery. The audit process includes third-party inspections in the first and second year of membership, followed by triennial on-site inspections alternating with annual desk-based reviews. Inspectors are required to operate independently from the production region, ensuring impartiality in verification (LIVE, 2020).

5.5.2.13. Sustainable Winegrowing New Zealand (SWNZ)

Sustainable Winegrowing New Zealand (SWNZ) was established in 1995 by New Zealand Winegrowers as one of the world's first sector-wide sustainability programmes in viticulture. It is designed to ensure continuous improvement in environmental, social and economic performance across both vineyards and wineries. Today, more than 96% of New Zealand's productive vineyard area is certified under SWNZ, and over 90% of the country's wine production is made in certified facilities (New Zealand Winegrowers, 2025).

The programme is structured around six focus areas—soil, water, plant protection, waste, people and climate change—all of which are aligned with the United Nations Sustainable Development Goals (SDGs). Members are required to optimise water use, reduce greenhouse gas emissions, apply agrochemicals responsibly, implement waste management strategies and ensure fair labour practices (New Zealand Winegrowers, 2025).

Although certification is geographically restricted to New Zealand, SWNZ is widely regarded as a global benchmark for sustainable winegrowing. Its success lies in its combination of rigorous, data-driven standards with verifiable outcomes that integrate environmental stewardship, social responsibility and economic resilience (New Zealand Winegrowers, 2025).

5.5.2.14. Entwine Australia:(Sustainable Winegrowing Australia)

Sustainable Winegrowing Australia (SWA) is the national sustainability programme for the Australian wine sector, officially launched in 2019. It evolved from earlier initiatives, including Entwine Australia (2009) and regional schemes such as the McLaren Vale programme. SWA is administered by the Australian Wine Research Institute (AWRI) in partnership with Wine Australia and Australian Grape & Wine, and is aligned with the United Nations Sustainable Development Goals (AWRI, 2025; Wine Australia, 2025).

The programme adopts a holistic approach encompassing environmental, social and economic dimensions of sustainability. Members commit to continuous improvement across areas such as soil health, water efficiency, biodiversity protection, renewable energy, waste management and workforce wellbeing. It also encourages the integration of innovative practices to reduce environmental impacts while supporting long-term economic viability (AWRI, 2025).

Certification is based on compliance with the Australian Wine Industry Standards of Sustainable Practice (AWISSP), which set specific requirements for both viticulture and winemaking. The process includes mandatory training sessions, independent third-party audits every three years, and annual monitoring through the submission of key data on greenhouse gas emissions, water use, waste generation and other performance indicators. Certified members may use the official SWA logo on their labels, signalling verified sustainability to consumers and trade partners (AWRI, 2025).

5.5.2.15. ACOs Certified Organic

The Australian Certified Organic (ACO) programme, established in 1987, is the principal organic certification scheme in Australia and is internationally recognised under standards including USDA National Organic Program (NOP), EU Organic Regulation, Japanese Agricultural Standards (JAS) and IFOAM (ACO Certification Ltd, 2025). For viticulture and winemaking, certification requires compliance with the Australian Certified Organic Standards (ACOS), which prohibit synthetic agrochemicals and genetically modified organisms (GMOs), mandate ecological soil management and ensure full product traceability throughout the production chain.

Certification involves a three-year conversion period, during which operators must progressively align their practices with ACOS requirements. During this phase, products may be marketed under the "In-Conversion" logo, provided they undergo annual audits by accredited inspectors. Once fully certified, producers are authorised to use the ACO "bud logo" on labels, indicating compliance with both national and recognised international organic standards (Australian Organic, 2025).

The process includes mandatory annual audits and may also involve unannounced inspections under the ACO Organic Integrity Programme. Certification is available to both vineyards and wineries, and successful operators can also access equivalence arrangements for export certification under NOP, EU Organic, JAS and Korean organic standards.

5.5.2.16. Integrated Production of Wine

The Integrated Production of Wine (IPW) programme is South Africa's national sustainability scheme for viticulture and winemaking. Established in 1998 under the administration of the Wine and Spirit Board, it became operational with the

first certified harvest in 2000. Its purpose is to ensure that grape and wine production follows environmentally responsible and consumer-safe practices, in line with the global sustainability principles of the FIVS and the International Organisation of Vine and Wine (OIV) (WOSA, 2025).

The IPW framework adopts a holistic approach, encompassing vineyard management—such as integrated pest management, soil and water conservation, and biodiversity protection—as well as winery practices, including waste management, sulphur dioxide use and product traceability. Certification requires annual self-evaluations complemented by external audits conducted by the Wine and Spirit Board on a three-year cycle, with producers required to achieve a minimum compliance score of 65% (SWSA, 2025).

In 2010, a joint seal was introduced, combining Wine of Origin with IPW certification, guaranteeing that the entire production chain—vineyard, winery and bottling—meets programme requirements. By 2023, 91.6% of certified wines were eligible to display this seal, signalling verified sustainability to consumers (SWSA, 2025).

5.5.2.17. Wine and Agricultural Ethical Trade Association (WIETA)

The Wine and Agricultural Ethical Trade Association (WIETA) is a multi-stakeholder, non-profit organisation established in South Africa in 2002. Its main purpose is to promote ethical labour practices and decent working conditions in the wine industry, while progressively extending its scope to other agricultural sectors (WIETA, 2025).

WIETA operates on the basis of a Code of Ethical Conduct, supported by independent social audits, mandatory training, and a traceability system that ensures respect for labour rights across the supply chain, from vineyard to bottling Certification begins with registration on WIETA's digital platform, completion of a self-assessment, and participation in an ethics awareness workshop. Independent auditors—such as NSF, BSI or Partner Africa—then carry out inspections. Where non-conformities are identified, corrective action plans are required before approval. Once successful, producers are authorised through an annual contractual agreement to use the WIETA Fair Labour Practice seal (WIETA, 2025)

The seal is exclusive to wine products and requires full social traceability. This means that the winery, bottling facilities and grape suppliers must all be certified, with at least 60% of grape suppliers already accredited and the remainder actively progressing towards certification (WIETA, 2025). The seal may appear

on front, back or neck labels and signals verified adherence to fair labour standards.

5.5.2.18. The Chilean Wine Sustainability Code

The Chilean Wine Sustainability Code is a voluntary certification scheme developed by Vinos de Chile A.G. with institutional support from CORFO. Its purpose is to promote sustainable wine production under a triple-bottom-line approach encompassing environmental, social and economic dimensions (Sustainable Wine of Chile, 2025). The standard is structured into four thematic areas: vineyard (Green Area), winery (Red Area), corporate/social management (Orange Area) and, more recently, sustainable wine tourism (Purple Area). This structure allows a comprehensive evaluation of the overall sustainability performance of wine companies.

The certification process is rigorous. Wineries must comply with mandatory critical requirements alongside broader general parameters to ensure alignment with national regulations and continuous improvement. Compliance is verified through external audits every three years, supported by annual internal audits and detailed documentation covering each thematic area. Achieving certification often requires substantial investment in technical upgrades, staff training and adjustments to production and social management practices. For small and medium-sized wineries, these demands can represent a greater challenge, frequently necessitating technical assistance programmes.

Certified wineries are permitted to use the "Certified Sustainable Wine of Chile" seal, which enhances traceability, visibility and credibility in global markets. This seal has become a strategic tool for maintaining access to export destinations where sustainability requirements are increasingly stringent. At the same time, certification promotes ongoing improvements in environmental, social and economic management, stimulates innovation and strengthens relations with local communities and workers. Collectively, these elements contribute to Chile's positioning as an international leader in sustainable winegrowing.

5.5.2.19. Argentina´s Winery Sustainability Protocol (BdA).

The Sustainability Protocol of Bodegas de Argentina (BdA) is the principal sustainability framework for the Argentine wine sector. It was developed by Bodegas de Argentina A.C., the country's main wine industry chamber, in collaboration with academic and technical institutions, and is supported by the National Institute of Viticulture (INV) and Wines of Argentina (BdA, 2024). The

protocol positions Argentine wine as a responsible and competitive product in international markets while aligning with the United Nations Sustainable Development Goals.

The scheme adopts a triple-impact approach, addressing environmental, social and economic dimensions of sustainability across the entire value chain—from vineyard management and winery operations to community relations and governance. The environmental requirements include efficient use of water and energy, responsible waste management, rational application of agrochemicals and biodiversity conservation. Social criteria focus on decent working conditions, occupational health and safety, gender equality, anti-corruption policies and respect for human rights. The economic dimension emphasises financial viability, ethical business practices and traceability of production (BdA, 2024).

Certification involves compliance with more than 170 technical indicators distributed across these three dimensions. Wineries must complete a digital self-assessment followed by an external audit carried out by accredited bodies such as Organización Internacional Agropecuaria (OIA), which verify both documentation and field practices. The certificate is valid for one or two years depending on the compliance level achieved, and renewal requires evidence of continuous improvement (OIA, 2024).

5.5.2.20. ISO 14001

ISO 14001, developed by the International Organization for Standardization (ISO), is the leading international standard for environmental management systems (EMS). It provides a framework for organisations in all sectors, including the wine industry, to identify, monitor and reduce their environmental impacts while promoting continuous improvement (ISO, 2024).

The standard is based on the Plan-Do-Check-Act (PDCA) cycle and requires organisations to integrate environmental considerations into their strategic planning and operations. In the viticulture context, ISO 14001 has been applied to optimise water and energy consumption, manage waste and by-products such as pomace and sludge, reduce greenhouse gas emissions through the use of renewable energy, and conserve biodiversity in vineyard areas (ISO, 2024).

Adoption of ISO 14001 in the wine sector remains uneven. Larger wineries are generally better positioned to allocate resources for certification, whereas small and medium-sized producers often face barriers such as the costs of external audits and limited technical capacity. To address these challenges, some regions

have implemented collective certification models, where groups of wineries undergo joint audits, thereby reducing costs and facilitating knowledge exchange .

ISO 14001 therefore constitutes a strategic tool for the wine sector, enabling producers to combine environmental responsibility with economic efficiency while meeting growing consumer and regulatory expectations for sustainability.

5.5.3 Designations of Origin (DO)

5.5.3.1. Importance of Designations of Origin in Sustainability

Designations of Origin (DO) are certifications recognised and regulated by the European Union under Regulation (EU) No 1308/2013, ensuring that products such as wine originate from a defined geographical area and comply with specific quality standards. In the wine sector, DOs are fundamental to guaranteeing authenticity, protecting producers against imitations and safeguarding consumer confidence (European Commission, 2013).

From a market perspective, DOs act as key differentiation tools. Wines carrying a recognised geographical indication are perceived by consumers as signals of quality and excellence, influencing purchasing behaviour, especially in premium segments (Santeramo & Lamonaca, 2020). Scientific methods such as isotopic and elemental analyses have been increasingly applied to strengthen traceability and verify the geographic origin of wines, with significant developments in France and other EU producing countries (Wu et al., 2020).

Beyond their commercial role, DOs have important cultural and socioeconomic value. They contribute to maintaining local winemaking traditions, reinforcing the identity of production regions and enhancing the global reputation of European wines, ultimately supporting rural economies (FAO, 2018; Bronzi et al., 2020).

In recent years, an additional dimension has been consolidated: sustainability. While historically centred on origin and quality, DO frameworks are progressively integrating environmental, social and economic criteria. This includes promoting sustainable viticultural practices, conservation of landscapes and cultural heritage, and production models that respect ecosystems and local communities .

For this reason, Designations of Origin today should be understood not only as a certification of provenance and quality, but also as a regulatory and developmental tool that fosters sustainability, territorial resilience and the long-term competitiveness of the European wine sector.

5.5.3.2. Types of Designations of Origin

At the global level, systems for recognising geographical origin differ across countries and regions, although they share common objectives of authenticity, consumer protection and preservation of cultural heritage. Within the European Union, three main legal schemes are established under Regulation (EU) No 1151/2012: the Protected Designation of Origin (PDO), the Protected Geographical Indication (PGI) and the Traditional Speciality Guaranteed (TSG) (European Commission, 2012; Glogoveţan et al., 2022).

The PDO status refers to products whose entire production, processing and preparation take place within a specific geographical area. This strict framework guarantees a strong and verifiable link between the product and its territory of origin, ensuring that its qualities and characteristics are essentially attributable to the natural environment and local know-how. The PGI, by contrast, allows for greater flexibility, as it requires only that one of the production stages occurs within the designated area. This permits a broader scope for producers, while still safeguarding the association of the product with its geographical identity. In turn, the TSG emphasises the preservation of traditional production methods and recipes, protecting products with long-standing historical and cultural significance, even when they are not linked to a particular territory.

These European quality schemes not only function as instruments of market differentiation but also contribute to safeguarding Europe's gastronomic heritage, enhancing consumer confidence, and fostering rural development by recognising the cultural and economic value of traditional production systems

Although terminology and legal structures vary across continents, these schemes share a common philosophy: they protect producers and consumers against misuse, reinforce the cultural and territorial identity of agri-food products, and act as strategic tools for promoting sustainability and regional development in the global agricultural and wine sectors.

5.5.3.3. European and Spanish Designations of Origin

Europe is home to some of the most prestigious and influential wine appellation systems in the world, which have contributed decisively to positioning the continent as the global benchmark for quality viticulture. Each major producing country has developed its own regulatory framework, recognised under the umbrella of the European Union's protected quality schemes.

In France, the Appellation d'Origine Contrôlée (AOC) system, regulated by the Institut National de l'Origine et de la Qualité (INAO), defines strict geographical

and technical requirements for wine production. Renowned regions such as Champagne, Bordeaux and Burgundy exemplify how appellations guarantee both geographical provenance and the use of traditional methods, ensuring a high degree of consumer trust and international recognition.

In Italy, two key categories dominate the quality framework: Denominazione di Origine Controllata (DOC) and Denominazione di Origine Controllata e Garantita (DOCG). These labels, supported by the Italian Ministry of Agriculture and regional consortia, represent rigorous control mechanisms designed to safeguard heritage, production standards and excellence. Iconic regions such as Chianti and Barolo are internationally recognised for their outstanding quality and historical significance (Ministero dell'Agricoltura, 2023).

Spain has a particularly comprehensive system of wine quality classifications, regulated by the Ministerio de Agricultura, Pesca y Alimentación (MAPA). Spanish legislation distinguishes between several levels of protection under the umbrella of the Protected Designation of Origin (PDO): Denominaciones de Origen (DO), Denominaciones de Origen Calificadas (DOCa), Vinos de Calidad con Indicación Geográfica (VC), and Vinos de Pago (VP). Alongside these, the country also recognises numerous Protected Geographical Indications (PGI) in accordance with EU Regulation (EU) No 1151/2012. (European Union, 2012)

According to updated data from MAPA (2025), Spain currently holds 103 Protected Designations of Origin and 43 Protected Geographical Indications for wines, making it one of the European Union countries with the highest number of appellations. Among them, two regions have achieved the superior classification of DOCa: Rioja and Priorat, both recognised for their exceptional and consistent quality control standards. In addition, Spain counts with seven regions registered as Vinos de Calidad and twenty Vinos de Pago, which represent unique single-estate vineyards of distinctive character.

Notable Spanish DOs include Ribera del Duero, Rueda, Cava, La Mancha and Rioja. Particularly significant is the La Mancha DO, which constitutes the largest wine-growing region in Europe, covering more than 150,000 hectares and often referred to as "the winery of Europe". The diversity and breadth of these classifications highlight the central role of DO schemes in the Spanish wine sector, both as a guarantee of authenticity and as a key driver of economic and cultural identity.

Given this institutional and regulatory context, the following table (Table 3) presents an overview of Spanish Denominations of Origin, classified by Autonomous Community, distinguishing the different PDO categories (DO,

DOCa, VC, VP) and highlighting the regions with the most significant concentration of quality schemes.

Table 3. Wine Designations of Origin in Spain, by Autonomous Community

Autonomous Community (CCAA)	Denominations
Andalusia (8)	PDO: Condado de Huelva, Granada, Jerez-Xérès-Sherry, Málaga, Manzanilla–Sanlúcar de Barrameda, Montilla-Moriles, Sierras de Málaga. VC: Lebrija.
Aragon (5)	PDO: Calatayud, Campo de Borja, Cariñena, Somontano. VP: Aylés.
Asturias (1)	VC: Cangas.
Canary Islands (11)	PDO: Abona, El Hierro, Gran Canaria, La Gomera, La Palma, Lanzarote, Tacoronte-Acentejo, Valle de Güímar, Valle de La Orotava, Ycoden-Daute-Isora. VC: Islas Canarias.
Cantabria (2)	PGI: Costa de Cantabria, Liébana.
Castile and León (17)	PDO: Arlanza, Arribes, Bierzo, Cigales, León, Ribera del Duero, Rueda, Tierra del Vino de Zamora, Toro. VC: Cebreros, Sierra de Salamanca, Valles de Benavente, Valtiendas. VP: Abadía Retuerta, Dehesa Peñalba, Urueña.
Castile–La Mancha (19)	PDO: Almansa, Calatrava, Jumilla, La Mancha, Manchuela, Méntrida, Mondéjar, Ribera del Júcar, Uclés, Valdepeñas. VP: Campo de La Guardia, Casa del Blanco, Dehesa del Carrizal, Dominio de Valdepusa, Finca Élez, Guijoso, Pago Calzadilla, Pago Florentino, Urbezo.
Catalonia (13)	PDO: Alella, Catalunya, Conca de Barberà, Costers del Segre, Empordà-Costa Brava, Montsant, Penedès, Pla de Bages, Tarragona, Terra Alta. DOCa: Priorat. VP: Finca Llobet, Mas La Plana.
Extremadura (3)	PDO: Ribera del Guadiana. PGI: Extremadura (Vinos de la Tierra), Cañamero (Vinos de la Tierra).
Galicia (5)	PDO: Monterrei, Rías Baixas, Ribeira Sacra, Ribeiro, Valdeorras.
Balearic Islands (3)	PDO: Binissalem-Mallorca, Pla i Llevant. PGI: Vino de la Tierra de Mallorca.
La Rioja (1)	DOCa: Rioja.
Madrid (1)	PDO: Vinos de Madrid.
Murcia (3)	PDO: Bullas, Jumilla, Yecla.
Navarre (2)	PDO: Navarra. VP: Pago de Otazu.
Basque Country (3)	PDO: Arabako Txakolina (Chacolí de Álava), Bizkaiko Txakolina (Chacolí de Vizcaya), Getariako Txakolina (Chacolí de Guetaria).
Valencia (10)	PDO: Alicante, Utiel-Requena, Valencia. VP: El Terrerazo, Los Balagueses, Chozas Carrascal, Vera de Estenas, Vinos de la Serranía, Parajes del Valle

Source: Own elaboration based on MAPA (2025).

Thus, while Designations of Origin continue to be key for ensuring wine authenticity and territorial differentiation, their integration of sustainability criteria positions them as a strategic complement to specific environmental, social, or governance certifications. The following chapter compares how the different sustainability certification schemes in the wine sector are evolving and interrelating

6. COMPARATIVE ANALYSIS OF SUSTAINABILITY CERTIFICATIONS IN THE WINE SECTOR

The review of sustainability certifications included in Chapter 5 should be understood not simply as an inventory of seals and standards, but as the representation of a historical and structural process in the wine sector. Over recent decades, the evolution of these certification systems reflects the transition of vineyards from models focused solely on input management—fertilizers, agrochemicals, or water resources—towards comprehensive sustainability frameworks that encompass environmental, social, economic, and governance dimensions.

This comparative approach makes it possible to interpret certifications not as isolated instruments, but as pieces within a broader ecosystem, where agronomic-origin standards coexist with frameworks that respond to new global commitments regarding climate change, biodiversity, fair trade, and corporate responsibility.

To clarify this diversity, two summary representations have been included. Figure 11 groups together those certifications created specifically for the wine sector, whose purpose is to verify sustainability throughout the entire wine production cycle, from vineyard to bottle. In contrast, Figure 12 features transversal certifications—that is, those which, although applicable to wine, are designed with a broader scope and cover other crops and agri-food systems.
In this way, the comparison not only shows which certifications exist, but also places the sector within a continuum ranging from wine-centered to comprehensive agri-food approaches. The contrast between both frameworks allows for a better understanding of ongoing logics of specialization and convergence: while some schemes reinforce the uniqueness of wine as both a cultural and agricultural product, others situate it within the global transition framework towards sustainable and responsible food systems

Figure 11. Comprehensive List of Wine-Exclusive Certifications Worldwide

Figure 12. Most Relevant Non-Wine-Exclusive Certifications Commonly Held by Wineries Worldwide

6.1 Historical evolution

As summarised in Table 4, the development of certifications has followed a trajectory that begins with pioneering ecological labels and moves towards wide-ranging ESG frameworks. The first wave, led by Demeter in 1928 and subsequently by initiatives such as EU Organic (1991), CCOF (1973), USDA Organic (2002), ACO (2001), Biodyvin (1995) or Respekt-BIODYN (2007), emerged as niche standards focused on banning synthetic inputs, restoring soils and safeguarding biodiversity. These schemes were primarily agronomic in nature, demanded conversion periods of several years, and delivered market premiums together with consumer recognition, albeit at the cost of high implementation and opportunity costs.

A subsequent stage, especially from the 1990s and 2000s, saw the appearance of more flexible environmental standards such as LEAF Marque in the UK, SQNPI in Italy or Zerya Residuo Cero in Spain. These programmes retained input monitoring and traceability, while enabling producers to maintain controlled use of synthetics under rigorous protocols. The emphasis was no longer solely on prohibition but on measurable reductions in residues, increased efficiency and gradual alignment with sustainability objectives.

From the mid-2000s onwards, certifications began to expand into holistic frameworks that combine environmental, social and governance aspects. Examples include Equalitas (Italy), VIVA (Italy), Haute Valeur Environnementale (HVE) and Terra Vitis (France), Fair'n Green (Germany), SWfCP (Spain), WASP and the new Portugal Sustainable Winegrowing Certification, as well as overseas models such as Sustainable Winegrowing New Zealand, Sustainable Winegrowing Australia, SIP Certified, CCSW, Napa Green or Lodi Rules. These certifications reflect a systemic vision of sustainability, establishing periodic audits, continuous improvement cycles and accountability on social and governance indicators in addition to environmental performance.

Finally, in the 2020s, institutional frameworks backed by states or regional bodies have been launched, aiming to unify criteria at the national level while guaranteeing international recognition. Programs such as the Chilean Wine Sustainability Code or the Protocol of Bodegas de Argentina illustrate this move towards country-wide frameworks that connect environmental performance with social justice and territorial development. Parallel to this evolution, other cross-sectoral certifications such as Fair Trade USA, WIETA, FairChoice or B Corp have gained traction, signalling the growing weight of social and governance dimensions in shaping competitiveness.

6.2 Thematic focus and classification

The multiplicity of schemes can be better understood through five major families, described in Table 5. The first group encompasses organic and biodynamic certifications such as EU Organic, USDA Organic, Demeter, Biodyvin, Respekt-BIODYN, CCOF and ACO. These maintain consumer recognition as the most visible eco-labels thanks to their strict rules on synthetic inputs, soil fertility and biodiversity. A second group gathers integrated and residue-free models, including LEAF Marque, SQNPI and Zerya, which rest upon integrated farm management and strict traceability rules while allowing a controlled use of inputs.

The third family covers holistic ESG certifications, among which we find Equalitas, VIVA, Terra Vitis, HVE, Fair'n Green, SWfCP, WASP, SWNZ, SWGB, SWA, CCSW, SIP, Lodi Rules, Napa Green, Vignerons Engagés, SOStain and the more recent Portuguese and Chilean frameworks. These instruments integrate climate change mitigation, biodiversity conservation, labour standards and governance transparency, and are clearly expanding in Europe and beyond.
A fourth group is represented by management system certifications such as ISO 14001 or EcoStep-Wein. These function less as consumer-facing labels and more as internal governance tools, favoured by medium and large wineries with greater administrative capacity. Finally, a fifth family of social and ethical certifications—including WIETA, Fair Trade USA, B Corp, FairChoice and the BdA Protocol—places the emphasis on fair wages, equitable governance and community accountability.

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Table 4. Key Wine Certification Schemes by Period: Origin, Scope and Main Focus (1928–2023)

	Certifications (Year)	Origin/scope	Main Focus
before 1990	Demeter **(1928)**	International (Germany)	Biodynamic agriculture
	CCOF **(1973)**	USA (California)	Organic no synthetic chemicals, prioritizing ecological health and transparency.
1990s	EU Organic **(1991)**	European Union	Organic (baseline EU standard)
	Biodyvin **(1995)**	France / Europe	Strict biodynamic viticulture: natural preparations, lunar cycles, no synthetics.
	SWNZ **(1995)**	New Zealand	Holistic sustainability (environment, soil, people)
	ISO 14001 (1996)	International	International standard for Environmental Management Systems.
	Terra Vitis **(1998)**	France	Integrated sustainable viticulture
	IPW **(1998)**	South Africa	Environmental sustainability across vineyard & winery
	ACOS **(1998)**	Australia	Australian national standard for organic production, no synthetics.
	Fair Trade USA (1998)	USA	Fair trade: labour rights, community premiums, social justice and environmental.
	LIVE (Formed 1997 Certification 1999)	USA (Oregon/PNW)	Low input viticulture, ecosystem focus
	USDA Organic **(2002)**	USA	U.S. government organic standard: no synthetic inputs.
	WIETA **(2002)**	South Africa	Ethical labour / fair trade
	LEAF Marque **(2003)**	UK / International	Integrated Farm Management (IFM)
	EcoStep-Wein (2005)	Germany	Integrated winery management (quality, environmental, safety)
	Lodi Rules (2005)	USA (California)	Rigorous sustainable viticulture
	B Corp (2006)	International (USA origin)	Global ESG certification for responsible businesses.
	Respekt-BIODYN (2007)	Austria / Central Europe	Biodynamic, strict ecological standards
	Napa Green **Winery (2008)**	USA (California)	Comprehensive sustainability
	SIP (2008)	USA (California)	Holistic: biodiversity, social, resource efficiency
	ZERYA (Zero Residue) (2009)	Spain / Europe	"Residue free" production (<0.01 ppm pesticides)
	Fair Choice (2009)	Germany	Social responsibility and ethical trade (alternative fair-trade certification for wine)
2010s	CCSW (2010)	USA (California)	Holistic sustainability program (vineyard & winery practices, continuous improvement, third-party verified)
	Vignerons Engagés**)**	France	ISO 26000 CSR-based sustainability
	Sustainability Code of the Chilean Wine Industry (2010)	Chile	Vineyard, winery, community certification
	SQNPI (2011)	Italy	National Integrated Production System
	BdA (2011)	Argentina (National)	Triple-bottom-line: env, social, econ. sustainability
	VIVA (2011)	Italy	Holistic sustainability
	Salmon-Safe BC (2011)	USA (Pacific Northwest)	Watershed and biodiversity protection
	SUSTWINE (2012)	Spain / EU project	LCA (Life Cycle, environmental costs)
	HVE (2012)	France	Biodiversity, agroecology
	Fair'n Green (2013)	Germany/Europe	Environmental, economic & social pillars
	SWfCP (2015)	Spain	Certification for holistic winery sustainability (climate, eco, social, governance).
	Equalitas (2015)	Italy	Holistic ESG wine sector
	WASP (2015)	Portugal (regional)	Regional sustainability model
	SWA (2019)	Australia	National standards, renewable energy & water efficiency
2020s	SOStain (2020)	Sicily (Italy)	Regional sustainability requirements
	SWGB (2020)	UK (England & Wales)	Comprehensive national sustainability
	Portugal's Sust. Wine Certification (2023)	Portugal (national)	ESG, 86 indicators
	RVA (2023)	International	Regenerative viticulture

Table 5. Certifications by main focus

Nº	Certification	Organic	Biodynamic	Holistic			Ethical / Fair Trade	ISO-based/int. Standard	Management System
				Env	Soc	Ec			
1	Demeter	✓	✓						
2	CCOF	✓							
3	EU Organic	✓							
4	Biodyvin	✓	✓						
5	SWNZ			✓	✓				
6	ISO 14001							✓	✓
7	Terra Vitis			✓	✓	✓			
8	IPW			✓					✓
9	ACOs	✓							
10	Fair Trade USA[1]			✓	✓	✓	✓		✓
11	LIVE (USA)			✓	✓	✓			
12	USDA Organic	✓							
13	WIETA						✓		
14	LEAF Marque			✓	✓	✓			✓
15	EcoStep-Wein			✓	✓	✓		✓	✓
16	Lodi Rules			✓	✓				✓
17	B Corp[2]			✓	✓	✓	✓		✓
18	Respekt-BIODYN	✓	✓						
19	Napa Green Winery			✓	✓	✓			
20	SIP			✓	✓	✓			
21	Zerya Zero Residue			✓					
22	Fair Choice						✓		
23	CCSW			✓	✓	✓			
24	Vignerons Engagés[1]			✓	✓	✓		✓	
25	Sustainability Code – Chile			✓	✓	✓			✓
26	SQNPI			✓					
27	BdA			✓	✓	✓			
28	VIVA Sust.			✓	✓	✓			
29	Salmon-Safe			✓					
30	SUSTWINE [3]			✓	✓	✓			
31	HVE (France)			✓					
32	Fair'n Green			✓	✓	✓			
33	SWfCP[2]			✓	✓	✓			
34	Equalitas			✓	✓	✓			✓
35	WASP-Alentejo			✓	✓	✓		✓	
36	SWA			✓	✓	✓			
37	SOStain			✓	✓	✓			
38	SWGB (UK)			✓				✓	
39	Portugal Sust.Wine Cert.			✓	✓	✓			✓
40	RVA[4]			✓					

From a strategic point of view, no single certification can comprehensively address all the requirements a winery may encounter. Instead, a logic of complementarity emerges. Certifications such as EU Organic or Demeter provide ecological credibility and market differentiation, while others like ISO 14001 reinforce environmental management and regulatory compliance. ESG-oriented frameworks—such as Equalitas, SWfCP, or VIVA—expand accountability to include social and climate dimensions. Social certifications like WIETA or Fair Trade USA guarantee labor rights and community engagement.

This complementarity is already evident in practice. In Spain, wineries frequently combine EU Organic certification with SWfCP to align ecological management with carbon accountability. Italian cooperatives often integrate Equalitas with VIVA, merging national reporting schemes and market positioning. In Portugal, regional models such as WASP coexist with the recently introduced national Sustainable Winegrowing Certification. In South Africa, IPW and WIETA are implemented in parallel to unite agro-environmental standards with labor protections.

The comparative framework highlighted in previous tables reveals three main dynamics. Chronologically, certifications have evolved from niche biodynamic schemes in the early 20th century to complex ESG-based national structures today. Thematically, they can be grouped into five families—ranging from input-focused models to holistic corporate and social accountability systems.

Thus, the optimal approach for European wineries is not to pursue a single "superior" certification, but to strategically combine complementary frameworks that maximize ecological credibility, market access, and governance capabilities. Promoting mutual recognition and harmonisation among schemes should be a policy priority, as this would reduce duplication, ease administrative burdens, and reinforce the contribution of certification to the climate transition and global competitiveness of the European wine sector.

7. CONCLUSIONS AND FUTURE PERSPECTIVES

The present guide on climate change adaptation in wineries and vineyards, developed within the framework of the LIFE CLIMAWIN project, confirms that climate change is already exerting measurable pressures on the wine sector. These range from shifts in vine phenology and water availability to increasing risks for the economic and social sustainability of wineries. The opening chapters of the document establish the scientific and sectoral context, underlining the urgency of adopting coordinated mitigation and adaptation measures.

The analysis of current responses shows that wineries are taking action, although the degree of adoption remains uneven. Within the framework of the project, 69 mitigation and adaptation measures were identified, compiled in a separate technical annex due to their scope and level of detail. Each measure is presented through a technical factsheet and an evaluation by the project partners, constituting a practical tool enabling wineries to tailor climate action to their specific conditions. In addition, a measure prioritisation exercise (Chapter 4) allows actions to be ranked according to their feasibility and impact, thereby facilitating strategic decision-making.

The guide also identifies the main barriers to implementation, including financial constraints, limited technical capacity, and regulatory fragmentation, with particular impact on small and medium-sized producers.

The mapping of European projects and relevant organisations demonstrates the existence of an active ecosystem of initiatives in the field of wine sector sustainability. However, these efforts often lack interconnection, limiting the exchange of good practices and the consolidation of shared methodologies at EU level. This same challenge is reflected in the comparative analysis of 40 sustainability certification schemes: while they provide valuable frameworks, they differ significantly in scope, indicators, and verification mechanisms. The absence of harmonisation hinders the comparability of results between regions and the alignment of certification requirements with policy objectives such as those of the European Green Deal.

A recurring conclusion throughout the document is the need for greater coordination and standardisation. The adoption of harmonised metrics for carbon and water footprint, biodiversity, and social indicators would facilitate comparability and mutual recognition between schemes. It would also be crucial to align certification criteria with the verifiable implementation of climate measures, such as those collected in this project, in order to reinforce their credibility and impact. Moreover, reducing administrative burdens and providing technical and financial support would improve access for smaller wineries.

Looking ahead, the climate resilience of the wine sector will depend on its ability to coherently integrate these different elements: contextual analysis, concrete prioritised measures, collaborative networks, and credible certification systems. This guide provides a structured basis for advancing in that direction. Future work should focus on strengthening the alignment between certification frameworks and EU climate policies, expanding knowledge exchange across regions, and monitoring progress through transparent and comparable indicators. Only through an integrated approach will the sector be able to

respond effectively to climate change while preserving the quality, identity, and socio-economic role of wine production in Europe.

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