

*Integrated waste management and life cycle  
assessment in the wine industry*  
*From waste to high-value products*



*With the contribution of the LIFE financial  
instrument of the European Union*



[www.haprowine.eu](http://www.haprowine.eu)

## ABOUT THE PROJECT:

Project location: Castilla y León

Start date: January 1<sup>st</sup>, 2010

End date: December 31<sup>st</sup>, 2013

Duration: 48 months

Total estimated budget: 1.508.636 €

Contribution of the EU: 660.611 €



*Visit from the EC - May 14, 2013*

## ABOUT THE TECHNICAL TEAM:



Coordinator: Fundación del Patrimonio Natural de Castilla y León

Partners:

- Fundación Centro Tecnológico Miranda de Ebro
- UNESCO Chair in Life Cycle and Climate Change (ESCi-UPF)
- PE International

*Cover photography by: Raúl Sánchez Palacios. First prize in the contest "Wine and Sustainable Development".*

*Back cover photography by Cristina González Lozoya "Traditional culture".*





# 1 The LIFE HAprowINE Project



The LIFE HAprowINE project seeks to contribute to sustainable development in the winery sector through the following specific objectives:

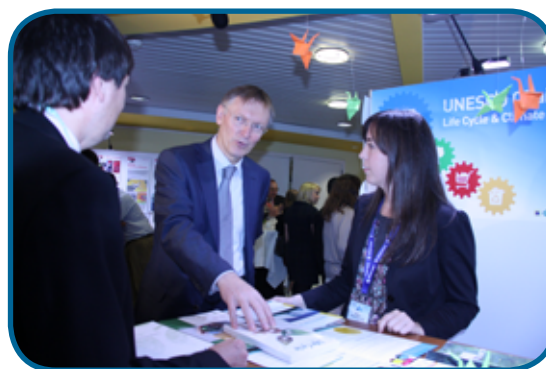
- ✓ Promote the rational and sustainable use of resources using a life-cycle approach.
- ✓ Promote the supply-and-demand of products with a smaller ecological footprint throughout their life cycle.
- ✓ Promote the prevention, recovery and recycling of winery wastes.
- ✓ Identify and promote the synthesis of high value-added compounds that can be obtained from the different wine waste streams.

To achieve these objectives, a series of actions were developed and applied to the wine sector in Castilla y León, using the information provided by wineries in the region. At the same time, the actions developed were defined using comparable and transferable methodologies that can be applied to any other wine region. The main results are detailed in this report and are summarized below:

- Analysis of the technical, economic, social and environmental characteristics of the wine life cycle and quantification of the different wine sector waste streams in Castilla y León.
- Screening of value-added compounds that can be obtained from wine waste streams and analysis of strategies to obtain them.
- Creation of a Guide to Good Practice and Best Environmental Techniques for the Wine sector in Castilla y León.
- Methodological development for the determination of sustainable wine production.
- Design of a label that distinguishes environmentally responsible wines.
- Definition of Product Category Rules (PCRs) and environmental quality criteria for the calculation of a Life Cycle Assessment (LCA).
- Creation of Environmental Product Declarations (EPD) for a series of participating wineries as pilot projects and the calculation of an average EPD.
- Development of a Strategic Environmental Sustainability Document for the wine sector in Castilla y León.



*LCM 2013 - Gothenburg (Sweden)*



*Greenweek 2011 - Brussels*

## 2 Stakeholders Advisory Group



The foundation for the success of the HAprowINE project is the close and extensive collaboration with industry and interested parties.

The Stakeholders Advisory Group was created on July 14th 2010, with the presentation of the idea in Valladolid and the immediate support of numerous entities. The group has continued to grow throughout the project with members from more than 25 organisation that represent the wine industry (wineries, D.O.), technological centers, government bodies, consulting companies and experts in environmental issues, industry distribution, etc.



During the project, four Stakeholders Advisory Group meetings were held, apart from the original start-up meeting and the presentation and delivery of the project results. In addition, many of the wineries that make up the Group formed the basis for the project work by providing access to their facilities and process data for which the Consortium developed Product Category Rules for a wine eco-label, the Life Cycle Assessment studies, and the Environmental Product Declarations of specific wines, the sector analysis and the Guide to Good Practice and Best Environmental Techniques, among others.

Without the collaboration, hard work and generosity of all of these entities, this project would not have been possible.



*Advisory Group meeting (June 8, 2011)*



*Official delivery of LCA-EPD to collaborating wineries - December 3, 2013*

# 3

## Characteristics of the Wine Sector in Castilla y León



### SOCIO-ECONOMIC CHARACTERISTICS

Castilla y León is high on the list of Spanish wine references. There is no doubt that its nine D.O. have contributed to this: Ribera del Duero, Cigales, Rueda, Toro, Bierzo, Arlanza, Arribes, Tierras de León and Tierra del Vino de Zamora; and four wine regions that market their wines by referencing Vinos de la Tierra, a quality standard that guarantees the origin and quality of the wines to the consumer. In Castilla y León there are more than 650 wineries, and of these, over 500 are enrolled in nine D.O. in the region.

The importance of the wine industry in Castilla y León, however, goes beyond the economic sphere, as it has a prominent social role in maintaining the population in rural areas, as a source of rural development and an important contributor to rural tourism and conservation.



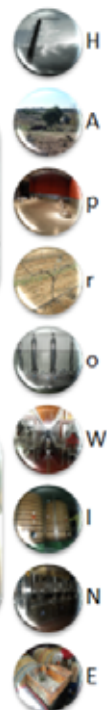
The richness of the landscape and monuments in the wine region of Castilla y León, along with the quality and variety of tourism (catering establishments, vineyards, wineries, prestigious professionals, upscale food products, gastronomic tours, shows, etc.) provide the region with more than adequate characteristics for the development of wine-based tourism.

*“Grape transportation”. Abdón F. Acevedo Álvarez. Third Prize in the HAprowINE photography contest “Wine and Sustainable Development”*

### ENVIRONMENTAL-TECHNICAL CHARACTERISTICS

The main environmental implications identified in the wineries are the high level of water use, generally caused by cleaning, and the large volume of effluents with a high organic load.

Other factors to consider are resource use (mainly energy) and the generation of noise and waste. Energy consumption takes places throughout all stages, but overall, this consumption is highly seasonal, as most of the equipment is only used during harvest season. The greatest environmental impact has been identified in those stages that require cooling equipment as auxiliary equipment, and during the bottling stage.

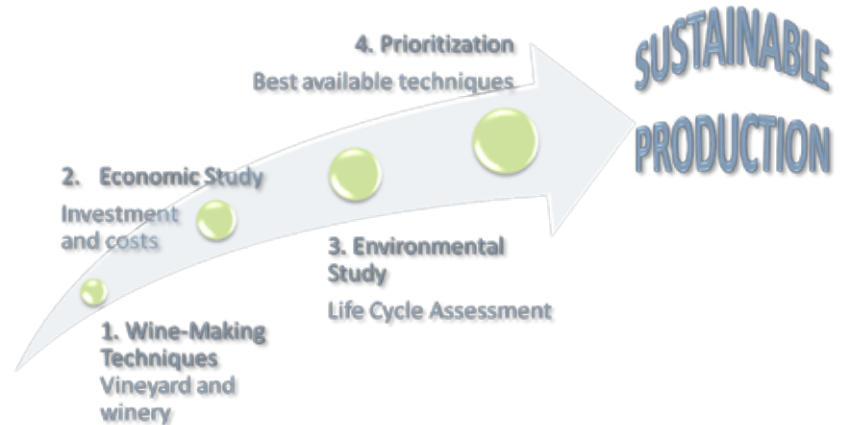




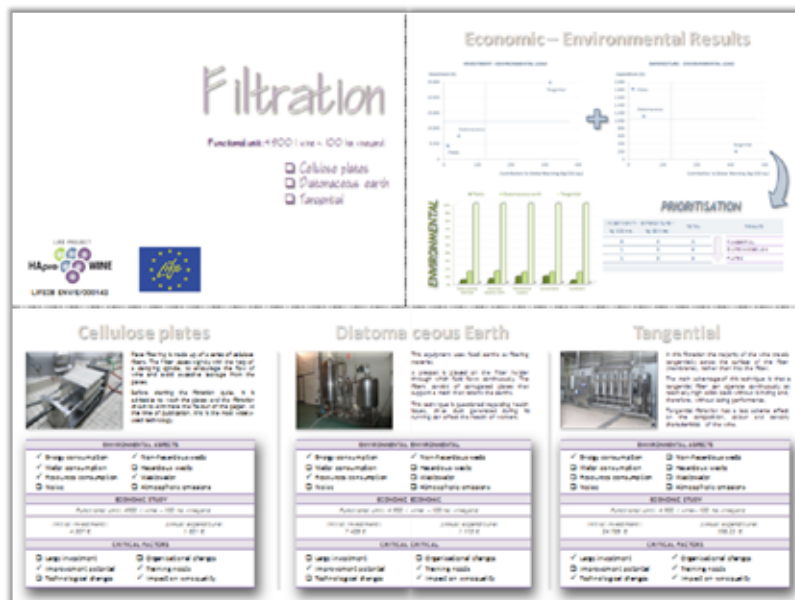


The Guide to Sustainable Wine Production in Castilla y León provides guidance for all those wineries and winemakers who, committed to the natural environment around them, want to improve the environmental performance of their activities and products, reducing the ecological footprint and carbon footprint, by providing them with basic information that will help them direct their environmental policy.

After analyzing the critical elements, the alternatives and the investment needed, we propose the use of Life Cycle Assessment methodology to address environmental sustainability policy for businesses in the wine sector, and to identify the most environmentally-friendly techniques.



At the same time, the guide provides a method to prioritise the techniques evaluated for each process, both for the vineyard and the winery, in order to identify those that are more sustainable from an environmental-economical perspective. Finally, a series of best practices for application are proposed for the different stages of the production process: planting, fertiliser and pesticide treatment, frost protection, harvesting, processing, bottling, cooling, cleaning and racking, and waste treatment.



It should also be mentioned that the publication of this guide would not have been possible without the selfless and fruitful collaboration of the Project Advisory Group, composed mainly of wineries and winemakers, to whom the Project Partners wish to express our profound appreciation.

## 5 Waste Recovery in the Wine Sector



One of the principal objectives of the HAprowINE project was the screening and cataloguing of high value-added compounds that can be obtained from the different waste streams in the wine sector in Castilla y León and the identification of those that have a greater viability through a pilot plant demonstration.

As part of this action, the different waste streams generated by the wine sector were identified, and the composition of each was analysed along with their principal organic compound. The potential applications of these compounds were evaluated, and more specifically, two alternatives were considered for further evaluation: production of bioplastics through enzymatic conversion and the preparation of composites reinforced with lignocellulosic fibers.



The first research area resulted in very low yields, so it was discarded as a viable recovery strategy at an industrial scale. However, the second line of research was carried out at a laboratory and pilot scale, and demonstrated that the industrial use of lignocellulosic by-products from the wine industry as a reinforcement in composite materials is technically feasible.



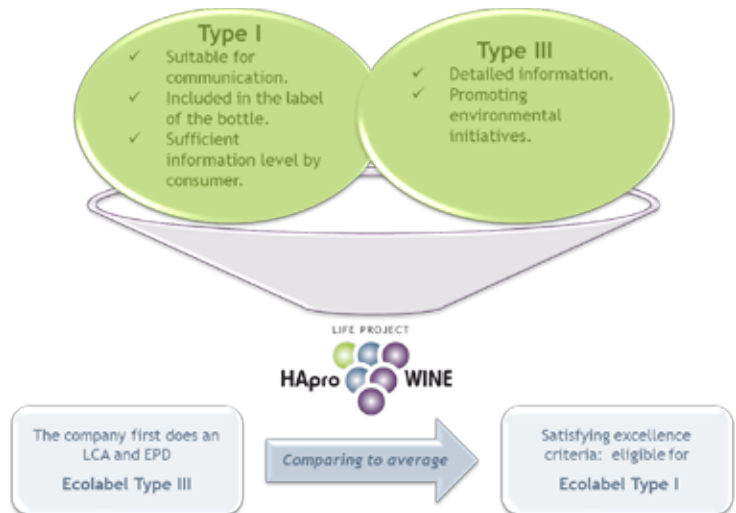
Lignocellulosic fibers are porous materials with low density that reduce the weight of plastic composites, a characteristic which is of great interest for various applications such as transportation, or the leisure or construction industries. In addition, the porosity reduces thermal conductivity, which is useful in the manufacture of thermal insulation panels for the construction sector.

Other applications for this type of waste that are already available on the market and are starting to experience demand and a high added-value, such as cosmetics, salts, etc. were also identified.

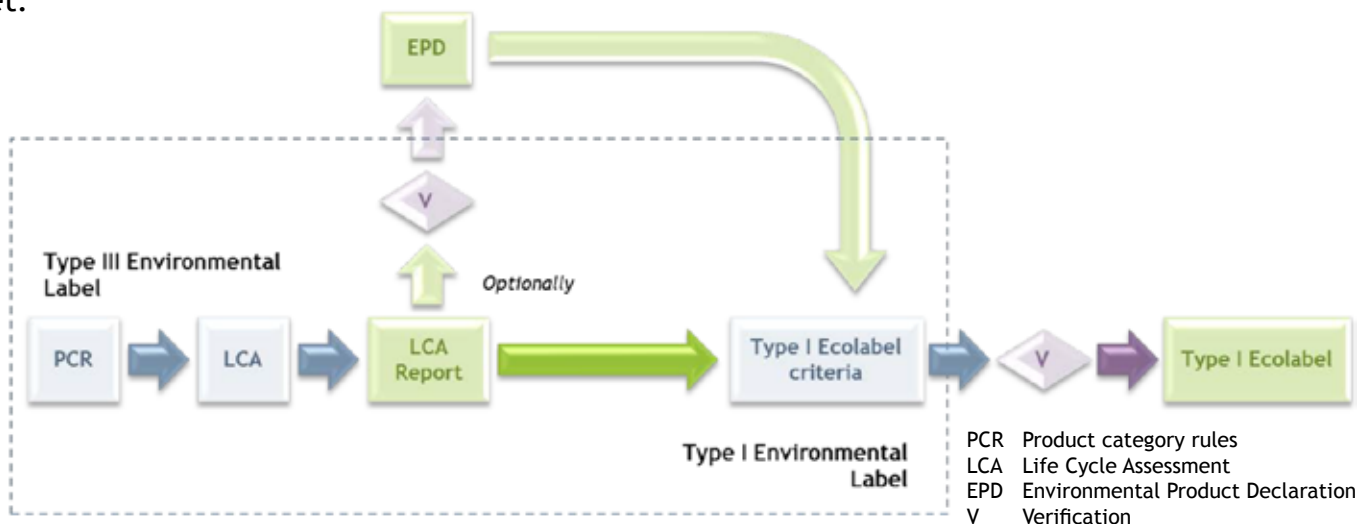


The eco-labelling scheme proposed in the Project aims to combine the advantages of two already-existing labels: Type I eco-labels (which distinguish products with lower environmental impacts) and Type III Declarations (which show the full quantitative environmental information of the product). The new approach developed in the HAprowINE project offers detailed product information, which can be used by both buyers and by the wineries themselves to improve their products. The label on the bottle also allows for quicker identification of products that have made an effort to reduce their environmental footprint.

Under the proposed scheme, the winery must first develop a comprehensive Life Cycle Assessment (LCA) of its product. The HAprowINE project has established specific calculation rules for wines (called Product Category Rules, PCR). The results and hypotheses of the LCA study are shown in a brief report called an Environmental Product Declaration (EPD or Eco-label Type III). To do this, a predefined template is provided and an external entity verifies that the established rules have been followed.



The second step consists of comparing the results of the environmental impact of the wine (shown in both the LCA and the EPD) with the industry average. The wine may only show the environmental seal that distinguishes it as the best in its sector if the environmental excellence criteria are met.



This eco-labelling scheme is innovative in comparison to already existing programmes, and as such has generated a large amount of interest in the international forums where it has been presented, such as the 2012 LCA Food Conference and 2013 Life Cycle Management Conference (LCM 2013).

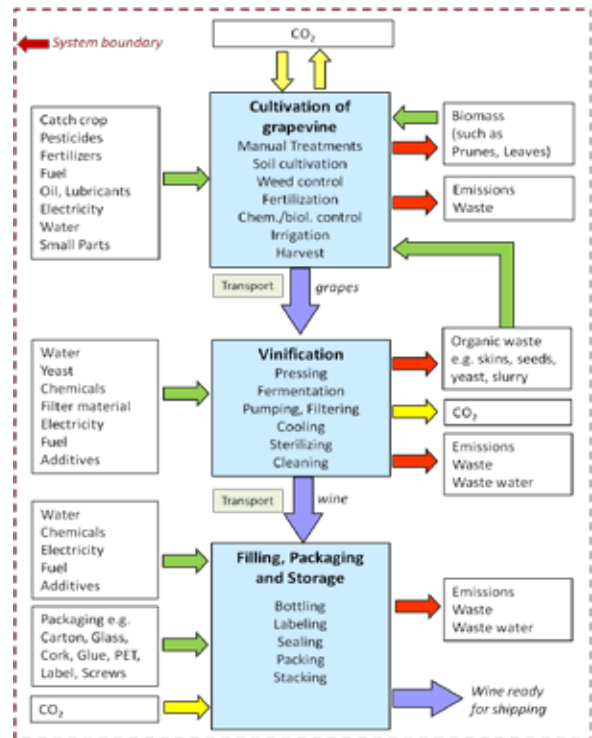




**PRODUCT CATEGORY RULES**

The same calculation rules have to be applied to different types and brands of wines to provide for a fair comparison of their environmental performance. As such, Product Category Rules (PCR) determine how to carry out a Life Cycle Assessment: what should be mandatory and what can be left out due to irrelevance, how necessary data should be collected, and how the environmental impact results should be calculated and presented, etc.

Using existing standards, available literature and the practical experience of the consortium members, a draft of the PCR was prepared, presented and discussed at several meetings with members of the Advisory Group. In addition, a two-week public consultation period was carried out through the project website to obtain the opinions of experts in the field.



The result of this process is a PCR document that is available in Spanish and English on the project website. The document provides LCA methodology to calculate the impacts generated by a 0.75 litre bottle of wine, including the necessary containers and packaging, throughout its life cycle.

**CRITERIA FOR ENVIRONMENTAL EXCELLENCE**

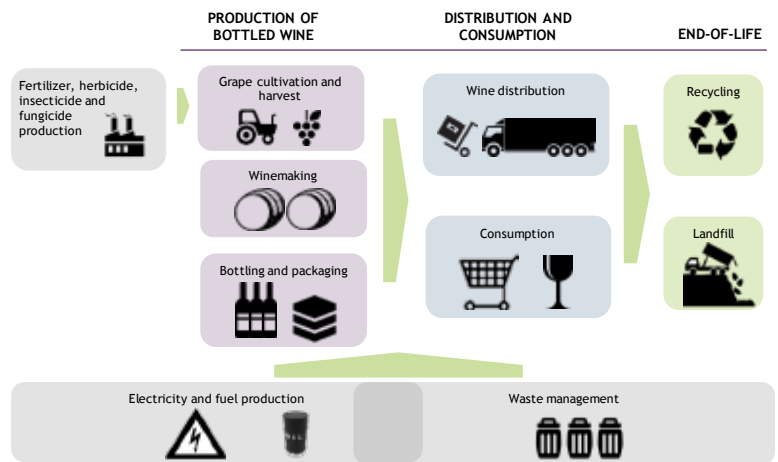
Wine will receive an environmental excellence label (Type I eco-label) if the values shown in the Environmental Product Declaration do not exceed the pre-established limits (environmental excellence criteria).

These environmental excellence criteria are based on a scoring system that uses the results of the 5 participating wineries and available literature. Threshold values are established for global warming, freshwater use, primary energy use and eutrophication.

Indicator	Winery 1	Winery 2	Winery 3	Winery 4	Winery 5	Winery 6
Global warming	-13,3%	18,4%	44,9%	-2,0%	-31,6%	68,4%
Freshwater use	32,2%	27,0%	5,2%	-12,1%	-67,8%	15,6%
Primary energy	35,9%	47,7%	39,8%	11,7%	-32,0%	68,0%
Eutrophication	-1,8%	-10,6%	-15,9%	-25,7%	-21,2%	74,3%

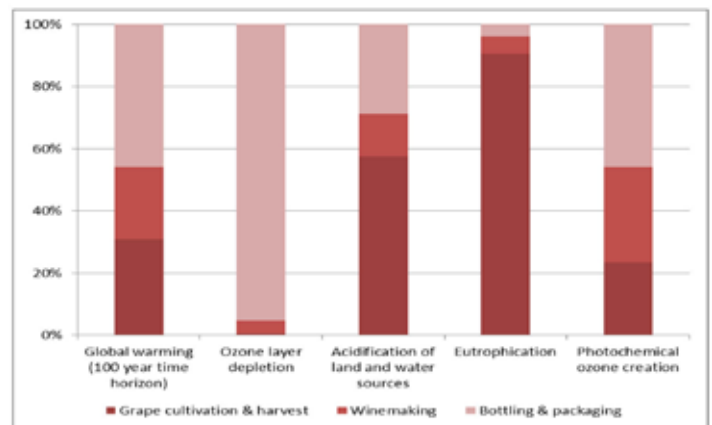


Life Cycle Assessments (LCA) and Environmental Product Declarations (EPD) were conducted for various wineries in Castilla y León by applying the Product Category Rules that were developed within the project. The information in the life cycle inventories provided by the participating wineries has been used to develop an LCA and an EPD for an average wine.



The LCA study refers to the production, distribution, consumption and end-of-life of a 0.75 litre bottle of wine based on the average of 5 wineries in Castilla y León. Data for the production of the bottled wine (including grape cultivation and harvesting, production of the wine and the packaging) was provided by the participating wineries. For the rest of the stages, hypotheses were made based on literature and the experiences of the wineries.

As for the results, it should be noted that the wine production and bottling stage (“cradle to gate”) has, by far, the largest impact. For the carbon footprint, 0.98 kg of carbon dioxide (CO<sub>2</sub>) equivalent are emitted in the average wine production process.



## Average Environmental Product Declaration of HAprowINE wineries

According to the Product Category Rules for wine - HAprowINE 1.2 version.

Baseline year: 2010-2012

1.0 version



“Grants and mills” Raúl Sánchez Palacios  
1st award of the HAprowINE photography competition  
“Wine and Sustainable Development”.

### Impact results (average of the 5 wineries)

IMPACT CATEGORY	UNITS	Winemaking and bottling	Distribution and consumption	End of life	TOTAL
Global warming (100 year time horizon)	kg of CO <sub>2</sub> equivalent	1.80E+01	6.14E+00	3.38E+00	1.00E+01
Ozone layer depletion	kg of CFC11 equivalent	2.33E+00	1.08E+00	2.73E+00	2.33E+00
Acidification of land and water sources	kg of SO <sub>2</sub> equivalent	3.19E+00	2.79E+00	2.79E+00	3.17E+00
Eutrophication	kg of PO <sub>4</sub> <sup>3-</sup> equivalent	2.54E+00	6.43E+00	1.45E+00	2.54E+00
Photochemical ozone creation	kg of ethane equivalent	2.32E+00	6.13E+00	1.00E+00	2.31E+00
INDICATOR	UNITS	Winemaking and bottling	Distribution and consumption	End of life	TOTAL
Primary renewable energy consumption	MJ	6.73E+00	6.53E+00	7.78E+00	1.70E+01
Primary non renewable energy consumption	MJ	5.87E+00	3.34E+00	4.41E+00	5.90E+00
Fresh water consumption	m <sup>3</sup>	6.53E+00	3.31E+00	2.80E+00	6.50E+00
Total waste	kg	5.83E+00	8.80E+00	5.47E+00	1.01E+01
Recyclable waste	kg	1.45E+00	8.80E+00	3.23E+00	6.48E+00



The task that had one of the highest levels of private sector participation was the development of a Strategic Document that outlines the main concerns and recommendations of the wine sector, which are considered necessary to ensure environmental sustainability.

Through this work we want to draw attention to key environmental issues that should be addressed by the wine sector and propose solutions to ensure environmental sustainability within the sector as an intrinsic part of product quality and the competitiveness of vineyards and wineries.

The end result is the product of intense discussions, through in-person meetings and contributions via email, between the technical team and all of the collaborating entities that agreed to cooperate, revise, correct and add to the document through a participatory process involving both Consultation Group members (see page 4) and other interested stakeholders.



*Working group - April 18, 2013*



*Working group - July 4, 2013*

The document is structured in two sections. The first one is the identification and analysis of Strengths and Weaknesses of the sector with regard to the challenge of sustainable development and the Opportunities and Threats that arise in the context of the sector.

The second section identifies a series of strategies that group together the steps considered necessary for the sector to move towards integrated sustainability in the daily management of the companies involved. As many as 45 steps are identified in the areas of waste management, water and energy use, the sustainable management of facilities and operations, the use of environmental technologies or the relation to oenology, tourism or heritage activities.



*Presentation - December 3, 2013*

As for the other project documents, the Strategic Document is available for download at [www.haprowine.eu](http://www.haprowine.eu). The official public presentation took place in Valladolid on December 3rd, 2013 and included the attendance of the Director General of Environmental Quality and Sustainability and the Director General of Agricultural Production and Rural Development for the Government of Castilla y León.



LIFE08 ENV/E/000143

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