SUMMARY

The following document comprises the environmental study of a winery. It is about the configuration of the winery (construction, energetic consumption, saving proposals, etc.) and also the production process (processes, equipment, wastes, etc.) which are involved during the winemaking activity.

The text is divided into the following sections:

- At first, I will provide a description of the winery, both of the activities performed and the constructive description of the building. A winery involves several activity areas, from the office to production rooms, and so it is important to identify the requirements and description, as well as the layout of the areas involved.

- Secondly, I will explain the different processes undertaken from the harvest to winemaking. We will see how the winemaking process involves a series of methodical and measurable procedures which have to be followed to comply with quality standards. Likewise, I will briefly describe the equipment required for the production process. This study allows us to know the operation of each step within the winemaking process and so I will identify their energetic consumption that will be later study.

- In the same way, I will briefly show the essential compounds of the final product which allow us to obtain the quality indicators in compliance with the standards and consumer demands. Then I will describe all the machinery and equipment involved in the winemaking process. This study allows us to know the operation of each equipment within the process and so I will identify their energetic consumption that will be later study.

- Thirdly, I will study all environmental aspects related to the winery, both during the production and during operation of the building. I will explain energy consumption, waste generation and emissions into the atmosphere, so I will identify and classify all the elements that generate environmental impact, thus dealing with them in accordance with the regulations and being as environmentally friendly as possible.

- Fourthly, I will develop an energy-saving and environmental study. It will consists of, from one hand, replacing part of the consumption generated through usual means consumption by renewable sources (especially photovoltaic and ACS solar panels) and, on the other hand, reducing de electrical consumption by improving lighting devices. All of these results will be verified by numerical calculations and schemes of the winery to prove the feasibility of the facilities.

- Finally, I will end up by mentioning several proposals to improve the energy and environmental issues discussed above. Therefore, considering that a winery implies a long term investment, is basic to work under sustainability criteria which will produce beneficial effect in a long run, both for the winery and for the environment.

1 INTRODUCTION

1.2. PRESENTATION

The work will consist in explaining the process, the basic components of the wine and the machinery needed to produce it, in order to get the licensing process of a winery located in Navàs.

The study will also contain and analysis of the waste generated and how to manage it correctly in order to reduce its environmental impact.

Having described the winery and its activity, we will analyse the consumption of energy resources currently available aiming to substitute them using sustainable criteria in order to reduce energy consumption as electricity and domestic hot water.

1.1 AIM

For the project development, I have set up the following goals:

- Getting a rigorous description of everything that involves the winery activity and the subsequent development of their product: wine.
- Analyze the production process, machinery and warehouse spaces in order to obtain the main indicators of energy consumption and environmental impact.
- Design and implement systems that optimize natural resources such as solar - both thermic and photovoltaic energies - and minimize the waste produced by making a proper management in order to reduce the environmental impact on the nearly land and its inhabitants.
- Propose systems and actions to improve production and contribute to the minimization of waste and environmental pollution.

Based on these objectives, we can perform the legalization of the winery and we will improve his process in all its fields in a sustainable and energy efficient way.

2 WINERY DESCRIPTION

2.1 TECHNICAL PROPOSAL

- LOCATION

The winery is located in Navàs, a town of the Bages region, in the province of Barcelona, and placed at precisely at Santa Teresina del nen jesús street, number 54.

Location	Longitude 1º52'49,02'' Altitude 41º54'7,86''
Altitude	365 meters
Extension	80,60 m^2
Population	76,2 inhabitants/km^2
Distance from Barcelona	86 km

Table 2.1.1. Location

CATALONIA

BAGES REGION

Fig.2.1.1. Catalonia and Bages region Map

Fig 2.1.2. Aerial photo of Navàs

Fig 2.1.3. Location map of the Winery

- ACTIVITY

It is a residential area that complies with local regulations, the “POUM” establishes that in that place an economical agricultural activity can be carried out.

The plot where the winery is located a residential area, is oriented as follows: the Southern face is a diving wall, whilst the Northern, Western and Eastern ones are isolated.
The winery’s vineyards are located 2 km away.
The winery has a ground floor of the house, a basement for the bottle storage and several semi-outdoor spaces that require the needs of the business.

The entrances are located to the west. We find the main entrance by staff (shared access to housing), and three entrances corresponding to larger warehouse and production area covered by the equipment shed.

The ground floor composed three main areas: the ground floor of the house, auxiliary areas and the interior yard.
The ground floor of the house contains the warehouse, laboratory, office, dressing room and production area.
Auxiliary areas are washing area, equipment shed and tasting area.

The yard contains a drinkable water tank, the electrical emergency system, containers for the grape skins, packaging and the waste water tank. There is also a water outlet to connect a hose for washing.

The basement is composed of a unique room mainly aimed at bottle storage after the bottling process. This room is equipped with a ventilation system including dehumidifiers and a water pump to avoid flooding.

The winery is also equipped with the required services: electricity, lighting, water, air conditioning, telecommunications, and ventilation.

The winery ventilation is done naturally, from the exterior to the interior yard, with the exception of the basement having its own ventilation system.

The built-up area of the ground floor is 263,65m^2, and of the basement is 21,45m^2. Overall, the winery has a total built-up surface of 285,10 m^2.

The surfaces of the different areas are as follows:

Ground Floor Useful Surfaces	
Warehouse	51,92m^2
Laboratory	6,10m^2
Office	16,10m^2
Changing room	6,30m^2
Tasting area	22,10m^2
Production area	61,90m^2
Washing area	11,35m^2
Equipment shed	44,41m^2

Table 2.2.1. GF Useful Surfaces

Basement Useful Surfaces	
Basement	19,50m^2

Table 2.2.2. BS Useful Surfaces

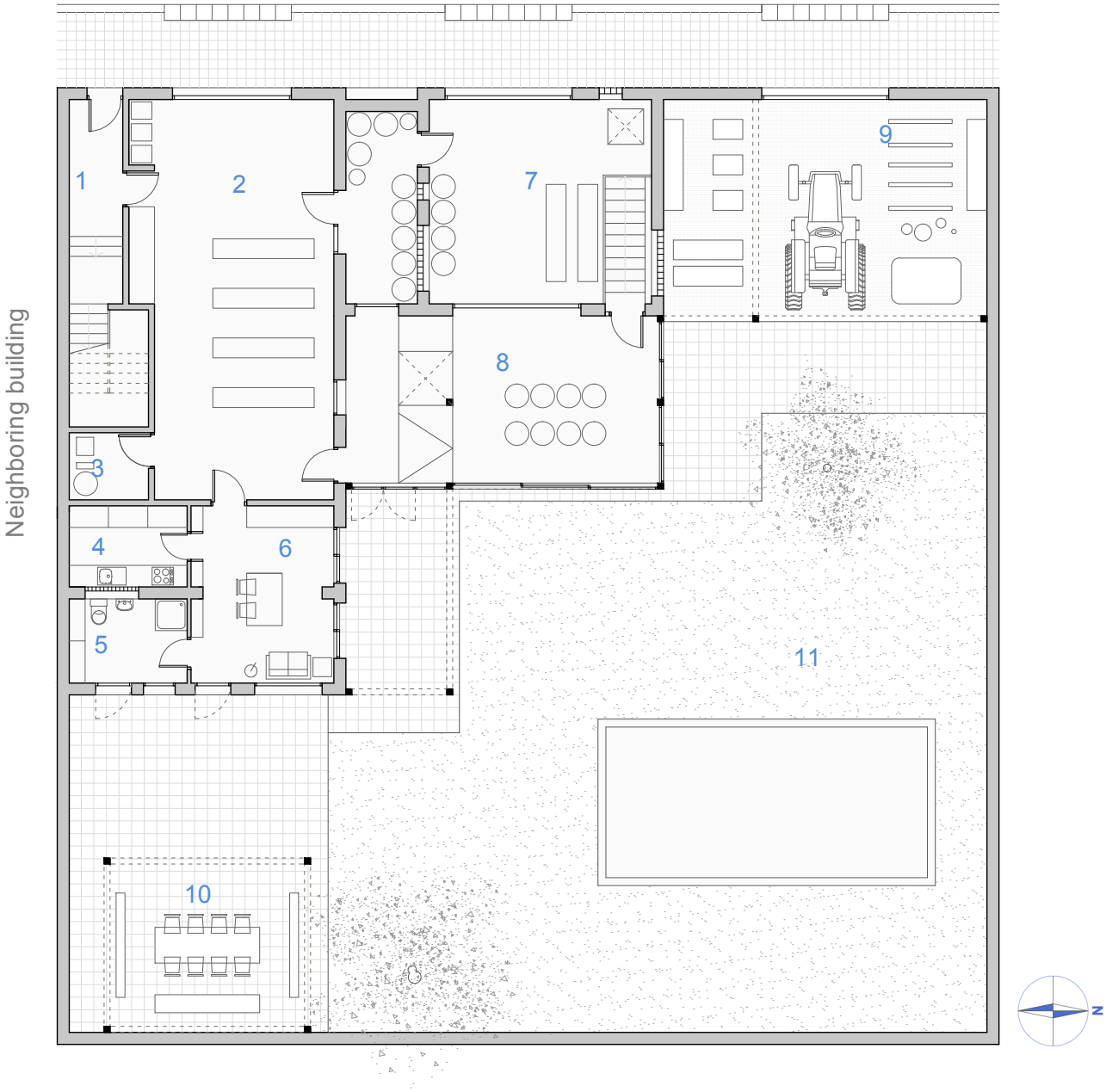
Surfaces summary	
GF Total Useful Surface	220,18m^2
BS Total Useful Surface	19,50m^2
TOTAL	**239,68m^2**

Table 2.2.3. Useful Surfaces

2.2 CONSTRUCTIVE MEMORY

Constructively we can talk about two areas: The ground floor of the property, which includes warehouse, laboratory, office, dressing room and wine cellar, and the auxiliary areas wich are washing the porch, the covered shed for the machinery and the tasting area.

Santa Teresina del nen jesús street, number 54



LEGEND

1. Main entrance
2. Warehouse
3. Boiler
4. Laboratory
5. Changing room
6. Office
7. Cellar (production area)
8. Washing area
9. Equipment shed
10. Tasting area
11. Interior yard

- FOUNDATION

The foundation consists of lineal shoes under load bearing walls, pillars while for both metal and masonry find isolated shoes. All shoes are mass concrete.

- VERTICAL STRUCTURE

The structure consists of walls of brick masonry "Gero", 30cm thick. There are also some pillars of masonry. In some sections of 15cm thick glass block is used to solve the structural wall but at the same time let light pass.

On the walls are load struts 20cm edge executed with concrete. The bridging joist, 60cm edge, and lintels, which solve the openings, are executed with reinforced concrete and oriented north-south.

The structure in auxiliary areas is metallic, consisting of pillars and cast iron beams.

The basement beneath the cellar is built of reinforced concrete retaining walls.

- HORIZONTAL STRUCTURE - CEILING

Ceilings are unidirectional and are composed of concrete joists placed in east-west direction. The relief consists of ceramic coffers. About this there is a layer of compression, 5cm thick reinforced concrete. The height between the floor and ceiling of the ground floor is 290 cm.

A ceiling tile ceramic substructure resting on a cast iron gives 5cm thick interior finishing work area. This substructure linked to the forged semi-joists allows uploading of machinery (cranes and pulleys). The rest of the areas are made with a plastering finish on the bottom face of the ceiling.

Auxiliary areas have no ceilings since they are directly under roof spaces.

- ROOF

The roof is three floors above, remember that the winery is located in the basement of a house 3 + PB. It is an Arabic tile roof on a slab and its dovetail is made of double brick walls, bound with mortar plaster.

The auxiliary areas, covered with porches, consist on Arabic tiles placed over a substructure made of 15cm section joists, which are made of cast iron.

- FACADE

The enclosing walls of 30cm, 15cm consist of outer wall, air gap with insulation and brick wall inside. In general, both the walls and the interior partitions are plastered with mortar full height and clad in glazed ceramic tiles inside.

The perimeter wall of the interior yard is brick.

The carpentry is PVC and aluminium, all double glazed and with an air gap.

- INTERIOR WALLS

Brick walls 10cm resolve internal divisions. Doors are two formats: the overall 90x210cm and the ones which let to pass the larger volume equipment or items measuring 300x250cm.

- PAVING

Generally, the paving is ceramic tile in all areas both indoors and outdoors except for the equipment shed which has a mass of concrete pavement more durable and suitable for the demands that may be in the area.

All floors except the office area, have water collection points. Each room has its separate and thus independently evacuate the water if dry.

- SYSTEMS

The electrical system is all in the cellar. It is a three-phase 230V and installation of 10kW contracted power.

Also we supply water in all rooms in the cellar. The boiler, combustion of diesel, is located in a room next to the warehouse.

The evacuation of roof's rainwater collectors is solved with PVC. All the rooms, except the office, have a point of water drainage and inclined pavement.

The office area has access to the telecommunications network.

The ventilation is natural possibility of cross ventilation in all areas of the cellar. We find mechanical ventilation and smoke extraction in the area of the basement warehouse.

4 ENVIRONMENTAL ISSUES

4.1 ENERGY

Energy is an important resource in wine productions, which has a cost and an impact on the environment that is important to be minimized.
Inside a winery, the following of steps and processes require energy:

a. Heating or cooling installations for cooling wine chambers and administrative areas.
b. Cleaning operations where water is needed.
c. Machine running: pumps, presses ...
d. Stages in the wine elaboration in which is necessary to control the temperature, whether hot or cold supply (fermentation).

An important fact is that the average power consumption per litre of wine produced is 0,284kWh.

The following table shows the most frequent uses of energy:

ENERGY	SOURCE	USES	EQUIPMENT
THERMAL	- Heaters. Public electrical grid.	- Hot water.	- Cleaning operations. - Heating equipment and systems. - Elaboration.
	- Solar panels.	- Hot water.	
MECHANICAL	- Mains public (primary energy source). - Generators. - Solar (complementary sources).	- Obtaining electricity	- Cooling. - Lighting. - Ventilation. - Operation of equipment (presses, filters, pumps, etc.). Lights.

Taula 4.1. Energy uses

The total energy consumption is shared by 60% of electricity and 40% in thermal energy. It is distributed as follows:

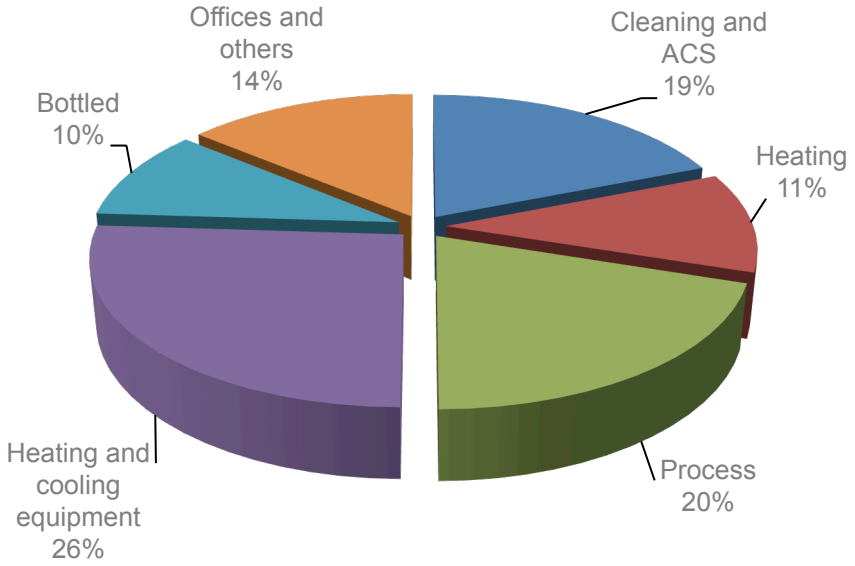


Fig 4.1. Energy distribution

4.1.1 ELECTRICITY

The groups that are consuming more energy are the machinery (press, pumps, compressors, refrigeration equipment, etc.).

The following quotes tell us its main indicators:

- The main consumers of electricity generation systems are cold. There are some of operations that need a constant supply of cold such as unfermented wine cooling, the temperature control during the fermentation, and the custody and tartaric stabilization.
- The energy consumption associated with the reception of the grapes is estimated at 10.8% of total energy consumption in the cellar.
- Pressing represents 3% of the total.
- Filtration involves less than 3% of energy expenditure.
- The energy consumption of pumps racking wine musts and some other deposits, might be 16 kWh / tonne for small wineries.
- The lighting can be up to 5%.

Within the consumer refrigeration, keep in mind that the phase and aging should be performed in rooms where the temperature should be between 12 and 15ºC with 70-80% humidity.

The construction of the cellar is on a main ground so it is necessary to use cooling equipment. This expense is reduced by the use of an underground room, but we must take in consideration that an air renewal is required.

The following table shows the power consumption of each device:

ENERGY EQUIPMENT	
Bottling	0,37kW
Capper	0,75 kW
Capping	0,2 kW
Destemmers	1,5 kW
Press	1 kW
Cooling equipment	1 kW
Equipment / cold	1,5 kW
Cold chamber	2,6 kW
Air Conditioning	1,3 kW
Other devices	0,5 kW

Taula 6.1.1. Energy consumption data

4.1.2 BOILER AND FUEL

The cellar generates hot domestic water using a combustion boiler that runs with diesel fuel (fossil fuel).
This HDW is distributed in areas such as office, laboratory, dressing, which is essential for optimum comfort.

4.2 WATER USE AND WASTE WATER

4.2.1 WATER USE

Water is a basic and essential for an optimum working inside a wine cellar.
Although it is not involved directly in the production process, it is an important element for cleaning and disinfecting equipment and systems. Water is also used in cooling circuits.
The largest amount of water is consumed in equipment cleaning process. The maximum consumption is when we get the grapes and the process begins. Approximately 80% of the volume consumed during the three months following the harvest. In the case of our winery, which also produces and bottles wine, water is also consumed in the following months.
The ratio for calculating water consumption is 2,2 water litres / wine litres for small wineries. In our case, since our production is 3.000l of wine a year, we take the ratio of water 2,2l / l wine.

3.000l wine x 2,2L water/L wine = 6.600L water = 6,6m^3 water

4.2.2 WASTE WATER

The activity of the winery generates wastewater. You can generate different types of water with different levels of pollution and different possibilities to be recovered:

- The water used in the cooling heat exchange. This has not suffered any water pollution and can join in the rain when it's removed. Temperature should be controlled before discharge.
- Water cleaning can be very clean if it comes from the cleaning and disinfection of a bottling area or, on another side, it can be a high pollutioned load and a big environmental issue if it comes from cleaning equipment, wine deposits or production area floor.
- There is also a waste water coming from the bathroom, the changing room, and the laboratory.

In general, any organic matter that brings water from the cleaning of tanks, machinery, etc. is readily biodegradable. The problem is that if soon we produce and dump this organic waste into the environment, it could cause problems of eutrophication.
Because the cellar studied is making a biodynamic wine production, there are no chemicals added, so the wastewater dropped into the environment is completely neutral for the environment and living beings.
The pH is usually acid, between 3.0 and 5.0. It is the same in all the process because the cellar is not using caustic soda to clean the deposits; therefore, it is not necessary to neutralize the water wash.

4.3 WASTE GENERATION

The waste from the activity of winemaking are:

<table>
<tr><th rowspan="2">WASTE</th><th rowspan="2">CLASS</th><th rowspan="2">CODE</th><th colspan="2">MANAGEMENT AREAS</th></tr>
<tr><th>RECOVERY</th><th>TREATMENT</th></tr>
<tr><td>- Breeze wine</td><td>Not dangerous</td><td>020701</td><td rowspan="3">- V33. Recovery of food.
- V61. Use as fuel.
- V83. Composting.
- V81. Use for agriculture.</td><td rowspan="3">- T31. Physiochemical and biological treatment.
- T21. Non-halogenated waste incineration.
- T12. Leave non-special waste.</td></tr>
<tr><td>- Sludge</td><td>Not dangerous</td><td>020701</td></tr>
<tr><td>- Earth filter</td><td>Not dangerous</td><td>150203
020701</td></tr>
<tr><td>- Glass bottles</td><td>Not dangerous</td><td>150107</td><td>- V14. Recycling glass.
- V51. Recovery, reclamation and reuse</td><td>- T11. Disposal of inert waste.</td></tr>
</table>

			of packaging.	
- Cardboard boxes	Not dangerous	150101	- V11. Recycling of paper and cardboard. - V51. Recovery, reclamation and reuse of packaging. - V61. Use as fuel.	- T11. Disposal of inert waste.
- Packaging / plastic bags	Not dangerous	150102	- V51. Recovery, reclamation and reuse of packaging. - V12. Recycling of plastics.	
- Capsules	Not dangerous	150104	- V41. Recycling and recovery of metals or metal compounds.	
- Cork	Not dangerous	030101	- V15. Recycling and reuse timber. - V61. Use as fuel. - V83. Composting.	- T21. Non-halogenated waste incineration. - T12. Disposal of non-hazardous waste.

Table 4.3. Waste from winemaking

An important part of organic waste, such as wind, grape skin, etc. use it as fertilizer in their own vineyard.
Also generate waste such as glass, cardboard and plastic, which comes in packages or containers of auxiliary materials that have been used in the winery. And the glasses come from possible breakdowns.
They are usually very few or almost zero hazardous waste, but in any case must be managed as indicated by the regulation.

4.4 ATMOSPHERE EMISSIONS

4.4.1 GAS EMISSIONS

Gas emissions that can be found in the cellar, will be produced in the process of winemaking.

- Emissions of gases from the fermentation of wine: CO_2 and ethanol in very small proportions.
- The carbon dioxide emissions produced during the preparation process occurring in alcoholic fermentation and the malolactic fermentation. Studies show that approximately 1 ton of grapes produces 100kg of CO_2.
- The carbon dioxide comes from the transformation of sugars of the grape, which is fixed for the plant through photosynthesis. Therefore, the carbon dioxide emitted in this way back to the atmosphere. In short, the overall contribution of CO_2 from fermentation is nil.

- Emissions associated with the combustion plants: SO_2, CO, CO_2.
  Take into account the gases emitted by combustion processes carried out at the winery as a source of energy for generating electricity or hot water.

4.4.2 NOISE

The main sources of noise are:

- Condensers and cooling equipment.
- Use of machinery (Destemmers, bottling ...)
- Transportation of raw materials.

Noise is also an issue of occupational safety and hygiene, especially in the areas of ancillary services and bottled (glass bottles).
The noise level can exceed 70dB at the specific time.
Already been approved 176/2009 Decree of 10 November, approving the Regulation of Law 16/2002 of 28 June, protection against noise pollution.
Noise limits of this Act Catalan are shown below
and wineries that are required to comply if there is no municipal legislation.

	EMISSION LIMIT VALUES		**VALUES OF ATTENTION**	
AREA SENSITIVITY	dB (A)		dB (A)	
	Day	Night	Day	Night
a. high	60	50	65	60
b. moderate	65	55	68	63
c. low	70	60	75	70

Table 4.4.2. Noise limit values

In our case, we have an area of sensitivity C values and limits will be quoted in the above table.