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Appendix

Appendix 1 - The 4R framework

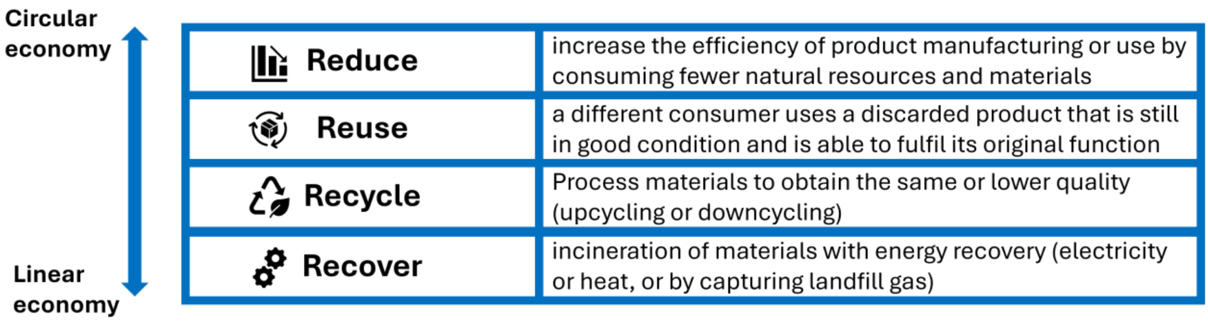

Figure 1: the 4R Framework (adapted from Malooly & Daphne, 2023)

Appendix 2 - Wine industry details

Appendix 2.1 The state of wine indutry in 2023

In 2023 (OIV, 2024), wine production in the European Union saw a significant decrease reaching 144.5 million hectoliters (mhl) (about 60% of the total wine production). France, the world's leading wine producer, saw a slight increase in production by 4.4%, reaching 48 mhl, surpassing its five-year average. However, Italy experienced historically low production levels, dropping by 23.2% to 38.3 mhl, attributed to heavy rainfall causing mildew and damage. Spain also faced a notable decline, reaching its lowest production since 1995 at 28.3 mhl, down 20.8% from the previous year due to severe drought and extreme temperatures. The USA and the South American countries are taking back 24.3% and 47 mhl respectively (i.e. 71 mhl, around 30% of the production). With regard to consumption, the EU accounted for 48% of the world's wine consumption, with a market size of 107 mhl. France remained the largest consumer within the EU, with an estimated consumption of 24.4 mhl. Italy, the second-largest market in the EU and third globally, saw a consumption level of 21.8 mhl. Germany, the third-largest EU market, recorded a consumption volume of 19.1 mhl in 2023. Spain, however, reported an increase in consumption reaching a total of 9.8 mhl. In the USA, the largest wine market globally, consumption decreased reaching 33.3 mhl (15% of the world consumption). We can see that the main players in this market are located in Europe and the USA.

Appendix 2.2. Grape Balance Sheet

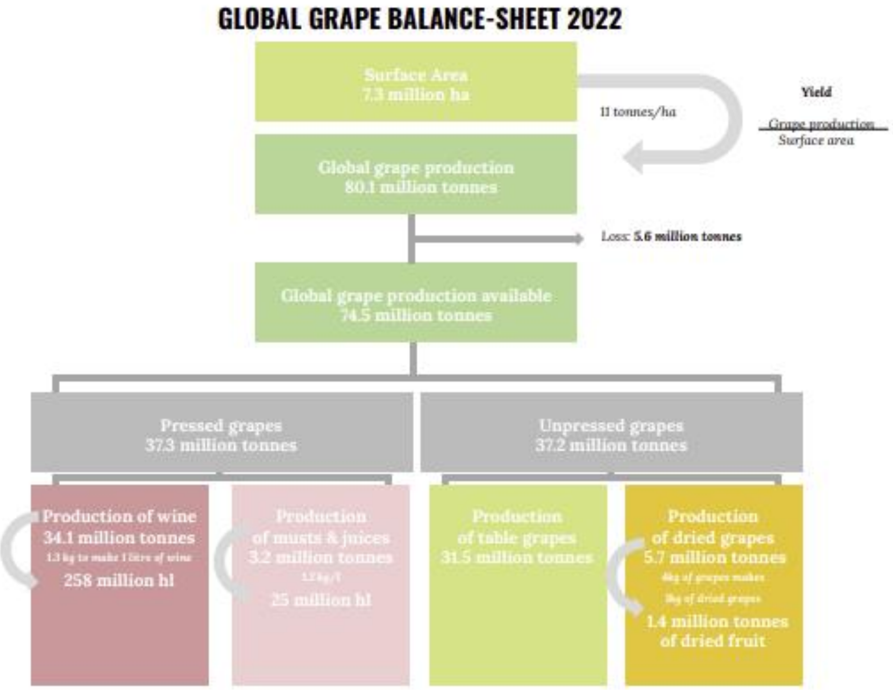

Figure 2: Annual Assessment of the World Vine and Wine Sector in 2022 (OIV, 2023)

Appendix 3 - Final survey

Appendix 3.1. Welcome message

My name is Martin Pirotte, and I am currently pursuing a master's degree in business engineering at the Louvain School of Management (Belgium). As part of my academic journey, I am conducting research (Master Thesis) on the implementation of circular economy practices within the wine industry.

The aim of the survey is to find out whether small and medium-sized companies in the wine sector are implementing actions linked to the circular economy, such as recycling waste or reducing the use of non-renewable resources.

The survey will take no more than 10 minutes! I appreciate your participation.

Appendix 3.2. Consent

I agree to participate to the survey and that the information will be used for research purposes (your answers are anonymous).

1. Yes
2. No

Appendix 3.3. Information on the vineyard or winery:

- What is the Annual production of your vineyard / winery ? Indicate the average number of bottles per year:
- Location:
    1. France
    2. Spain
    3. Italy
    4. Others (please Specify)
- Annual Turnover of your vineyard/winery:
    1. Less than 2 million (≤ € 2 m)
    2. Between 2 and 10 million (2 m ≤ turnover ≤ € 10 m)
    3. Between 10 and 50 million (10 m ≤ turnover ≤ € 50 m)
    4. More than 50 million
    5. I don't have this information

Appendix 3.4. Circular economy and wine industry:

(Adapted from Flash Eurobarometer 441 (European Commission, Brussels, 2016))

- Are you familiar with the concept of circular economy ?
  Scale: 1 to 7 (1: not at all familiar – 7: Very Familiar)

- Have you implemented any circular economy initiatives in your vineyard?

Circular economy initiatives involve practices that reduce waste, conserve resources, and promote sustainability. For example, using less water, renewable energy, and recycling materials. These initiatives help vineyards and wineries operate more efficiently and minimize their environmental impact.

1. Yes
2. No

- If "YES", please specify which category/categories your initiatives fall under:
    1. re-planning of the way water is used to minimize usage and maximize re-usage;
    2. use of renewable energy;
    3. re-planning energy usage to minimize consumption;
    4. minimizing waste by recycling and reusing waste or selling it to another company;
    5. redesigning products and services to minimize the use of materials or use recycled materials
    6. Other (please specify)

- If you have implemented one or more of the above practices, which pillar(s) of sustainable development do you think it has impacted? (Check all that apply):
    1. Environmental
    2. Economic
    3. Social

- If "NO", what are the barriers preventing you from implementing circular economy initiatives? (Check all that apply):
    1. Lack of human resources
    2. Lack of expertise
    3. No clear idea about cost benefits or improved work
    4. No clear idea about investment required
    5. Complex administrative or legal procedures
    6. Cost of meeting regulations or standards
    7. Difficulties in accessing finance
    8. Other (please specify)

- (If Yes) For each category of circular economy initiatives, please indicate the primary barrier(s) you face:

	Lack of human resources	Lack of expertise	Complex administrative or legal procedures	Cost of meeting regulations or standards	Difficulties in accessing finance	Other or None
Replanning of water usage						
Use of renewable energy						
Replanning energy usage						
Recycling and reusing						
Redesigning products and services						

Appendix 3.5. Survey conclusion

- Is there anything else you would like to add regarding circular economy practices in the wine industry or the barriers to their implementation?

- Contact Information (Optional) : If you are willing to provide further information or participate in follow-up interviews, please leave your contact details here

- Thank you for your participation !

Appendix 4 – In-going firms (CE): industries comparison

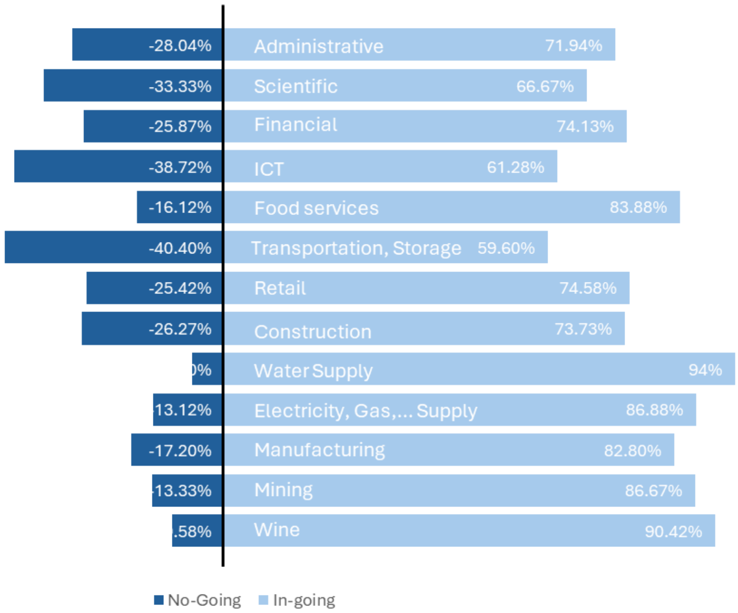

Figure 3: In-going firms comparison: CE implementation (Source: Garcés-Ayerbe et al.(2019) & Survey Results (2024))

Appendix 5 – Eurobarometer Survey number 441: In-Going and No-Going firm's distribution

	N	% (*)
In-Going Firms (*N* = 7843)		
CE Activities' Implementation		
Water	1998	25.47
Renewable Energy	1850	23.59
Energy Consumption	4323	55.12
Recycle/Reuse	6052	77.16
Redesign	3652	46.56
Barriers to CE		
Lack of human resources	1677	21.38
Lack of expertise to implement these activities	1708	21.78
Complex administrative or legal procedures	2459	31.35
Cost of meeting regulations or standards	2228	28.41
Difficulties in accessing finance	1798	22.92
No-Going Firms (*N* = 2775)		
Barriers to CE		
Lack of human resources	423	15.24
Lack of expertise to implement these activities	576	20.76
No clear idea about cost benefits or improved work	717	25.84
No clear idea about investment required	598	21.55
Complex administrative or legal procedures	467	16.83
Cost of meeting regulations or standards	436	15.71
Difficulties in accessing finance	610	21.98

Figure 4: In-Going and No-Going firm's distribution (Source: Garcés-Ayerbe et al.(2019))