

Product vs Corporate Carbon Footprint: A Case Study for the Spirit Drinks Sectors

Rubén Leivas, Jara Laso, Daniel Hoehn, María Margallo, Pere Fullana-i-Palmer, Rubén Aldaco*

Department of Chemical and Biomolecular Engineering, University of Cantabria, Av. de los Castros s/n, 39005 Santander, Spain
 aldacor@unican.es

The use of Life Cycle Assessment (LCA) has become a common mechanism to evaluate and report the environmental performance of services and products due to its holistic approach and for its standardised method which guaranteeing reproducibility. There is a huge ongoing effort to improve and promote the use of LCA in Europe, by means of the Single Market of Green Products Initiative, which promotes the use of the Product Environmental Footprint (PEF) and the Organisation Environmental Footprint (OEF). Although LCA has been applied in a great variety of industries, there is an even higher worldwide trend of simplification focussing on a single indicator, carbon footprint (CF), relevant to global warming, which is internationally considered as a critical environmental concern. The scope of the CF assessment could be corporate (when all production processes of a company are evaluated) or product (when one of the products is evaluated throughout its life cycle). However, sometimes product CF studies collect corporate data, since for most companies it is easier to report global annual consumptions and emissions instead of the product's specific inputs and outputs. In this framework, this study aims to apply and compare the product and corporate CF methodologies to the case study of the spirit drinks sector in Cantabria (Northern Spain). In particular, to a SME dedicated to the artisanal elaboration of premium spirit drinks such as gin and vodka.

The value obtained of the Product Carbon Footprint (PCF) was 0.57 kg CO₂ eq. for a bottle (70 cl) of classic gin whereas the Corporate Carbon Footprint (CCF) presented a value of 4.58×10³ kg CO₂ eq. for Scope 2 and 5.58×10⁴ kg CO₂ eq. for Scope 3 in the year 2017. The results indicated that significant environmental impacts were caused during the production of the glass bottle as well as the production of the electricity required in the beverage company.

1. Introduction

1.1 Life Cycle Assessment based carbon footprint methodologies

In the past decades, pressure from environmental authorities and an increasing interest from consumers and foreign importers for information regarding the environmental impact of the products they purchase, have led to new easy-to-understand indicators (Navarro et al., 2017a). In this sense, there is a huge effort to improve and promote the use of Life Cycle Assessment (LCA) in Europe through the Product Environmental Footprint and Organisation Environmental Footprint methodologies by means of the Single Market of Green Products Initiative (EC, 2013a). This initiative introduces two measurement methods and a set of principles for the communication of the environmental performance of products and organisations. Its objective is to handle the problems that companies face when they wish to market its product as a green product and they have to apply different schemes in order to compete based on environmental performance in the different national markets. This wide variety of ecolabels, currently more than 400 worldwide, makes that consumer feel confused by the stream of incomparable and diverse environmental information (EC, 2013b). Although LCA has been applied in a great variety of industries, there is an even higher worldwide trend of simplification focussing on a single indicator, carbon footprint (CF), relevant to global warming, which is internationally considered as a critical environmental concern (Navarro et al., 2017b). The assessment of carbon emissions and environmental impact of production

is indispensable to achieve a sustainable industrial production for those companies willing to compete in new international green markets (Kiliç et al., 2018). The CF is nowadays one of the most widely used environmental indicator to report direct and indirect greenhouse gas (GHG) emissions and to support sustainable consumption decisions (Alvarez et al., 2015a). Demand for low CF may be a key factor in stimulating innovation while prompting politicians to promote sustainable consumption. However, although CF indicator has been very successful in terms of reaching a great audience, researches highlight the methodological divergence between product and corporate CF (Alvarez et al., 2016). CF may be assessed at a product level, following the LCA methodology (ISO, 2006) for only this one impact category and following standards such as PAS 2050 (2011), ISO 14067 (2013) of GHG Protocol for products (2011). On the other hand, it can also be assessed at corporate level, following standards such as ISO 14064 (2006) or GHG Protocol for organisations (GHG protocol corporate, 2011).

1.2 The carbon footprint in the alcoholic drinks sector

To the best of our knowledge, there is not studies that assess the environmental profile of the production of gin, identifying the main hotspots in terms of CF. Nevertheless, the environmental impact of different alcoholic drinks has been assessed using LCA. Vazquez-Rowe et al., (2017) evaluated the production of *pisco* in Peru by means of 13 impact categories. Eriksson et al. (2016) presented the LCA of Swedish single malt whisky of one bottle (70 cl) of whisky using 4 environmental indicators. Amienyo and Azapagic (2016) performed the LCA of the beer production and consumption in UK. On the other hand, the production and consumption of wine has been environmentally assessed by several authors, such as Gazulla et al. (2010) and Martins et al. (2017) by means several environmental indicators, and focusing only on the CF (Ponstein et al., 2019). Other authors, such as Navarro et al. (2017a; 2017b) evaluated the PCF and CCF of 18 wineries. With the aim of filling the gap about spirit drinks, the main objective of this study is to assess the PCF and the CCF of the production of classic gin by a Spanish company in Cantabria.

2. Methodology

2.1 Standard methodology description for Product Carbon Footprint (PCF) and for Corporate Carbon Footprint (CCF)

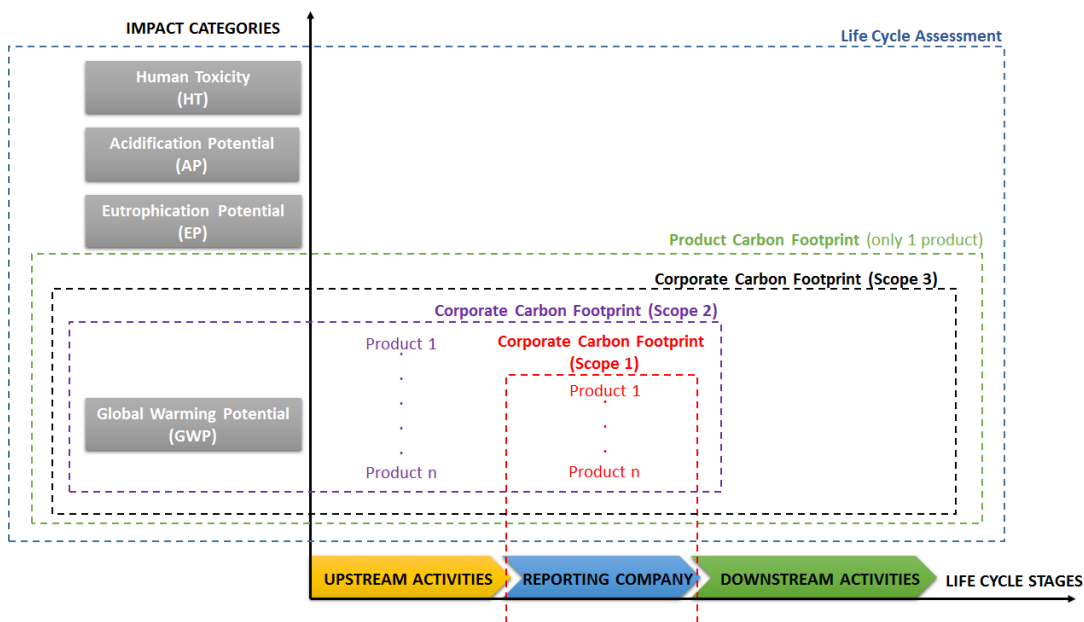


Figure 1: Differences between life cycle assessment versus corporate and product carbon footprint.

Figure 1 displays the differences among LCA, PCF and CCF. The LCA seeks to give a complete picture of the environmental burdens, including many impact categories, caused by a single product through a systematic mapping of operations and associated environmental pressures throughout a product's life cycle (Alvarez et al., 2015b). On the other hand, CF includes only one impact category: global warming potential. Between PCF and CCF, the main difference is that one company can produce many products, so a CCF includes all the products of the company in the assessment, while the PCF is applied to only one product. In addition, a CCF may include

scopes 1, 2, and 3. For instance, Scope 1 includes direct emissions from sources possessed or operated by the organization (boilers, furnaces, mobile combustions, fugitive emissions, etc.). Scope 2 considers electricity indirect GHG emissions based on the generation of power elsewhere used by the company (as these emissions take place outside the company, like power plants, they are considered indirect emissions). Finally, Scope 3 includes other indirect GHG emissions as a voluntary category of the protocol, including upstream and downstream phases of products lifecycles (like emissions related to raw material extraction or usage of products) (Harangozo and Szigeti, 2017).

2.2 Case study of Cantabrian gin

The methodological issues postulated before were applied to the beverage company Siderit, located in Cantabria (Northern Spain). This company, dedicated to the artisanal elaboration of premium spirit drinks such as gin and vodka, produces more than 250,000 units per year, exporting 50 % in more than 35 countries. The reference unit for the study was defined as the production of a bottle of gin composed by 70 cl of gin, primary packaging (glass bottle, wooden cap and three labels) and secondary packaging (cardboard box and pallets). This can be considered as the functional unit (FU) for PCF because it determines the hotspots in the life cycle of the product. However, in the case of CCF, there is no FU, but only key performance indicators to relate the impact to the production of the company. For instance, in the spirit drinks sector many different products can be found, varying from different types of gins (classic, Gingerlime, Hibiscus) to vodka, with different production processes and types of packaging. These key performance indicators are calculated by referring the GHG emissions calculated per year in relation to the production achieved in the same year. That is to say, the results will be expressed in number of t of CO₂ eq. emitted in 2017, while a key performance indicator could be defined as number of kg of CO₂ eq. emitted per bottle of gin produced, permitting then to compare 2017 emissions with other years. Nevertheless, this key performance indicator is not equal to the PCF of a bottle of gin produced by the company.

Figure 2 displays the flow diagram of the production of gin. The main raw materials of the product are its botanicals stands. The Rock Tea, an endemic to Picos de Europa Mountain's plant, makes it as unique and unequalled product. Other essential botanicals are the Flower of Jamaica that gives a floral aroma and a fresh aftertaste in the case of Hibiscus gin, and the ginger and lime for Gingerlime gin. Regarding the production and filling stage, it is composed by seven steps: raw materials reception, soaking, distillation, homogenisation, filling, labelling and packaging. The distillation is made from the maceration of its twelve botanicals, double distilled in batches in a reflux fractional column. The entire equipment is made of glass to prevent foreign smells or tastes. The distillery operates with electric power and the packaging is composed by a glass bottle, a wooden cap and three labels (primary packaging), and the cardboard box, HDPE film and pallets as secondary packaging. Finally, regarding to residues generation, three types of residues are distinguished: organic matter and heads and tails of the distillation.

Input and output of primary activity data were collected through technical questionnaires filled out by the chief engineering of the Siderit company. Ecoinvent database was chosen as the preferred database for secondary activity data. Capital goods were excluded from the assessment. Table 1 collects the main inputs and outputs of the life cycle inventory from year 2017.

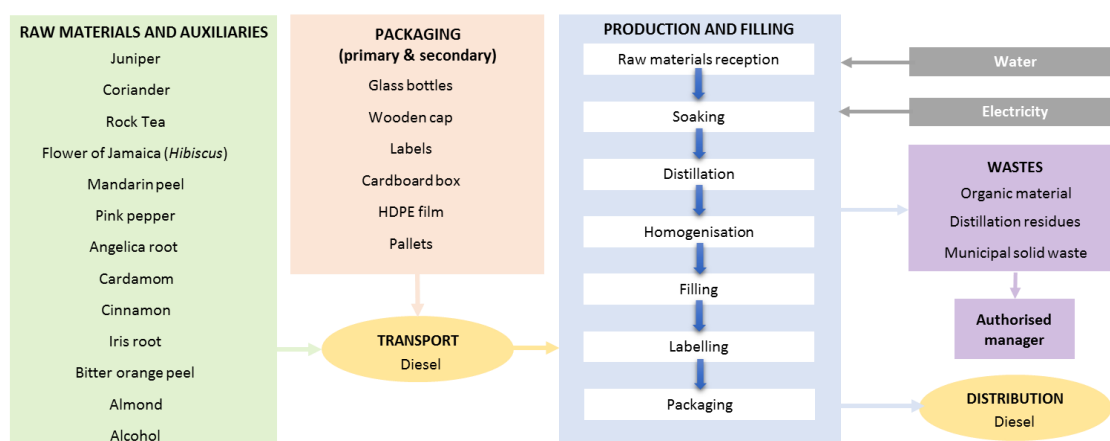


Figure 2: Flow diagram of the system under study.

Table 1: Summarised annual life cycle inventory of the Classic gin footprint and corporate footprint in 2017.

		Product	Corporate
	Unit	Quantity	
Inputs			
Botanicals	kg	2,700	4,500
Tap water	m ³	10	108
Spring water	m ³	18	33.6
Alcohol	m ³	12	22.4
Electricity	MJ	18,828	48,488
Glass bottle	uds	1	109,000
Cap	uds	1	109,000
Label	uds	1	109,000
Cardboard box	uds	0.17	18,166
Paper	kg	-	117
Outputs			
Gin	m ³	30	56
Organic matter	kg	2,700	60,300
Municipal solid wastes	kg	1,200	2,240
Distillation residues	kg	2,700	5,040

3. Results and discussion

The CF analysis was performed by aid of the Gabi 6 software (Thinkstep) which included LCIs of energy and chemicals. The global warming potential (GWP) was measured in kg of CO₂ equivalent emissions using the impact factors developed by the Intergovernmental Panel on Climate Change (IPCC, 2013). Figure 1 shows the PCF of one bottle (70 cl) of classic gin produced in 2017. The value of the PCF was 0.57 kg CO₂ eq., being the filling stage the major contribution to the total PCF. This was due to the production of the glass bottle that generates 0.47 kg CO₂ eq. per bottle. Other stages that may have a significant contribution were the packaging stage (4 %) where the production and transportation of the cardboard box produce 0.023 kg CO₂ eq., and the distillation stage (4.5 %) where the electricity used generated 0.026 kg CO₂ eq. per FU. Comparing the value of the PCF of one bottle of classic gin with other alcoholic beverages assessed in the literature, it can be observed that for one bottle (50 cl) of *pisco* results ranged from 1.7 kg CO₂ eq. to 4.0 kg CO₂ eq. (Vázquez-Rowe et al., 2017). On the other hand, Naravarro et al. (2017a) reported a PCF range of one bottle (75 cl) of wine between 0.17 and 2.18 kg CO₂ eq. being the average value around 0.85 kg CO₂ eq. These values are aligned with the obtained in this study; however, it must be taken into account that the production of *pisco* or wine have the vineyard stage, which is intensive in terms of energy and chemicals, so their PCF is a little more elevated.

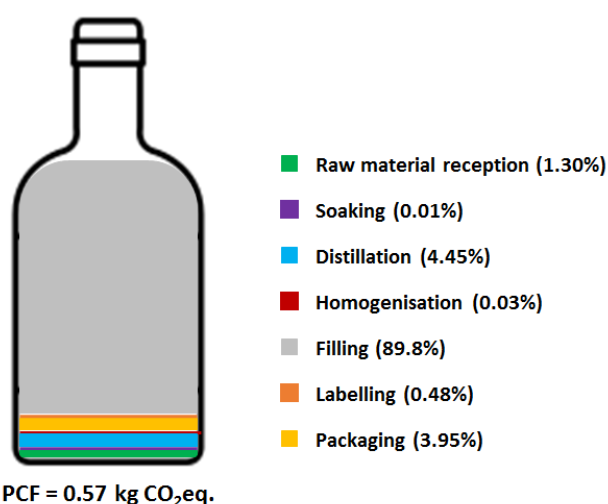


Figure 3: Product carbon footprint of one bottle (70 cl) of classic gin.

Regarding to the CCF, Figure 4a displays the GHG emissions values for Scope 2 and 3. The beverage company does not have direct emissions, so the Scope 1 could not be calculated. The total value of the CCF (Scope 2) was 4.58×10^3 kg CO_{2eq.} comprising the emissions generated by purchased electricity consumed by the beverage company. In addition, other indirect emissions, such as the production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the beverage company, not covered in Scope 2, outsourced activities, waste disposal, etc., were considered in Scope 3. Scope 3 emissions generated 5.58×10^4 kg CO_{2eq.} considering the production and transportation of botanicals, the industrial water consumption, the production of the packaging and the paper used in the offices. Figure 4b shows that the production of the glass bottle presented the highest GHG emissions, representing 93 % of the total CCF (Scope 3).

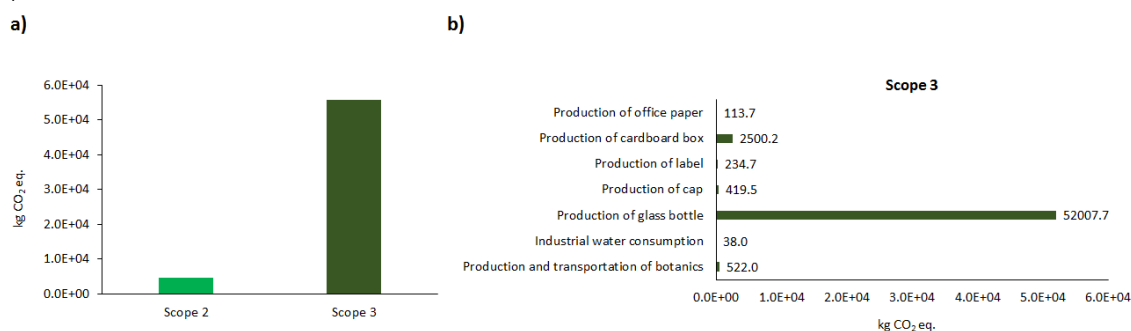


Figure 4: Corporate carbon footprint. a) Greenhouse emission values for each scope, and b) contribution of the different process considered in Scope 3.

4. Conclusions

The main novelty of this study is the assessment of the PCF and CCF of a Spanish beverage company, which were not reported previously in the spirit drinks sector. This is a very convenient approach to push small-medium enterprise companies towards eco-innovation and sustainability because it is easier for them to understand and apply.

The FU defined for the PCF was one bottle (70 cl) of classic gin including the secondary packaging. The value obtained of the PCF was 0.57 kg CO₂ eq. whereas the CCF presented a value of 4.58×10^3 kg CO₂ eq. for Scope 2 and 5.58×10^4 kg CO₂ eq. for Scope 3. They show that the emissions from the production of the glass bottle and the consumption of energy were the hotspots of the beverage company and had the highest contribution to the total CF.

The work developed depicts the fact that PCF and CCF can serve as a first step to provide improvement options to industries in order to decrease their GHG emissions. However, a more exhaustive further work is necessary to provide a useful decision framework for incorporating sustainability concerns in the spirit drinks sector.

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