

The link between LCA and CSR with espresso coffee as an example

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ABSTRACT

Corporate Social Responsibility (CSR) and a 360 degree approach to sustainable development including environmental, social and economic aspects are of growing interest. Lavazza is engaging its efforts to ensure an integrated approach aimed at providing a holistic perspective of sustainable development. Lavazza's efforts in ecodesign and LCA activities began in 2009 as part of the company's wider CSR programme. Gradually LCA and CSR have been linked in order to create an integrated approach. Whilst LCA adopts a product perspective, at the same time it contributes to the overall CSR strategy. The coordinated work between departments, within Headquarters, promotes an integrated approach to CSR, which includes the different technical corporate aspects, where LCA is one of the specific tools available fostering continuously improved environmental management. Other examples of tools are PackageExpert, which allows the performance of simplified LCA by packaging designers and the communication of results to managers, and a CSR tool that collects CSR data, partially originating from LCA activities, and enables the calculation of requested indicators. This approach is not only useful to enhance information exchange within the company, but is also a *conditio sine qua non* of an integrated CSR strategy.

Keywords: LCA, CSR, espresso coffee, sustainability, integrated approach.

1. Introduction

Sustainable development and minimization of environmental impacts within the coffee supply chain, the second most valuable commodity worldwide, are of growing interest. This trend is also visible by the increased application of current (ISO 14040:2006; ISO 14044:2006; ISO 14064-1:2012) and new environmental management standards (ISO 14067:2013; ISO 14046:2013) which focus both on product and corporate perspectives. Lavazza's innovative approach consists in ensuring that Life Cycle Assessment (LCA) is not only used as a technical tool but is part of the overall Corporate Social Responsibility (CSR) and that the two are used complementarily for environmental management.

Lavazza's corporate sustainability strategy identifies four key areas: product sustainability, production processes, human resources valorization and the interaction with stakeholders along the value chain.

Lavazza has been active on ecodesign and LCA activities since 2009; efforts to draft the first sustainability report, according to Global Reporting Initiative (GRI) standards, are ongoing (Lavazza 2014). Furthermore, Lavazza participates in a project of the Italian Ministry for the Environment, Land and Sea aimed at measuring, reducing and eventually compensating CO₂ emissions of two main coffee products: espresso coffee capsules and moka coffee (Italian Ministry for the Environment, Land and Sea 2014). At the sector level through the SAI platform, Product Category Rules (PCR) have been defined for Carbon Footprint (International EPD[®] System 2014).

Lavazza developed its strategies on environmental management and sustainable development, both at policy and at product level, by using LCA and CSR as two complementary approaches with different perspectives. The corporate perspective initially concentrated within the company's boundaries (gate to gate), is projected to expand those boundaries to external stakeholders such as suppliers, clients and consumers (simplified cradle to gate for all products). The product perspective looks at a particular section of the company's supply chain, analyzing the life cycle stages of a single product (detailed cradle to grave).

Although some studies have identified weaknesses of the LCA technique, its overall evaluation is nevertheless positive (Matuszak-Flejszman 2007; Lewandowska 2011). In detail, LCA has the advantage of providing an holistic perspective which is not limited to the boundaries of the organization (design, development, production processes, energy resources consumption and waste management), but also analyses the effects of environmental policies and practices of manufacturers and suppliers, extraction, transformation and distribution of raw materials, finished products distribution, use and waste management. From this point of view, a distinction between direct and indirect environmental aspects is important. Direct environmental aspects are associated with activities, products and services over that the organization has direct control. Indirect aspects concern the potential activities over which the company has no direct control but could be expected to influence.

The LCA approach measures ecological impacts, related to both direct and indirect environmental aspects. Espresso coffee is a complex food system with a multiple-actor supply chain which involves coffee plantations worldwide, green coffee traders and exporters, packaging suppliers, the coffee manufacturer, the distribution chain, consumers, clients and finally waste disposal management.

Although the involvement of all stakeholders might initially be more cumbersome, a holistic approach will transform barriers into mutual opportunities and thus strengthen market of all stakeholders on environmental management (Furfori et al., 2012).

LCA and CSR both contribute to the continuous improvement process aimed at the minimization of environmental, social and economic impact of the company's operations. LCA methodology follows a bottom-up approach, providing ecodesign feedback to R&D and pointing out possible improvement options (e.g. for green coffee cultivation and packaging) that can be implemented by the environmental product strategy. In this way, LCA has started at R&D (bottom-up) and is now contributing to core values of the company. On the other hand, CSR follows a top-down approach, starting at the management level and embedding LCA in the corporate strategy. This double strategy allows the company to have a complete perception of its environmental performances, both at corporate and product level.

The link and information exchange between LCA (product) and CSR (corporate) are crucial and specific tools, and have been developed to facilitate the interaction between the two levels. Examples of such tools are PackageExpert, which allows the performance of simplified LCA by packaging designers and the communication of results, and a CSR tool that collects CSR data, partially originating from LCA activities, and enables the calculation of the requested indicators and graphics.

The link between LCA and CSR will be illustrated with espresso coffee as an example, showing results from the tools applied. This link is not only useful to enhance information exchange between product and corporate perspective, above all it allows alignment between the CSR strategy with the product sustainability strategy.

2. Methods

2.1. LCA of espresso coffee capsule and moka coffee

LCA is a tool which allows to assess the potential environmental impact of a product, process or service along its entire life cycle (Guinée, 2002). In collaboration with the Italian Ministry for the Environment, Land and Sea LCA has been also applied to espresso coffee (Italian Ministry for the Environment, Land and Sea 2014).

The objective of Lavazza is to combine various LCAs that are interconnected in the coffee supply chain, in order to enhance ecodesign and communication and to reduce the environmental impact related to a cup of coffee.

The functional unit is defined as one cup of espresso coffee (30 cc.), prepared with an espresso machine using capsules. In case of moka coffee the functional unit is identical, but applied to moka coffee. The espresso machine is assumed to prepare 5000 cups of coffee during its lifetime. The system boundaries of espresso coffee include green coffee cultivation, processing and transport to Italy, coffee roasting, grinding and packaging, distribution, use phase (preparation of one cup of espresso with an espresso machine) and the end of life of coffee, packaging and the espresso machine. The system boundaries of moka coffee are identical, except for the production plant which is located in Torino and the preparation of the moka coffee which takes place with an electric moka machine.

In order to facilitate the elaboration of the complex life cycle of espresso coffee (containing more than 350 process units), the LCA has been divided into four sub LCAs as represented in Figure 1: LCA of coffee, LCA of manufacturing, LCA of packaging and LCA of the espresso or moka machine. Primary data are obtained from green coffee plantations and packaging suppliers using personalized questionnaires. To conduct LCA of agricultural products is a very complex task taking into account the data acquisition, modeling and compilation but it is a fundamental step for understanding the potential environmental impacts and then establishing the basis for product ecolabelling. Different agricultural practices produce different environmental performances. The amount of chemicals is directly related to cultivation practices such as tillage rotation, density of plants, etc. The goal of the LCA study on green coffee was to establish a good correlation of the agricultural practices and potential en-

environmental impacts of coffee, increasing the internal knowledge on environmental sustainable aspects related to the raw material.

Future updates of this research will collect a large and representative number of primary data from the biggest suppliers (in this study, the primary data come from Brazil, India, Vietnam) and show the evolution of the natural resources management as land use, new agricultural practices, lower fertilizer and chemical use.

Also inventory data of Lavazza's production plants and the use phase of the espresso or moka machine are based on primary data and direct measurements. Secondary data are obtained from scientific literature, particularly for the green coffee cultivation phase (Coltro et. al., 2006) and the Ecoinvent database v2.2. Greenhouse gas emissions and other impact categories are quantified using IPCC 2007 (IPCC, 2007) and ReCiPe (Goedkoop et. al., 2008). The LCA has been conducted in line with ISO 14040/14044 (ISO, 2006), using SimaPro software (PRé, 2013).

At the product level LCA is used for ecodesign, hot spot analysis and environmental communication; whilst at the corporate level, LCA is used both strategically, to align CSR with product sustainability, and operationally, to provide a scientific basis for environmental data collection in a life cycle perspective, feeding tools such as the PackageExpert and the CSR tool.

2.2. PackageExpert

PackageExpert is a simplified ecodesign tool, which allows corporate packaging designers to develop simplified screening LCAs of different packaging solutions, enabling comparative analysis. By inserting packaging input data, such as, components' materials and weights, typology of transport, manufacturing processes and end of life options (ISPRA, 2012), PackageExpert calculates the Carbon Footprint and the Cumulative Energy Demand of the selected packaging solution.

The link between PackageExpert and the product level consists in its use by packaging designers working on ecodesign. On the other hand, the tool is regularly updated and based on scientific LCA knowledge. The link with the corporate level is the possibility to apply PackageExpert to all packaging solutions performed in a company's production plant, providing aggregated data to the CSR tool.

2.3. CSR tool

The CSR tool is a simplified tool with a corporate approach, which allows the collection of LCA data related to the entire supply chain of all products manufactured in a certain production plant. By inputting aggregated input data, such as total amount of green coffee transported to the plant, typology of transport, total amount of coffee manufactured, total distribution and waste treatment, the CSR tool calculates the Carbon Footprint and the Cumulative Energy Demand of the entire supply chain of all products manufactured in the production plant.

The link between CSR and the product level consists in including ecodesign activities in a corporate strategy: this way, LCA is embedded in a context and becomes a core tool for environmental management. Operationally, LCA provides useful information that needs to be collected for the implementation of a CSR strategy. The link between the CSR tool and the corporate level speaks for itself: the collection of environmental, economic and social data, and their aggregation in key indicators requires a dedicated tool. The CSR tool focuses on the environmental dimension, combining and aggregating LCA data with material flows and production volumes in order to obtain relevant key environmental performance indicators.

3. Results

3.1. LCA of espresso coffee capsule and moka coffee

Greenhouse gas emissions and other impact categories are quantified using IPCC (IPCC, 2007) and ReCiPe (Goedkoop et. al., 2008), as illustrated in Figure 2. The results express the relative contribution of each life cycle stage to the total impact of one cup of espresso coffee.

The results show that the most significant impacts are generated during the upstream processes (55%-82%), a small part is caused by the core processes of the coffee manufacturer (4% - 14%), while a significant remaining part is generated during the downstream processes (16%-42%). The environmental hot spots are the green coffee

cultivation (32%-70%), coffee consumption (17%-28%) and packaging (3%-19%). Overall, the LCA results appear to be consistent with other studies published on coffee (e.g. Humbert et al., 2009; TCHIBO, 2008).

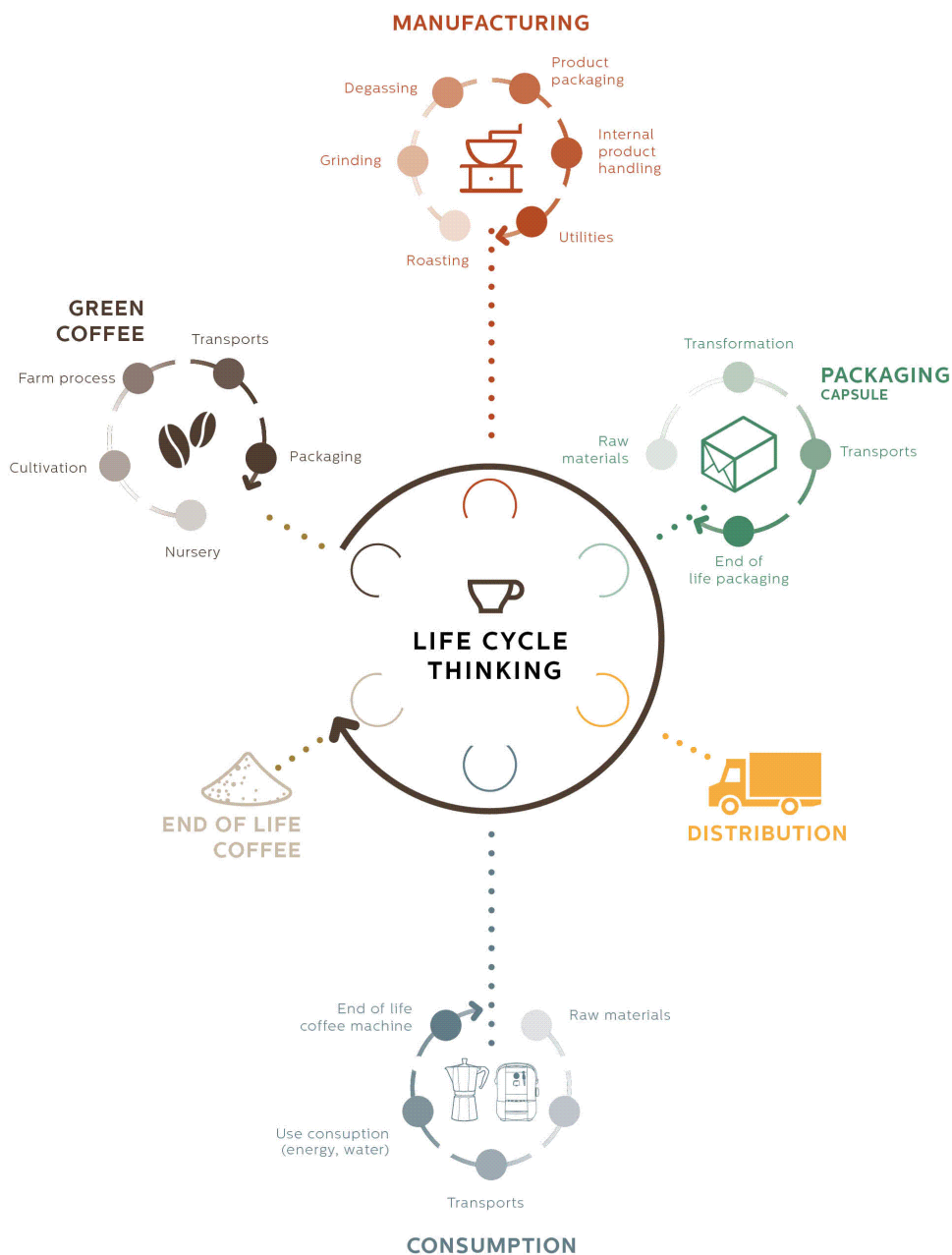


Figure 1. Combined espresso coffee LCAs .

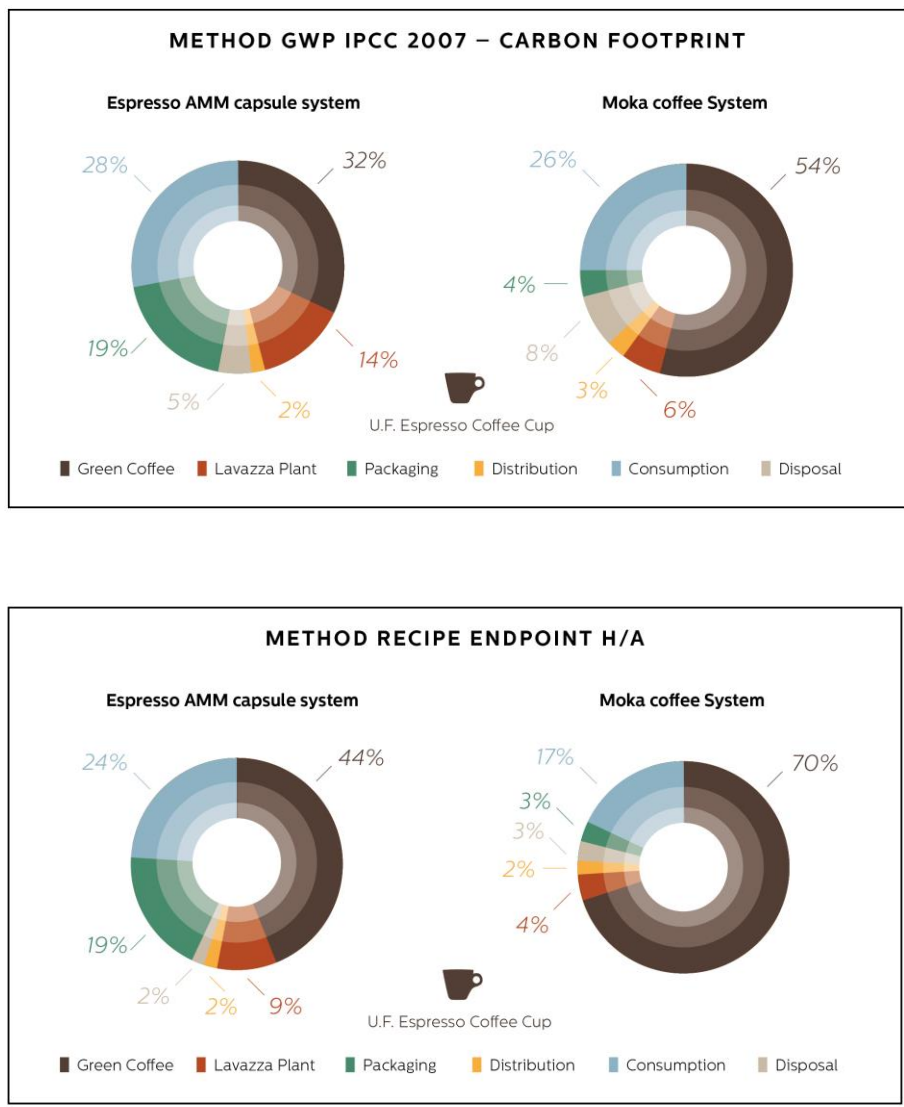


Figure 2. LCA results of one cup of espresso coffee, according to IPCC and ReCiPe.

3.2. PackageExpert

An example of the results of PackageExpert is shown in Table 1, illustrating the environmental indicators of the life cycle of a single packaging solution. Since PackageExpert is a simplified tool, it is feasible to apply the tool to all packaging solutions performed in a company’s production plant. This allows to calculate not only the impact of single packaging can be evaluated (product level), but also the environmental contribution of all packaging solutions within a given production plant (corporate level).

3.3. CSR tool

The CSR tool enables aggregation of LCA data into environmental performance indicators at the corporate level. Figure 3 shows the results of the CSR tool applied to the entire supply chain of the Torino production plant, expressed in CO₂ eq. (Carbon Footprint) and MJ (CED) per life cycle stage. The CSR tool can be applied to each location and comprises besides the gate to gate analysis (processing at plant) as well as upstream (green coffee) and downstream processes (distribution, end of life). In a simplified way, based on aggregated LCA data,

material flows and production volumes, the CSR tool evaluates the life cycle stages (excluding the use phase) of all main products manufactured at the production plant. In other words, it represents an aggregation of many product levels into the corporate level.

Table 1. Example of results of PackageExpert for a single packaging solution.

Packaging Life cycle	Carbon Footprint (IPCC) [g CO _{2eq}]	Cumulative Energy Demand [MJ]
Raw materials	48,5	1,291
Raw materials transport	0,8	0,014
Processing	6,5	0,131
Packaging Transport	0,5	0,009
End of life	8,0	0,008
Total	64,3	1,453

Table 2. Example of results of PackageExpert for multiple packaging solutions performed at the corporate level.

Packaging	Amount (pieces)	[g CO _{2eq}]for 1 piece	[tCO _{2eq}] tot.	[MJ] for 1 piece	[GJ] tot.
Packaging 1	1.000.000	115	115	2,85	2.850
Packaging 2	2.000.000	100	200	2,50	5.000
Packaging 3	1.000.000	200	200	5,00	5.000
Etc.					
Corporate			515		12.850

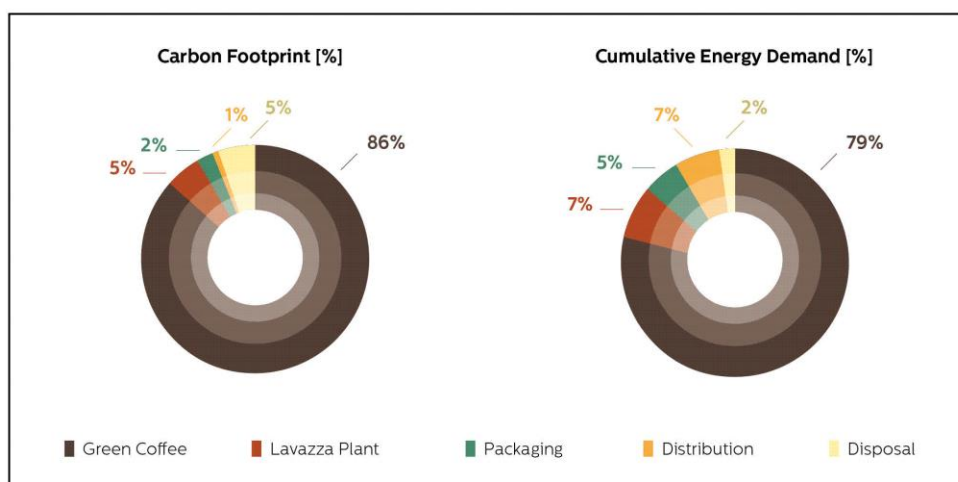


Figure 3. Results of the CSR tool for the entire supply chain of all products of the Torino production plant.

4. Discussion

LCA studies on coffee show that environmental hot spots are in particular green coffee cultivation, preparation of coffee during the use phase and packaging. In relation to the above, coffee processing (core) only generates a limited environmental impact. This emphasizes the need to view the environmental performance of coffee in a life cycle perspective (upstream and downstream).

In Lavazza, LCA was at first used in the R&D department (bottom-up) while the next step required embedding of LCA in the corporate strategy. This was achieved through CSR (top-down) thus allowing the company to have a complete perception of its environmental performances, both at product and corporate levels.

Information exchange between LCA (product) and CSR (corporate) with crucial and specific tools was developed to facilitate the interaction between the two levels. Examples of such tools are PackageExpert, which allows the performance of simplified LCA by packaging designers and the communication of results to managers, and a CSR tool that collects CSR data, partially originating from LCA activities.

Initial experiences with the different tools indicate that the tools are well interlinked, and provide added value both at the strategic and the operational levels. LCA is used strategically to align CSR with product sustainabil-

ity, and, operationally, to provide a scientific basis for environmental data collection in a life cycle perspective, feeding tools like PackageExpert and the CSR tool. Besides single packaging solutions, PackageExpert can be applied to all packaging solutions of a company's production plant, providing aggregated data to the CSR tool. On the other hand, CSR takes care of embedding LCA and ecodesign activities in the corporate strategy.

The integrated LCA and CSR approach, in the context of being used for identification and assessment of environmental aspects in the corporate strategy, has advantages but also its limitations (Figure 4, SWOT). The main weaknesses, from the point of view of the considered application, includes higher time consumption and the complexity of the assessment. On the other hand, LCA enables a number of possibilities like capturing of indirect aspects, obtaining quantitative results, fostering a holistic approach through the cooperation of all stakeholders.



Figure 4. Advantages and limitations of LCA with regard to using in CSR strategy.

5. Conclusion

In conclusion, whilst an integrated LCA and CSR approach can seem more time consuming and complex to manage in terms of costs as well as unification of data, at the same time it provides a distinct advantage in terms of holistic approach, data collection, optimization and verification as well as methodology. Further, it provides an unique opportunity to achieve maximum alignment of product and corporate strategies as well as an effective stakeholder engagement.

Future work on the integrated LCA and CSR approach will focus on the improvement of the interaction between the two concepts, both at the strategic and the operational level, enhancing the information exchange between tools and systems. The obtained experience will be used to further implement this integrated approach to the entire organization of Lavazza, both at all production facilities and along the entire coffee supply chain.

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