

LCA of Packed Food Products

– the function of flexible packaging –
– Case Study: Coffee –

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Uster, January 2008

Executive Summary

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Imprint

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Executive Summary - Case Study: Coffee

“LCA of Packed Food Products: the function of flexible packaging”

Büsser S., Steiner R. and Jungbluth N. (2008) LCA of Packed Food Products: the function of flexible packaging. ESU-services Ltd. commissioned by Flexible Packaging Europe, Düsseldorf, DE and Uster, CH.

The evaluation of the environmental performance of packaging usually concentrates on a comparison of packaging materials. Other aspects including sustainable consumption and production of packed goods are often neglected. The same applies to the functional role of flexible packaging, which is the distribution of goods to society to satisfy human needs.

Broader approaches, which focus on the life cycle of packed goods, including the entire supply system and the consumption of goods, are necessary to get an environmental footprint of the food supply system with respect to sustainable production and consumption.

And as the only reason to produce packaging is to enable the consumer to consume products the relevant question from a sustainability point of view can be only to optimize the sustainability along the total supply chain of consumer goods rather than focussing on parts of it.

The three main targets of this study are:

- the investigation of the environmental performance of flexible packaging with respect to its function within the life cycle of goods, i.e. within the supply chain and consumption of goods,
- the investigation of the role of flexible packaging in view of resource efficiency and prevention of spoilage of packed goods, and
- the investigation of the environmental relevance of stages and interdependencies within the life cycle of goods while taking consumers' patterns and portion sizes into consideration.

The study illustrates the environmental relevance of flexible packaging within the supply chain. While the results of this study are not immediately transferable to other packaging systems or types of products this study shows that the environmental impact from the packaging of the investigated sample products is minor in comparison to the impact from the production of the product, its processing and the consumer behaviour in the use of the product. Additionally, depending on the product, packaging can contribute to minimise the environmental impact of production, processing and use by reducing spoilage and overconsumption.

The results of this study are calculated for eight environmental indicators based on the CML 2001 method. The main impact assessment and discussion is based on five indicators which are:

- Cumulative energy demand (CED), non-renewable (MJ eq.)
- Global warming (kg CO₂ eq.)
- Ozone layer depletion (ODP) (kg CFC-11 eq.)
- Acidification (kg SO₂ eq.)
- Eutrophication (kg PO₄³⁻ eq.)

The life cycle inventory for coffee encompasses the whole food supply system from the cultivation, processing, packaging, and transportation of the coffee beans to production and packaging of ground and soluble coffee, transport to retailers and households, and the brewing ending with a cup of coffee ready to drink. The growing as well as the first stages of coffee processing occurs commonly in countries near the equator due to climatic reasons. Most of the coffee, however, is going to be consumed in the industrialised countries (e.g. Europe).

As water vapour and oxygen reduce the quality of coffee its packaging material consists of laminate with a number of layers made of different materials to prevent the diffusion of these substances through the packaging. This study investigates packaging where the barrier layer consists of aluminium foil (typically 6 to 12 µm, in this study 7 µm).

The functional unit for the coffee life cycle is defined as ‘to prepare one cup of coffee ready to drink at home’.

The impact assessment of coffee consumption includes a standard scenario for coffee made from ground or instant coffee with water and eventually milk as well as different spoilage, packaging disposal, and consumer behaviour scenarios.

The standard case assumes: average roasted coffee in a roastery with emission control, brewing the coffee or heating the water by an automatic coffee machine, normal user behaviour concerning coffee machine switch off, and PET/Al/PE bag.

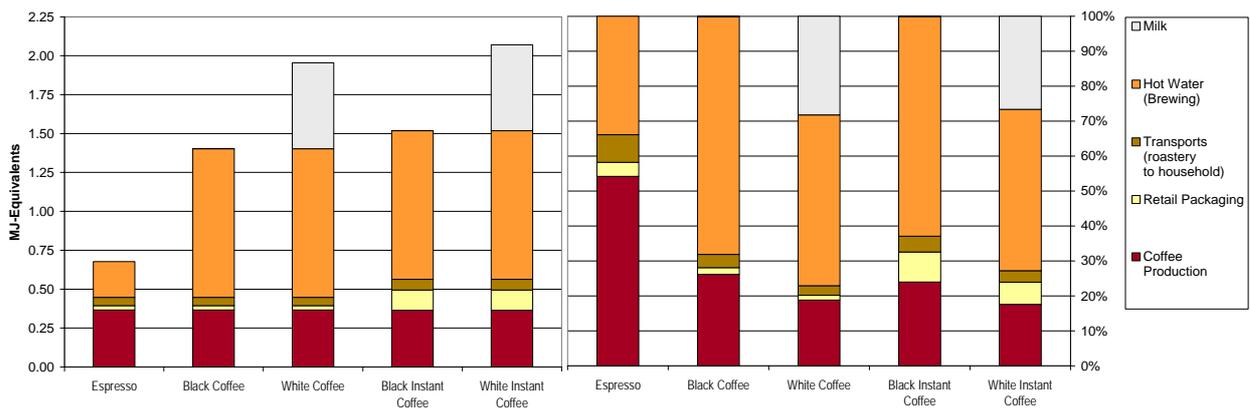


Figure 1: Results of the standard case for a cup of coffee with regard to the non-renewable cumulative energy demand. Left are shown the absolute values and on the right side the results are scaled to 100 %.

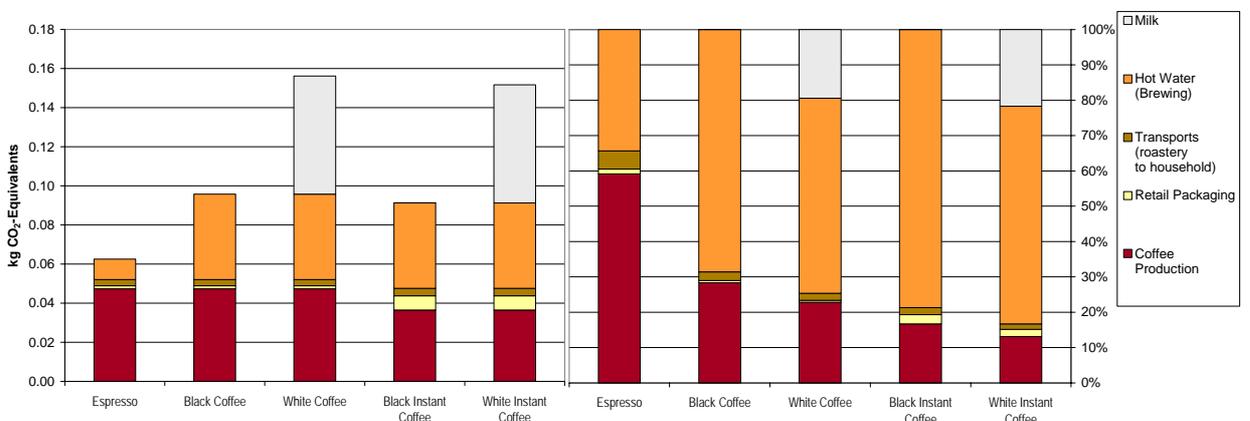


Figure 2: Results of the standard case for a cup of coffee with regard to the global warming potential. Left are shown the absolute values and on the right side the results are scaled to 100 %.

The study shows: the most relevant environmental aspects for a cup of coffee is brewing (i.e. the heating of water) and coffee production compared to transport and retail packaging which are of minor importance. Brewing and coffee production have a considerable impact share between 82 percent (ozone layer depletion, black instant coffee) and 99 percent (eutrophication, black coffee) In the case of white coffee the milk added is of great environmental relevance. The instant coffee in the one-portion stick-pack needs more packaging material per cup of coffee and leads, as a consequence, to higher shares of the retail packaging in all indicators. On the other hand: a one-portion stick-pack can prevent spoilage or over-consumption, and even when in this case hot water is also wasted resources related to coffee production can be saved.

A sensitivity analysis was conducted regarding the following parameters: brewing behaviour, i.e. normal (75% water excess) vs. economical (10%) resp. negligent (150%), brewing device (coffee machine vs. kettle), spoilage (no leftovers vs. 33% spoilage of coffee in case of ground coffee resp. hot water in case of instant coffee), packaging disposal (incineration vs. landfill), grocery shopping (average distances vs. urban resp. countryside scenario), adding up: best case / worst case.

The sensitivity analysis has shown the following results: the influence of packaging disposal is very small due to the general low influence of packaging. In contrast, the brewing behaviour is highly relevant for the environmental impact of a cup of coffee. That applies similarly to the type of heating device – i.e. using a kettle or an automatic coffee machine. Spoilage leads to a significant increase of all indicators. Under the spoilage scenario the coffee from one-portion stick-packs has a better environmental performance concerning all indicators, because in case of instant coffee spoilage of hot water and in case of ground coffee spoilage of prepared coffee has been predicted. Regardless of urban or countryside distances, grocery shopping has low impact.

In the best case scenario a kettle is used to prepare the coffee, the user behaves in an economic way regarding the brewing, the coffee packaging is incinerated resp. recycled (cardboard box) and the urban transport scenario is chosen for bringing the coffee from the supermarket to the household. In the worst-case scenario a coffee machine is used, the user behaves in a negligent way (switch-on time 24 h/d), the coffee packaging is landfilled and the countryside transport scenario is chosen.

Conclusions for the consumption of coffee: the most important factors concerning the environmental impact from the whole supply chain of a cup of coffee are the brewing of coffee, its cultivation and production, and the milk production in case of white coffee. The optimisation potential in the cultivation and production of coffee was not analysed. Against this background, the study highlights consumer behaviour and packaging related measures to reduce the environmental impact of a cup of coffee:

- Economic user behaviour, e.g. switching the machine on only when needed and reducing the stand-by usage.
- Using a kettle instead of an automatic coffee machine contributes to the reduction of electricity consumption, however, convenience and coffee experience aspects may not always allow to substitute a kettle for a coffee machine.
- Reducing leftovers of brewed coffee and hot water by preparing the coffee on a cup per cup basis. This avoids wastage of coffee in its drinking form including all the previously resources needed to produce and allocating the coffee and wastage of hot water.
- Minimising the amount of packaging – the cardboard box for the instant coffee packaging is not to be neglected in view of some indicators.
- Optimising the amount of packaging by choosing adequate packaging sizes.

Concluding remarks: Packaging has an environmental impact, though low, in relation to those along the full life cycle relevant to evaluate the sustainable consumption of drinking coffee. While single serving packaging normally needs more packaging per filling, tailor-made packaging, on the other hand, can reduce spoilage, thus improving overall resource efficiency along the food supply chain. However, com-

pared to the reduction potential of other measures (e.g. economic coffee machine utilisation) packaging is not considered to be of primary importance for this type of product. Consumer's behaviour influences the environmental impacts of coffee consumption much more than the type of common packaging.

Summary

It should be the aim of every type of industry to minimize the environmental impacts directly related to their products. This study shows that in case of packaging industry this goal can only be reached if also aspects indirectly influenced by the product are taken into account. Thus, the packaging industry does not only aim to improve the production process of their packages, but also to provide packages whose functionality helps to reduce other more relevant environmental impacts in the life cycle. Depending on the product tailor-made packaging may also help to increase overall resource efficiency.