ifeu -
Institut für Energie-
und Umweltforschung
Heidelberg GmbH

Meta analysis:
LCA studies on beverage cartons and alternative packaging

Executive summary

Commissioned by:
the Alliance for Beverage Cartons & the Environment (ACE) and
the World Wide Fund for Nature (WWF)

Authors:
Eva von Falkenstein
Andreas Detzel
Frank Wellenreuther

Heidelberg, November 2009

Executive summary

Background, goal and key questions

In the past years, numerous life cycle assessments (LCAs) on the environmental impacts of beverage packaging systems have been conducted. The Alliance for Beverage Cartons & the Environment and the World Wide Fund for Nature asked the Institute for Energy and Environmental Research (Heidelberg, Germany) to conduct a comprehensive evaluation of those existing studies, with a special focus on beverage cartons. The current report presents a technical evaluation and a condensed overview of the findings and conclusions of the individual LCA studies included in this meta analysis.

The **goal** of this meta analysis was to provide a structured overview of life cycle assessments (LCAs) on beverage cartons (BCs) and other packaging systems which have emerged during the last 10 years. This report is to allow a quick understanding of the analysed studies' main characteristics, highlighting both similarities and differences not only in terms of results but also regarding the applied methodologies.

The **key questions** this meta analysis aims to answer are:

1) Is it possible to draw general conclusions regarding the environmental performance (in terms of strengths and weaknesses) of beverage cartons in comparison to alternative packaging systems from these existing LCAs?
2) If certain trends arise across these LCA studies regarding the environmental performance of beverage cartons compared to other packaging systems for beverages, what can be said on their validity and limitations?

LCA studies covered

The meta analysis covers 22 LCA studies, all of which fulfil the following criteria:

☑ LCA-based approach (life cycle assessment as basic principle of evaluation)

☑ beverage or food carton must be among the products evaluated in study

☑ comparative approach (comparison of different products, i.e. a beverage carton and at least one other packaging type)

For this meta analysis, each of the selected studies was categorised:

- either as a core study (7 studies focussed on Europe, conducted in 2000 or later, and peer-reviewed)
- or as a basic study (15 further studies deemed likely to be relevant to the meta analysis).

Validity and limitations of findings

The findings presented are valid within the framework conditions described in this report. They are subject to limitations a) arising from the methodological approach taken within this meta

analysis and b) inherent in the original LCA studies that were analysed – and thus beyond the influence of the authors of this meta analysis. Typical limitations concerning, amongst other things, the general applicability of the conclusions, arise from the specific settings and the valuation methods applied in the analysed LCA studies.

Conclusions

In order for the meta analysis to achieve robust comparative conclusions, some results (from the analysed LCA studies) were excluded from interpretation:

- results, for which the original report does not clearly specify the fill good
- fill good categories as well as impact indicators and inventory level categories that are analysed by less than 3 LCA studies for a specific fill good

With this, the conclusions apply to packaging systems for the fill goods juice (and nectar), ambient and chilled milk.

Climate change

All analysed LCA studies assess the greenhouse gas emissions and in the great majority of cases, the BC is attributed with the lowest impact. This applies in spite of a variety of settings covered in the individual LCA studies and is generally reflective of both non-carbonated soft drinks (including juice) and milk.

Acidification

Acidifying impacts are examined by most LCA studies. For the fill good milk, the BC is always attributed with the lowest impact. For juice, the results show a trend in the same direction. This favourable picture for beverage cartons applies for a variety of different settings covered in the individual LCA studies.

CED (total, non-renewable, fossil)/fossil resource consumption

For the fill goods juice and milk, the consumption of non-renewable/fossil resources, often analysed with a focus on energy carriers, is assessed by all but three studies. In all cases but one, the BC is attributed with the lowest impact.

Land use (forest)

Only some of the analysed LCA studies explicitly regard the occupation of land surface by forests. In those studies that do so, the BC is always associated with a larger use of forest area than the compared alternative packaging systems. This is a direct consequence of its material composition: around three quarters of the BC consist of paperboard from wood fibre. Alternative products, however, use relatively little biomass feedstock or none at all.

For the following environmental indicators / categories, no sound conclusions were possible.

Land use (sealed, landfill)

Due to the small number of studies addressing the topic, no sound conclusions can be drawn on the ranking of the BC regarding this environmental issue.

Summer Smog

Over half of the analysed LCA studies examine summer smog. The respective results indicate a possible trend towards attributing the BC with the lowest impact.

Eutrophication

Terrestrial eutrophication is explicitly covered by over half of the examined LCA studies, and the BC is almost always attributed with the lowest environmental impact.
Aquatic eutrophication is only explicitly examined by a few studies and the results show a very mixed picture. No evidence of any trend can be derived from this meta analysis.

Ecotoxicity

Only 3 of the LCA studies covering juice and milk explicitly examine ecotoxicity, in all cases attributing the BC with the lowest impact. However, due to the small number of studies addressing the topic, no sound conclusions can be drawn on the ranking of the BC regarding this environmental issue.

Human toxicity

Human toxicity is only examined by 3 of the LCA studies covering packages for juice and milk, and the results show a mixed picture: the results vary strongly depending on the indicator used and the case group. Therefore, no evidence of any trend can be derived from this meta analysis.

Water consumption

Due to the small number of studies addressing the topic, no sound conclusions can be drawn on the ranking of the BC regarding this environmental issue.

Waste

Due to the small number of studies addressing the topic and the strong variation in results, no sound conclusions can be drawn on the ranking of the BC regarding this issue.

Further environmental issues

The report includes a section on additional environmental-related topics that generate questions from stakeholders within the beverage carton and liquid packaging board industry. The topics addressed are the origin of wood sources, biodiversity and water use.