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Imprint

Publisher:

Fachverband Kartonverpackungen
für flüssige Nahrungsmittel e.V. (FKN)
Tel.: +49 (0) 611 - 187 88-0
e-mail: fkn@getraenkekarton.de

Editor/text:

Michael Kleene

Design/layout:

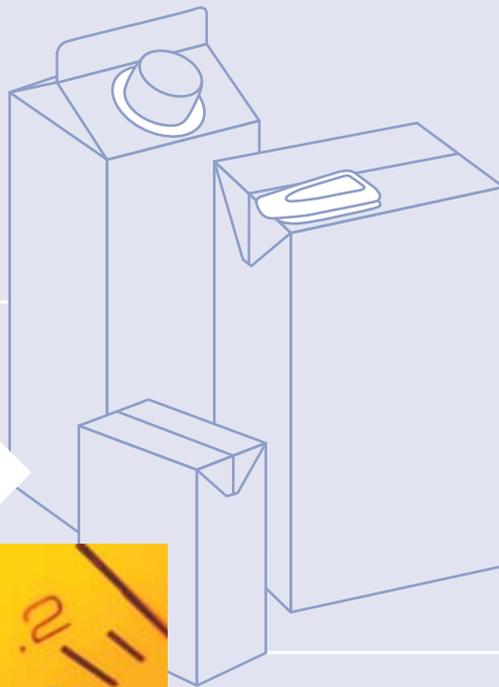
Habemus DITO
Design Agentur GmbH, München
www.habemus.de

Mai 2007

Printed on 100% recycled paper

Life cycle assessment

→ Beverage cartons under test



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|-----------|--------|---------|--|
| Editorial | Method | Studies | |
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Contents

| | |
|---|----------------|
| Editorial | Page 3 |
| Method | Page 4 |
| ➔ From the cradle to the grave | |
| ➔ ISO standard increases credibility | |
| ➔ The 4 steps of a life cycle assessment | |
| ➔ Life cycle of a milk carton | |
| Studies | Page 9 |
| ➔ Life cycle assessment for fresh milk packaging | |
| ➔ Life cycle assessment for packaging for alcohol-free beverages and wine | |
| ➔ Life cycle assessment for fruit juice cartons | |
| ➔ Life cycle assessment for beverage cartons/PET bottles | |
| Press reviews | Page 22 |
| Environmental lexicon | Page 23 |



Life cycle assessment

Beverage cartons are → “environmentally advantageous”

It has long been considered environmentally irresponsible to sell milk and fruit juice in cartons. Anybody wanting to act in an environmentally conscious way opted for the refillable bottle, which after all is reused and causes no waste. “Refillable systems are good, disposable systems are bad” is an environmental doctrine which has rarely been queried and which allowed no refined interpretation.

In the mid 1980s carton manufacturers tried to dispute the refillable approach with scientific facts but they were unsuccessful: From the outset, life cycle assessments which were commissioned by industry had the taint of prejudice. At that time there were no uniform, internationally recognised standards laying down how to carry out life cycle assessments. The discussion about methods had still not really started.

The situation today is very different: Since 1997 ISO standards 1440-43 have prescribed internationally applicable procedures which are binding for both the private and public sectors. Life cycle assessments have become a key instrument of German and European environmental policy. They can help companies identify weak points and so allow them to improve their products from an environmental perspective.

The manufacturers of beverage cartons were quick to act – and have had success: On 9 August 2000 the German Environment Minister, Jürgen Trittin, declared “From an environmental point of view there is a stalemate between refillable bottles and disposable beverage cartons”. The beverage carton is an “environmentally advantageous” packaging.

The basis for this statement was the results of a life cycle assessment of the Federal Environment Agency on packaging for alcohol-free beverages and wine. This is known as “UBA II” in expert circles. In this brochure we would like to summarise these results, along with those of three other ISO-compliant studies commissioned by the FKN. To enable even laymen to understand the concept of a “life cycle assessment” we have included a short section on the methodology involved: What actually is a life cycle assessment? How is it prepared? What can it tell us?

*Dr. Wilhelm Wallmann
Director of the Fachverband
Kartonverpackungen für flüssige
Nahrungsmittel e.V.*



German Environment Minister, Jürgen Trittin: “From an environmental point of view there is a stalemate between refillable bottles and disposable beverage cartons.”



From the cradle to the →grave

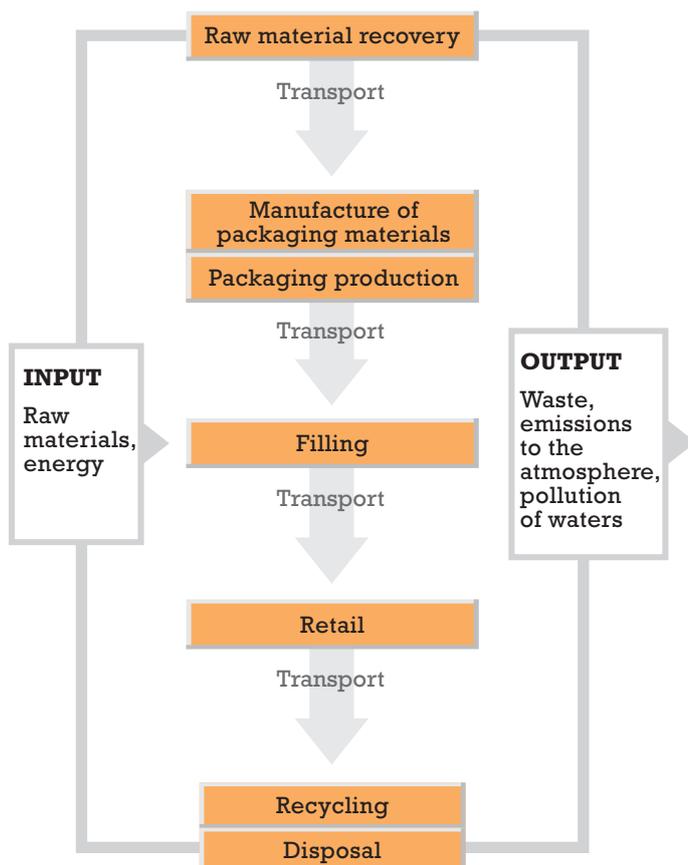
Life cycle assessments are a relatively new instrument for environmental management: Back in the 1970s, following the oil crisis, the pioneers of life cycle assessments started asking themselves how the energy consumption of complex production processes can be rationalised.

The primary aim was for companies to identify where savings could be made. Other criteria such as resource consumption, emissions and waste came later. Life cycle assessments only truly became popular, however, at the start of the 1990s – and this was particularly so in Germany. The majority of product life cycle assessments that have been undertaken worldwide have been carried out in Germany. A third of these have concerned packaging systems.

The main interest is the environmental effects of a product during its full life cycle – from recovery of raw materials via the production through to disposal or recycling. At each of these stages of the life cycle there is an impact on the environment (water, air, soil). These effects have to be quantified and assessed.

Production technologies and recycling technologies are becoming ever more advanced. A change in the conditions under which the products are manufactured, transported or recycled necessarily means that the results of the original life cycle assessment then only have limited meaning.

→ Product life cycle



Life cycle assessment

ISO standard → increases credibility

The initial euphoria about life cycle assessments led to the belief that all environmental properties of products could be described in detail and summarised using just a few parameters. The complex array of process data was compressed until an environmental winner was identified. Important details got lost in the process, the meaningfulness of the data was overestimated and unlike was often compared with unlike. The impression of

the outside world was that life cycle assessments allowed any desired result to be obtained.

A breakthrough came in 1997 after more than 4 years of discussions on methods: Since that time the International Standardisation Organisation (ISO) has prescribed methodological rules which lay down how life cycle assessments must be undertaken.

Dr. Manfred Marsmann → chairman of the ISO committee on life cycle assessments

Dr. Marsmann, you were highly involved with the development of standards for carrying out life cycle assessments. Is the debate about methodology finally over?

Dr. Marsmann → *The objective of the ISO standard series 14040 ff. is to create a binding basis which allows serious, objective assessments to be drawn up which are not manipulated in any way and which represent the current state of science. Despite slightly different opinions on some aspects of methodology, a general consensus was reached about what methodological rules and procedures are required in order to obtain a fair and balanced life cycle assessment. The debate about methods continues however despite the standardisation. Life cycle assessment methods are constantly being advanced, but that is quite normal.*

For comparative studies the ISO standard prescribes a “critical review” by independent experts. What specifically is reviewed here?

Dr. Marsmann → *The critical review is a means of monitoring the quality of the study; the experts are present from the outset and monitor whether the specifications of the standard have been fulfilled. For example, whether the data that have been used are representative and reliable and whether the method that has been used is suitable to realise the objective of the study.*



Dr. M. Marsmann: “Serious, objective life cycle assessments are the goal.”

The 4 steps of a → life cycle assessment

1

1. Definition of the objective and scope of the study

This section describes the reason for carrying out the study. Is the commissioning party concerned with improving his product from an environmental standpoint? Does he wish to use the study for marketing purposes or does he need it as justification against political decision-makers in order to avert legal measures? The requirements on life cycle assessments become stricter the more they are directed at the public and the greater the comparative character. If this is the case, then scientific supervision of the study by an independent critical review panel is imperative.

2

2. Life cycle inventory

First of all the life cycle of the packaging system is reconstructed. This considers not only the packaging itself, but rather all system components – namely also the bottle labels, closures and transport pallets (see chart on Page 8). Thereafter all the available data are collated, organised and put in a systematic context.

Decisive here are the boundary conditions under which the systems are compared. For example: How far are the packagings transported? How high is the recycling quota? What percentage of the residual waste is incinerated or deposited as landfill? How often is a bottle refilled? All available data are integrated into the base scenario which reflects the status quo. So-called sensitivity analyses can then be undertaken to vary these data in order, for example, to determine the influence of altered transport distances or recycling methods on the overall result.



Life cycle assessment

3

3. Estimation of effects

The wealth of life cycle inventory data is initially complex and cannot be interpreted. A cumulative value, which indicates, for example, how many grams of a substance are emitted into the atmosphere during glass smelting says nothing about the effects on the environment. All substances emitted into the environment must therefore first of all be assessed from an (eco-)toxicological standpoint and be assigned to specific environmental impact categories. These include the environmentally important areas of global warming potential, acidification and resource consumption (fossil). Other impact categories are added depending on the particular interest of the party commissioning the study.

When assessing the potential environmental effects of individual substances there are, however, often uncertainties involved. For example, methane, according to the current state of scientific knowledge, is 20.5 times more harmful than CO₂ for the global warming potential. This factor could however be greater or small than this. Due to this uncertainty, there has to be considerable differences between the products that have been studied when interpreting the data before unambiguous statements can be made.

4

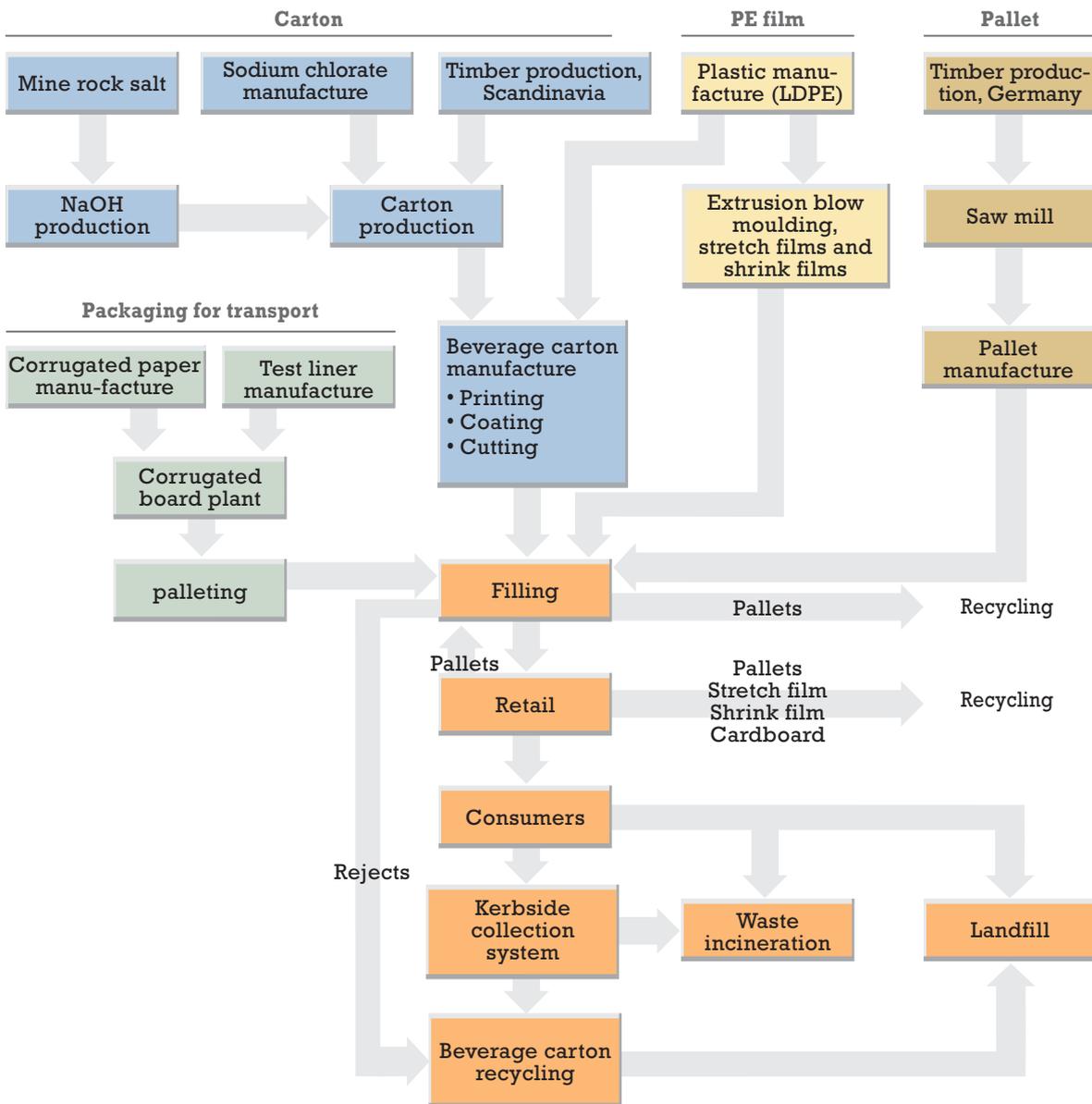
4. Assessment

The results of the life cycle inventory and the estimation of effects must be interpreted with reference to the objective of the study. It is vital that the results are comprehensible and can be understood by laymen and that the company concerned can draw conclusions for optimising their product. DIN/ISO standard 14043 prescribes some principles for this.



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|-----------|--------|---------|--|--|
| Editorial | Method | Studies | | |
| | | | | |
| | | |  | |

→ Life cycle of a milk carton



Highly simplified flow chart of the life cycle

Life cycle assessment for fresh milk packaging

Life cycle assessment for fresh milk packaging

→ Fraunhofer Institute IVV (1999)

Background

The first life cycle assessment of the Federal Environment Agency on beverage packaging systems was carried out in 1995 (known as: UBA I). Direct comparison of milk bottles with milk cartons put the bottles just ahead. Environmental improvements in pulp and cardboard production and drastically improved recycling quotas for cartons meant that four years later a new study was necessary. In March 1999 the Fraunhofer Institute for Process Engineering and Packaging IVV, commissioned by the Fachverband Kartonverpackungen für flüssige Nahrungsmittel e.V. (FKN), submitted the first life cycle assessment on beverage packaging which was undertaken in accordance with the specifications of the new DIN/ISO standard series 14040.

The critical review panel consisted of representatives of TNO-Institut (Delft) and the Eidgenössischen Materialprüfungsanstalt EMPA (St. Gallen), the chairman of the ISO committee on life cycle assessments and an employee of the Federal Environment Agency.

Scope of the study

Two milk carton systems were studied: brick-shaped block cartons and gable-shaped cartons. These were both compared to refillable glass bottles. The most recent data was used. Several sensitivity analyses were undertaken to ascertain the effects of different transport distances and the number of refilling cycles. The effect on the results if packagings, which ended up in the waste container, were no longer disposed of as landfill as has been the case up until now but were incinerated was also analysed. This result is important because laws enacted in 2005 mean that untreated waste may no longer be disposed of as landfill.





Results

The summary of the study states: **“Unambiguous and full environmental prioritisation of one system type for fresh milk (disposable or refillable) cannot be deduced from the results at the level of the individual impact categories.”**

Expressed more simply: **→ There is no environmental winner!**

- In some environmental impact categories the carton systems were superior whilst in others the bottles prevail.
- The results for all the packaging systems were close to each other.
- Even regarding landfill waste there is a stalemate between the systems if the residual waste is energetically recycled in a waste incinerator.
- There are opportunities for optimising all the packaging systems.

→ Life cycle assessment for fresh milk packaging

| Impact category | Beverage cartons (block) in % worse than refillable bottles | Beverage cartons (block) in % better than refillable bottles |
|------------------------------------|---|--|
| Global warming potential | | 6% |
| Eutrophication | | 34% |
| Energy consumption (total) | 20% | |
| Energy consumption (non-renewable) | | 11% |
| Acidification | | 13% |
| Landfill waste | 250% | |
| Special waste | | 26% |
| Minerals | | 95% |
| Water consumption | 69% | |

Source: Fraunhofer IVV, 1999

Life cycle assessment for fresh milk packaging

**Paul W. Gilgen, → Eidgenössische Materialprüfungsanstalt (EMPA),
member of the critical review panel**

In six of the nine environmental impact categories the brick-shaped packaging was superior to the refillable bottle. Can we not then conclude a score of 6:3 for the beverage carton?

P. Gilgen → *This conclusion first of all assumes that all the environmental impact categories have the same weighting in the assessment. Such a simplified assessment would not be correct and is also not covered by ISO standards. Much more important, however, is to recognise that the results for the packaging systems were very similar in almost all the impact categories. The differences are marginal and do not differ significantly from each other. Even if the computer calculations gives the results to one decimal place the differences still lie in the one and same results' range. When drawing conclusions, account must be taken of the naturally large range of scatter of the results due, amongst other things, to the very variable date quality.*

Besides having an advantage in the waste category, the refillable bottle has advantages over the carton in the energy consumption and water consumption categories. When interpreting the results, does one not also have to consider qualitative aspects, namely what fuel is being used – oil or wood? And are we using purified drinking water or merely river water?

P. Gilgen → *The combining of individual fuels to arrive at an overall energy value or the combining of different water resources to give an overall water consumption is a simplification. The study therefore states that ca. 36% of the energy requirement for the carton system is provided by renewable raw materials. Regarding water consumption there is indeed a qualitative difference as to whether purified drinking water or untreated surface water is used. This was also taken into account in the study: For cartons only ca. 10% drinking water was used, yet this value was ca. 80% for the bottles.*



Paul W. Gilgen: “The differences are marginal.”

Life cycle assessment for beverage packaging II for alcohol-free beverages and wine

→ Federal Environment Agency (2000/2002)

Background

In the definition of the objective of the study the Federal Environment Agency states “as always there is much political interest in the further reduction of the environmental impact of packaging”. “Environmentally advantageous” packaging systems should be promoted and further optimisations of all beverage packaging pushed through.

In 1996 four research institutes were commissioned to evaluate the environmental-friendliness of different beverage packagings: Prognos, IFEU, GVM and Pack Force. The study consisted of two parts: An analysis of the status quo, reflecting the environmental scenario in 1996, and an optimisation scenario (phase II), predicting future developments. The latter covered, for example, reduced packaging weight, new technologies for glass smelting and carton recycling, increased use of recycled content for manufacturing cans and the effects of statutory regulations for disposing of waste (TASI). Part 1 of the study was published in August 2000 and Part II in July 2002.

The life cycle assessment was undertaken according to DIN/ISO standards. The chairwoman of the critical review panel, as for the fresh milk study, was Mrs A. de Groot-van Dam of TNO (Delft). In a move beyond the requirements of DIN/ISO 14040, the project was supervised by a committee which included representatives of the packaging industry and members of consumer and environmental groups.

Scope of the study

The study covered 28 disposable and refillable packaging systems with filling volumes ranging from 0.25 to 1.5 litres for mineral water, beverages with and without CO₂ and wine. Phase II also included new packaging systems which had gained in significance since 1996 or which were expected to become more significant in the future. This particularly concerned disposable PET bottles, 0.5 litre cans and 1.0 litre lightweight glass bottles.

Life cycle assessment UBA II

Results

In August 2000 the Federal Environment Minister, Jürgen Trittin, summarised the results of the first part of the study as follows:

“From an environmental standpoint there is a stalemate between refillable glass bottles and disposable beverage cartons. ... The dividing line does not run exactly between refillable and disposable systems, but rather between environmentally advantageous and environmentally unfavourable packaging systems.”

On presenting the future scenario (phase II) in July 2002 the President of the Federal Environment Agency, Prof. Andreas Troge, stated:

“Although there have been considerable improvements to report regarding disposable and also refillable packaging systems, refillable systems will remain superior to disposable systems for the foreseeable future. Beverage cartons are however an exception here.”



Prof. Andreas Troge, president of the Federal Environment Agency, and Jürgen Trittin, German Environment Minister, present the life cycle assessment.



Prof. Andreas Troge, president of the Federal Environment Agency:

“Beverage cartons are an exception.”



The results in summary

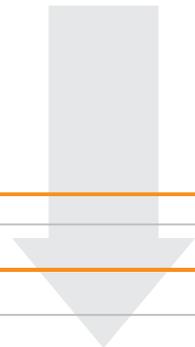
Impact categories

→ In four of the five environmental impact categories classified as being of high or very high importance by the Federal Environment Agency, the carton is superior to the bottle; in four other environment categories the carton is inferior (see figure → Life cycle assessment for beverage packaging systems).

→ Life cycle assessment for beverage packaging systems (no CO₂) UBA 2000

| Environmental importance | Impact category | Beverage cartons (block) in % worse than refillable bottles | Beverage cartons (block) in % better than refillable bottles |
|--------------------------|-------------------------------|---|--|
| Very high | Global warming potential | | 6% |
| High | Terrestrial eutrophication | | 86% |
| | Resource consumption | | 23% |
| | Acidification | | 20% |
| | Summer smog | 2% | |
| Medium | Space requirements (landfill) | 50% | |
| | Aquatic eutrophication | 680% | |
| | Space requirements (forest) | 1300% | |

Source: UBA 2000



Life cycle assessment UBA II

Recycling

→ According to the Federal Environment Agency, the positive outcome for beverage cartons is due to the “advanced state” of recycling technology. The material recycling of aluminium realised since 2001 and the further increased recycling quotas lead to “significant improvements” compared to the status quo of 1996 (see figure → Optimisation calculations for 1.0 litre beverage cartons).

Waste treatment

→ Since 2005 no untreated waste may be deposited as landfill and therefore the in-use area of the waste disposal site no longer plays a role. A further positive effect for beverage cartons is that methane emissions from the site are prevented. This leads “in some cases to a considerable reduction” in the other environmental impact categories (see figure → Optimisation calculations for 1.0 litre beverage cartons).

→ Optimisation calculations for 1.0 litre beverage cartons, UBA 2000

| Impact category | 11% weight reduction (realised since 1997) | Recycling quota 64% (realised since 1997) | Al recycling (realised since 2002) | Thermal treatment of the residual waste (realised since 2005) |
|-------------------------------|---|--|---------------------------------------|---|
| | Improvement by: | Improvement by: | Improvement by: | Improvement by: |
| Global warming potential | 6% | 2% | 9% | 16% |
| Terrestrial eutrophication | 6% | 1% | 0% | 1% |
| Resource consumption | 6% | 0% | 16% | 7% |
| Acidification | 6% | 0% | 9% | 3% |
| Summer smog | 7% | 1% | 1% | 4% |
| Space requirements (landfill) | 10% | 11% | 0% | 94% |
| Aquatic eutrophication | 4% | 4% | -6% | 0% |
| Space requirements (forest) | 4% | 4% | -7% | 0% |

Source: UBA 2002

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|-----------|--------|---------|--|
| Editorial | Method | Studies | |
| | | |  |

Life cycle assessment for fruit juice cartons

→ IFEU (2004)

Background

This study is a continuation of the life cycle assessments of the Federal Environment Agency (UBA II) and updates the data for beverage cartons and refillable bottles to 2002/2003 status. This was necessary because in the UBA studies closures and pouring aids on beverage cartons were not included in the assessment due to their low market relevance at that time. Today, however, most beverage cartons are fitted with closures.

The “life cycle assessment of fruit juice cartons” drawn up by the Institute for Energy and Environmental Research (IFEU) in Heidelberg was commissioned by the Fachverband Kartonverpackung für flüssige Nahrungsmittel (FKN). It was carried out according to the DIN/ISO standard series 14040 ff. and was appraised by a critical review panel (Prof. Dr. Walter Klöpffer (LCA Consult & Review) and Dr. Paul Gilgen (EMPA)). The methodical approach and assessment methods of the Federal Environment Agency were adopted for this study.

Scope of the study

The study assessed beverage cartons and refillable glass bottles for fruit juices (CO₂-free drinks). For the first time other packaging sizes of 200 ml and 1500 ml were assessed in addition to the standard 1 litre size.

Sensitivity analyses were used to determine, for example, the effect of technical standards of filling plants or different transport distances. The study also provided valuable information about how packaging and closure systems can be improved from an environmental standpoint.



Life cycle assessment for fruit juice cartons

Results

Since the publication of the life cycle assessment of the Federal Environment Agency (UBA II) the eco-profile of beverage cartons has not worsened due to the increased use of plastic closures. The summary of the study states:

- “Both 1 litre beverage cartons and 1 litre refillable glass bottles have in the meantime significantly improved environmental impact profiles.”
- “The improvements in the two packaging systems are roughly equivalent.”
- The lower the filling volume, the more favourable the beverage carton compared to the refillable glass bottle: The 0.2 litre beverage carton was superior to the small refillable bottle in virtually all impact categories.

→ Life cycle assessment for 1.0/0.2 litre beverage packaging systems (no CO₂) IFEU 2004

| Environmental importance | Impact category | Beverage cartons (block) in % worse than refillable bottles | Beverage cartons (block) in % better than refillable bottles | Size |
|--------------------------|-------------------------------|---|--|------|
| Very high | Global warming potential | 5% | | 1.01 |
| | | | 34% | 0.21 |
| High | Terrestrial eutrophication | | 46% | 1.01 |
| | | | 57% | 0.21 |
| | Resource consumption | | 7% | 1.01 |
| | | | 30% | 0.21 |
| | Acidification | | 7% | 1.01 |
| Summer smog | | 29% | 0.21 | |
| Medium | Space requirements (landfill) | 31% | | 1.01 |
| | | 11% | | 0.21 |
| | Aquatic eutrophication | 492% | | 1.01 |
| | | 251% | | 0.21 |
| | Space requirements (forest) | 1571% | | 1.01 |
| 1624% | | | 0.21 | |

Source: IFEU 2004

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|-----------|--------|---------|--|
| Editorial | Method | Studies | |
| | | | |
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Life cycle assessment of beverage cartons and disposable PET bottles

→ IFEU (2006)

Background

The life cycle assessments (LCAs) carried out in 2000 and 2002 by the Federal Environment Agency (UBA) provide little specific data about packaging systems for fruit-based beverages, ice tea and fresh milk drinks. This is particularly so for disposable PET bottles which had little market significance prior to 2003. Just two years later, however, PET had largely displaced disposable glass bottles and reusable containers as the packaging systems for fruit-based drinks. PET now ranks second behind beverage cartons as the most commonly used packaging system for fruit juices. Experience from other countries indicates that, in the case of fresh milk drinks, a similar development cannot be excluded. Moreover, the fact that the life cycle assessment of the Federal Environment Agency on fresh milk packaging systems (UBA I) was already 10 years old meant that an update had become necessary.

FKN commissioned IFEU (Institute for Energy and Environmental Research) in Heidelberg to undertake this first comprehensive LCA on beverage cartons and PET bottles. The study complied with ISO standards and the methodology which was adopted was similar to that employed by the Federal Environmental Agency. The supervisory project group included representatives of the beverage filling and waste disposal sectors. Unfortunately no industrial association representative from the polymer industry was available to participate. In accordance with ISO requirements, the LCA was subsequently subjected to a critical review process.

Scope of the study

The study covered beverage cartons and disposable PET bottles for fruit-based drinks (fruit juices and nectars), ice tea and fresh milk drinks (pasteurised milk, ESL milk ¹⁾, milk-mix drinks) having filling volumes in the 200 ml to 1500 ml range. Packaging systems that were available in the German market in 2005 were studied. With regard to beverage cartons, all varieties were considered with respect to their relevant market shares. As such, the study was representative of the overall market. Moreover, technologically conceivable improvements to PET bottles (e.g. reduced bottle weight, recycled content of 25%) were simulated in a “future scenario 2010” and compared to current beverage cartons. Although there are also potential improvements for beverage cartons, a corresponding sensitivity analysis was not undertaken – to remain on the safe side. A further future scenario concerned the 1000 ml PET milk bottle. At the time of the assessment, this packaging system was not available in Germany but was, for example, available in Italy.

¹⁾ Shelf-life up to 21 days



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Life cycle assessment for cartons/PET bottles

The composition of the packaging materials is highly dependent on the required minimum shelf-life (MSL) of the respective product. To allow comparison of packagings having the same protective function, three case categories were formed:

1. Fruit juice/nectar packaging systems with an MSL of at least 12 months;
2. Fruit juice/nectar/ice tea packaging systems with an MSL of 6–7 months;
3. Fresh milk drink packaging systems with an MSL of 10–12 days.

Results:

→ Regarding 1-litre packaging systems for **fruit-based drinks** with extended shelf lives, the beverage carton performs considerably better than the disposable PET bottle in six of the eight impact categories. For smaller volume packaging systems (500 ml, 200/330 ml) there is a similar picture. “Noteworthy are the substantial differences in the global warming potential and resource consumption (fossil) categories.” The environmental importance of these impact categories is rated by the Federal Environment Agency as being “very high” and “high” respectively.

→ The differences between the 1.5 litre **ice tea packaging systems** are not so distinct and are due to the fact that PET monolayer bottles without barrier properties are used. Here again, though, much the same applies: “In the global warming potential and resource consumption (fossil) categories the impact indicators for the carton are considerably lower than those for the PET bottle.”

→ Comparison of packaging systems for **milk-mix drinks** with short shelf-lives showed that the beverage carton is more environmentally advantageous in all the impact categories apart from aquatic eutrophication and space requirements (forest). “With regard to the global warming potential and resource consumption (fossil), the system differences between the carton and PET bottle are more pronounced than is the case for the packaging systems for juices and ice tea.” This is due to the absence of an aluminium layer in the beverage carton.

→ Regarding the 1 litre **fresh milk packaging systems** “... the overall environmental impact is largely the same as the results for the packaging systems for milk-mix drinks”. Here again, no barrier layers are necessary in these packaging systems.



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|-----------|--------|---------|--|
| Editorial | Method | Studies | |
| | | |  |
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» Given the benefits of the beverage carton in case categories 1 and 3, plus the advantages in the particularly important impact categories of resource consumption (fossil) and global warming potential, it can be stated overall that there are clear environmental advantages for the beverage carton over the disposable PET bottle. This applies for all the packaging systems that were compared within the scope of this life cycle assessment. «

→ Comparison beverage cartons¹⁾/PET bottles²⁾ for fruit juice (1.0 l/0.5 l), IFEU 2006

| Environmental importance | Impact category | Beverage cartons in % worse than PET bottles | Beverage cartons in % better than PET bottles |
|--------------------------|-------------------------------|--|---|
| Very high | Global warming potential | | 1.0l 167% 0.5l 162% |
| | | | |
| High | Terrestrial eutrophication | | 1.0l 37% 0.5l 41% |
| | Resource consumption (fossil) | | 1.0l 164% 0.5l 152% |
| | Acidification | | 1.0l 23% 0.5l 27% |
| | Summer smog | 42% 1.0l 43% 0.5l | |
| | | | |
| Medium | Aquatic eutrophication | | 1.0l 26% 0.5l 39% |
| | Space requirements (forest) | 99% 1.0l 89% 0.5l | |
| No classification | Energy consumption (total) | | 1.0l 48% 0.5l 55% |

1) 1.0 l / 0.5 l beverage cartons with closure
2) 1.0 l / 0.5 l PET multilayer bottles (38 g/28 g)



Life cycle assessment for cartons/PET bottles

→ Comparison beverage cartons¹⁾/ PET bottles²⁾ for ice tea (1.5 l), IFEU 2006

| Environmental importance | Impact category | Beverage cartons in % worse than PET bottles | Beverage cartons in % better than PET bottles |
|--------------------------|-------------------------------|--|---|
| Very high | Global warming potential | | 117% |
| High | Terrestrial eutrophication | | 1% |
| | Resource consumption (fossil) | | 119% |
| | Acidification | 11% | |
| | Summer smog | 92% | |
| Medium | Aquatic eutrophication | 138% | |
| | Space requirements (forest) | 1325% | |
| No classification | Energy consumption (total) | | 14% |

1) 1.5 l beverage cartons with closure

2) 1.5 l PET monolayer bottles without barrier (41.5 g)

→ Comparison beverage cartons¹⁾/PET bottles²⁾ for milk-mix drinks (0.5 l), IFEU 2006

| Environmental importance | Impact category | Beverage cartons in % worse than PET bottles | Beverage cartons in % better than PET bottles |
|--------------------------|-------------------------------|--|---|
| Very high | Global warming potential | | 199% |
| High | Terrestrial eutrophication | | 29% |
| | Resource consumption (fossil) | | 217% |
| | Acidification | | 53% |
| | Summer smog | | 18% |
| Medium | Aquatic eutrophication | 90% | |
| | Space requirements (forest) | 1836% | |
| No classification | Energy consumption (total) | | 63% |

1) 0.5 l beverage cartons without aluminium, with closure, for refrigerated distribution of milk/ milk-mix drinks

2) 0.5 l PET monolayer bottles without barrier (20 g)

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| Editorial | Method | Studies | |
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Comments from the press

Die Welt, 10.8.00

“What was long known is now finally official: Carton packaging systems do not have a greater impact on the environment than refillable glass bottles. Nevertheless, that message still is exciting today - because of all people the green Federal Environment minister, Jürgen Trittin, had to announce that.”

Die Zeit, 10.08.00

“After several years of research work strictly following ISO standards, the Federal Environment Agency has found out that the once disputed PET bottle – as soon as it is refilled – is equivalent to a refillable glass bottle from an environmental standpoint. Even more astonishing, however, is that the life cycle assessment now being presented also grants political absolution to beverage cartons which are only filled once.”

Süddeutsche Zeitung, 10.08.00

“Unspoilt nature is good, human utilisation of nature is disastrous. Glass is good, plastic is bad. The eco-community has grown up with such truths, but time and again life proves to be more complicated and that includes the environment. (...) Is some of our “green wisdom” being lost as a result? Most surely not. Refillable systems should as before still be the first choice. One has merely to be freed of ideological conscience. If a PET bottle can be sufficiently often refilled, why should people be forced by the state to lug heavy glass bottles up steps to their flat on the fifth floor? And if (disposable) beverage cartons are almost equivalent due to the superior recycling methods, one’s environmental conscience can be pacified. ...“



Life cycle assessment

Brief environmental lexicon

Global warming potential

→ Excessive heating of the Earth's atmosphere; Cause: Water vapour and "greenhouse gases" such as carbon dioxide, methane etc. let the visible light from the sun pass through but the heat radiation emitted by the Earth is however largely absorbed by these gases; Consequence: An increase in the global temperature.

Eutrophication

→ Excessive supply of nutrients in surface waters and the soil; Cause: Nitrogen oxides, ammonia, phosphorus, nitrate, etc. from amongst other things energy generation and traffic; Consequences: Strong algal growth and oxygen removal from surface waters and over-fertilisation of the soil.

Resource consumption

→ Consumption of fossil fuels such as crude oil, natural gas, lignite and bituminous coal.

Acidification

→ Input of acid into surface waters and the soil; Cause: Sulphur oxides, nitrogen oxides, fluoro/chloro hydrocarbons, etc. from industrial processes, traffic, households, etc.; Consequences: Harm to the soil, plants and surface waters, weathering of buildings and structures.

Summer smog

→ Formation of near-ground ozone by the action of the sun's rays; Cause: Hydrocarbons and nitrogen oxides from traffic, energy generation, etc.; Consequences: In high concentrations, sensitive persons may experience irritation to the mucous membranes, the eyes and respiratory organs.

Space requirements (forest)

→ The size of the cultivated area of forest required to produce wood and paper.