

SUBMISSION FROM THE PAPER PACKAGING CO-ORDINATION GROUP

With reference to the 2005/06 AEA Technology Environment and associates report commissioned and published by the Environment and Rural Affairs Department of the Scottish Executive.

It has been drawn to the attention of the European paper and board industries that the French Carrefour study (Evaluation des impacts environnementaux des sacs de caisse Carrefour, Ecobilan, 2004) was used as the basis for the AEA report.

We would like to clearly state that the Carrefour study is only applicable to the specific case of Carrefour purchasing policies in France¹, and cannot be generalised to other cases. This is also the opinion of the authors of the Carrefour study, and this point is acknowledged in the study. The paper and board industries therefore have serious concerns about the application of the Carrefour study outside of France, and in particular its use for the development of waste policy and regulation.

In addition, the paper and board industries recently commissioned an independent peer review by STFI-Packforsk in Sweden (enclosed). The STFI-Packforsk review concludes that, not only are the findings of the Carrefour study for paper carrier bags not applicable to cases other than Carrefour France, but may be flawed even for the specific case of Carrefour.

It should also be noted that the Carrefour study is even less applicable to paper products in general. Unfortunately not only does the AEA Technology Environment and associates report not reflect the narrow focus of the Carrefour study, but it also goes on to make more general unsubstantiated claims, such as the environmental impact of paper being worse than that of plastics.

The AEA Technology Environment and associates report takes no account of the fact that a higher percentage of paper packaging is recycled in Europe compared with any other packaging material, both in terms of absolute volumes and in rate². The scenario that land filling would increase if paper bags were not under a levy, is therefore highly unlikely (Scenarios 1A and 1B of the AEA report).

The paper and board industries would therefore ask that the Scottish Executive recognises the limited validity of those claims made in the AEA report that are based on the Carrefour study, and reconsiders the suitability of this study as a basis for future policy development in this area.

For your further information and reference the key findings of the STFI-Packforsk review are listed below.

We remain at your convenience for any further information or discussion on this or related issues,

* Currently the following organisations participate in the PPCG:

CEPI, Confederation of European Paper Industries

CITPA, International Confederation of Paper & Board Converters
ACE, Alliance for Beverage Cartons & the Environment
ECMA, European Carton Makers Association
ECO, European Containerboard Organisation
EMBALPACK, European Association of Makers of Packaging Papers
ESBO, European Solid Board Organisation
CEPI EUROKRAFT, European Kraft Paper Producers for the Flexible Packaging Industry
EUROSAC, Fédération Européenne des Fabricants de Sacs en Papier à Grande Contenance
FEFCO, European Federation of Corrugated Board Manufacturers
GROUPEMENT ONDULE, European Association of Makers of Corrugated Base Papers
PROCARTON / CEPI CARTONBOARD, Association of European Cartonboard & Carton Manufacturers
PAPERPLUS, Speciality Paper Manufacturers Association

Key findings of the STFI-Packforsk review:

- 1) The comparison between paper and plastic bags is based on an incorrect volume of plastic bags. If similar functionality were to be compared, the PE bag inputs and outputs should be doubled throughout the life cycle.
- 2) LCA data for paper production derives from a paper grade that would not normally be used for this product type. The most common paper bag raw material would be produced more energy efficiently and with more renewable energy.
- 3) The time span of the study is set so that the PE bag would not yet emit GHG, while the emissions from paper are included to a large extent. A correct time perspective is essential for an unbiased comparison. Furthermore, the share of land filling of paper products varies from country to country, and in France is lower than the EU average.
- 4) The energy mix used in production is unique in each country and this has an impact on the environmental performance of the product. On average, paper is produced with over 50% of biomass based energy and over 90% CHP, which is far beyond the performance of the plastic industry.

¹ E.g. the Carrefour study has a setting where paper bags were produced in Italy while the plastic bags were produced locally. The former were transported long distances on road haul while the latter were also shipped on boat.

² According to the latest data released by the European Commission, paper and board packaging had again the highest rate of all packaging materials, 68% on average in EU-15 (compared to 24% of plastic packaging) and was performing more than proportionally to the volume put on the market. See http://www.europa.eu.int/comm/environment/waste/pdf/1997_2002.xls



Comments on the Carrefour life cycle report on carrier bags

- Brief review

STFI-Packforsk report number: 58

Assignment ordered by: PPCG,
CEPI
250, Avenue Louise
B-1050 BRUSSELS
BELGIUM

Contact person: Ulf Hill, CEPI Eurokraft

Address: Rådmanngatan 88
113 29 STOCKHOLM
SWEDEN

Assignment carried out by: Pär Weström, Martin Johansson

Reference no. (offer, order, project): 7048-0509

Stockholm, 2005-10-17

STFI-Packforsk AB
Packaging & Logistics
Packaging systems

Pär Weström
Project manager

This report shall be communicated unabridged unless otherwise agreed in writing with STFI-Packforsk AB.

Comments to the Carrefour life cycle report on carrier bags

2 (12)

Table of contents

	Page
Key findings	4
1 Introduction	6
1.1 Aim.....	6
1.2 Background.....	6
1.3 Project activities	6
2 STFI-Packforsk's comments on the Carrefour report	7
2.1 General comment about the study	7
2.2 Comments and questions	7
2.2.1 Are all the bags in the study fully comparable as regards functionality?	7
2.2.2 Brief comparison with other studies	9
2.2.3 End-of-life scenarios	10
2.2.4 Influence of national data for electricity production.....	11
3 References	12

Key findings

STFI-Packforsk has, on behalf of CEPI PPCG, made a short review of the report “Évaluation des impacts environnementaux des sacs de caisse Carrefour”¹ (Ecobilan 2004) and evaluated possible weaknesses in the performance that affect the results in an incorrect negative way for paper carrier bags. The key findings in this study are listed below.

STFI-Packforsk's comments on the Carrefour report

The aim of the Carrefour study was not to do a general study of carrier bags on a European level; it was made especially to evaluate the environmental impact from four different types of carrier bags used by Carrefour. **STFI-Packforsk would not recommend this study to be used for general conclusions about the environmental impact from carrier bags.** The comments and questions below, presented in order of priority, give the reason for our point of view.

1) Are all the bags in the study fully comparable as regards functionality?

This comment focuses on the differences in characteristics of the disposable PE-bag (6.04 g; 16 µm; 14 l) and the paper bag (52 g; 90 g/m²; 20,5 l).

- The functional unit chosen, “to pack 9000 litre of purchased Carrefour products”, only considers volume – not weight. In reality, the considerably higher strength of the paper bag would give a much more efficient load capacity than that of the disposable PE-bag. Thus, in our opinion, **more PE-bags than stated in the Carrefour report would be necessary to carry home 9000 litres of mixed products.**
- In addition, **the type of carrier bags used differs from country to country.** In Sweden for example, **no 16 µm PE-carrier bags are sold at all** by the largest supplier, instead the average bag (15 l, LDPE) has a thickness of 32 µm and weighs 12.2 g, thus double the thickness and weight in comparison with the Carrefour study.
- **A weight ratio of 1:2.6 (PE:Paper) was used in another recent study (GUA, 2005) in comparison to 1:5.9 in the Carrefour study.**

If a LCA was performed with double the weight (12 g) for the disposable PE-bag, it would double the resulting inputs and outputs for almost every step in the life cycle.

Conclusively, STFI-Packforsk stress the importance of considering the functionality of the different carrier bags in the Carrefour study before drawing any general conclusions from the results.

¹ In the following referred to as “Carrefour report” or “Carrefour study”)

2) Brief comparison with other studies

The LCA data used for paper production in the Carrefour report derives from Fefco (Testliner for corrugated board production). A quick comparison with a current LCI study on paper sacks (ESG, 2005) was made. It shows that **24 % of the energy input for sack paper production is renewable energy, while for Testliner production 0 % is renewable energy. Thus, the choice of Testliner LCA data in the Carrefour study has a negative effect for the paper carrier bag** as regards the impact categories 'Consumption of non-renewable energy', 'Emission of climate changing gases' and 'Production of solid residues'.

3) End-of-life scenarios

The results from the end-of-life scenarios gives at hand that the paper bag case emits ca 133 g of methane while the disposable PE bag case emits -5.04 g methane. This is due to the fact that a perspective of 100 years is used for landfill. As a consequence, emissions of methane from paper are included to a large extent, but emissions from landfilled plastics (less degradable) will arise in a longer time perspective. As methane is a 23 times stronger greenhouse gas than carbon dioxide this system boundary has a large impact when comparing fibre based materials to plastics. **It would be more relevant to study the products within a longer time perspective.**

Furthermore, if the biogas from the paper bag in the landfill is incinerated the CO₂ emitted is considered "bio-based CO₂" with no contribution to "climate change". However, if the biogas is emitted directly to air it will contribute to this impact category, with a factor 23 times higher than fossil CO₂, no matter if it is "bio-based" or "fossil-based" CH₄. **Thus, a correctly chosen time perspective for landfill is very important when comparing the effect on climate change from plastic bags and paper bags.**

4) Influence of national data for electricity production

In the Carrefour report the paper bags are produced in Italy while the disposable PE-bags are produced in France. The electricity mix in Italy and France differs considerably. As an effect, the French electricity mix, which consists mainly of nuclear energy, has a lower impact on a number of the environmental impact categories presented in the report (fossil CO₂, acidification and formation of photochemical oxidants) than the Italian electricity mix consisting mainly of fossil fuels. Hence, **the energy situation is unique for the systems studied and consequently general conclusions concerning plastic and paper bags can not be drawn from the results.**

1 Introduction

1.1 Aim

The aim of this project is to make a short review of the report “Évaluation des impacts environnementaux des sacs de caisse Carrefour”² (Ecobilan 2004) and evaluate possible weaknesses in the performance that affect the results in an incorrect negative way for paper carrier bags.

1.2 Background

The Carrefour report on carrier bags, which shows negative results for paper bags, is more and more quoted as a reference when dealing with paper sacks in general and this causes problems in France and now in other countries such as Scotland. CEPI, PPCG, (Paper Packaging Co-ordination Group) is interested in knowing if the results are reliable and under which conditions they can be used correctly.

1.3 Project activities

1. Review of the Carrefour report
2. Brief comparison with other studies
3. Identification of weaknesses in order of priority
4. Comments and conclusions

² In the following referred to as “Carrefour report” or “Carrefour study”)

2 STFI-Packforsk's comments on the Carrefour report

2.1 General comment about the study

First of all, we would like to point out that Ecobilan's Carrefour study is very competently performed. Most of our questions and comments do not refer to the performance itself, but rather to the way the results are being interpreted.

2.2 Comments and questions

When analysing and interpreting the results from a comparative LCA study, it is always important to remember the scope, objective and system boundaries of the study. Drawing general conclusions can be very misleading, e.g. conclusions on a European level if the studied systems contain national or even site specific data.

The Carrefour study was made especially to evaluate the environmental impact from four different types of carrier bags used by Carrefour. The aim was not to do a general study of carrier bags on a European level. Therefore it is our opinion that the interpretation of the results must be done very carefully. **STFI-Packforsk would not recommend this study to be used for general conclusions about the environmental impact from carrier bags.** Our comments and questions below, presented in order of priority, give the reason for our point of view.

2.2.1 Are all the bags in the study fully comparable as regards functionality?

The characteristics of the studied carrier bags are presented in Table 1 (Table1, page 11 in the Carrefour report).

Table 1: Description of the studied carrier bags

	Disposable PE-bag	Reusable PE-bag	Paper bag	Biodegradable bag
Material	HDPE virgin	LDPE virgin	Recycled paper	50% starch, 50% Polycaprolactone
Unit weight	6,04 g (average)	44 g	52 g	17 g
Thickness	16 µm	70 um	90 g/m ²	27 µm
Volume, useful	14 l (average)	37 l	20,48 l	25 l
Reusable	No Yes, in a sensitivity analysis	Yes	No, in general Yes, in a sensitivity analysis	No

This comment focuses on the differences in characteristics of the disposable PE-bag and the paper bag, respectively.

The chosen functional unit is “to pack 9000 litre of purchased Carrefour products” (based on one year’s consumption for a typical customer).

This means that the total material sums up to 3.9 kg for the disposable PE-bag and 23 kg for the paper bag (table 2, page 11 in the Carrefour report). Thus, the paper bag system uses 5.9 times more material than the disposable plastic bag system.

Is this really a just comparison? The functional unit chosen only considers volume. What about the weight of the purchased Carrefour products?

In our opinion, the bags have different functionality. For example, the paper bag is most probably strong enough to carry 20 litres of milk (ca. 20 kg) but we doubt that the disposable PE-bag could carry 14 litres of milk (ca. 14 kg). Another case where the disposable PE-bag would have poorer functionality is for sharp edged products, e.g. plastic trays for various kinds of foodstuff. In reality, the considerably higher strength of the paper bag would give a much more efficient load capacity than that of the disposable PE-bag. Thus, in our opinion, **more PE-bags than stated in the Carrefour report would be necessary to carry home 9000 litres of mixed products.**

In addition, **the type of carrier bags used differs from country to country.** In Sweden for example, the paper carrier bags that are normally used in supermarkets and hypermarkets are similar to the one in the Carrefour study. However, the disposable plastic bags are made of LDPE and are much thicker than those in the Carrefour study. Contacts with Stenqvist (the largest supplier of carrier bags in Sweden) give at hand that an average paper bag (20 litre, 90 g/m²) weighs 47 g. As regards PE-bags though, **Stenqvist does not sell 16 µm PE-carrier bags at all in Sweden**, instead the average bag (15 l, LDPE) has a thickness of 32 µm and weighs 12.2 g, thus double the thickness and weight in comparison with the Carrefour study.

In another recent study (The Contribution of Plastic Products to Resource Efficiency, January 2005, by GUA) it was assumed that a 1 kg PE carrier bag equaled a 2,6 kg paper bag for the same function. Thus a **weight ratio of 1:2.6 (PE:Paper) was used by GUA, in comparison to 1:5.9 in the Carrefour study.**

If a LCA was performed with double the weight (12 g) for the disposable PE-bag, it would double the resulting inputs and outputs for almost every step in the life cycle. An exception would be ‘bag manufacturing’, where the bag weight would not be directly related to the results.

Conclusively, STFI-Packforsk stress the importance of considering the functionality of the different carrier bags in the Carrefour study before drawing any general conclusions from the results. This is especially important in comparisons between different countries, as different prerequisites may occur.

2.2.2 Brief comparison with other studies

The LCA data used for paper production in the Carrefour report derives from Fefco (Testliner for corrugated board production). CEPI's comment to this choice and Ecobilan's answer are available in the report (page 68).

ESG – the European Paper Sack Research Group³ are just finalising an LCI study including both kraft sack paper production and paper sack production, cradle-to-gate, presenting European average data for 2003. These data are based on paper production from virgin fibre, which - according to the above mentioned comment from CEPI - is the most common type of paper on the market for paper carrier bags.

Based on the current ESG LCI study the total energy input for production of 23⁴ kg kraft sack paper is presented in Table 2.

Table 2: Total energy input for production of 23 kg kraft sack paper, cradle-to-gate, European average (mix of 81.5 % unbleached and 18.5 % bleached paper).

Energy input 23 kg kraft sack paper	2003			
	[MJ]	[%]	% Renewable	
Electricity	67.7	38 %	10.2 MJ *	5.7 % *
Wood fuel (bark)	31.0	18 %	31 MJ	18 %
Heavy fuel oil	28.7	16 %		
Natural gas	28.0	16 %		
Diesel	14.2	8.1 %		
Hard coal	3.4	1.9 %		
Peat	2.4	1.4 %		
Gasoline	0.4	0.2 %		
Lignite	0.3	0.2 %		
Light fuel oil	0.1	0.1 %		
Other fuel	0.0	0.0 %		
Sum energy input	176	100 %	41.2 MJ	24 %
Energy from Processes	169	96 %		
Energy from Transports	7	4 %		

* Electricity - European average, ca 15 % Hydro power.

The energy figures for paper production in the Carrefour report (Annexe V, page 12) are presented in Table 3.

³ ESG is financed by CEPI-Eurokraft and Eurosac and the research projects are conducted by STFI-Packforsk.

⁴ 23 kg corresponds to the functional unit in the Carrefour report.

Table 3: Energy figures for paper production in the Carrefour report, 23 kg Testliner

Energy input 23 kg testliner	MJ	%
Feedstock energy	384	67 %
Fuel energy	186	33 %
Electricity	0	
Total primary energy	570	
Non renewable energy	197	35 %
Renewable	372	65 %
Total primary energy	570	

The 176 MJ ('Sum energy input') from the ESG results corresponds well with the 186 MJ of 'Fuel energy input' in the Carrefour report. However, within these figures there is a considerable difference as regards renewable and non-renewable energy. In the Carrefour case, the Testliner production is based purely on natural gas, i.e. **0 % renewable energy**. In the ESG case, on the other hand, the kraft sack paper production is based on mixed energy sources, where **24 % is renewable energy**. **Thus, the choice of Testliner LCA data has a negative effect for the paper carrier bag** as regards the impact categories 'Consumption of non-renewable energy', 'Emission of climate changing gases' and 'Production of solid residues'.

2.2.3 End-of-life scenarios

The end-of-life scenarios for the studied systems are recycling, incineration (with 88 mass-% energy recovery), and landfill. For the landfill scenario the biogas (mainly methane) emitted is partly collected for energy recovery by incineration. Part of the biogas emitted (10-20%) is leakage from the landfill which is not incinerated. In the Carrefour study, division of the usage of the biogas differs depending on the type of material in the bag. However, the figures applied for the respective bags are not shown in the Carrefour report.

Studying the calculated results from the end-of-life scenarios gives at hand that the paper bag case emits ca 133 g of methane while the disposable PE bag case emits -5.04 g methane. This is due to the fact that a perspective of 100 years is used for landfill. This means that only emissions taking place within 100 years from landfilling are considered (page 99). As a consequence, emissions of methane from fibre based, easily degradable, materials such as paper are included to a large extent. But emissions from landfilled plastics will arise in a longer time perspective since plastics are less degradable. As methane is a stronger greenhouse gas than carbon dioxide (23 times with the method used here), this system boundary has a large impact when comparing fibre based materials to plastics. **It would be more relevant to study the products within a longer time perspective.**

Furthermore it should be noted that if the biogas from the paper bag in the landfill is incinerated the CO₂ emitted is considered "bio-based CO₂" with no contribution to the environmental impact category "climate change". However, if the biogas is emitted directly to air it will contribute to this impact category, with a factor 23 times higher than fossil CO₂, no matter if it is "bio-based" or "fossil-based" CH₄. **Thus, a correctly chosen time**

perspective for landfill is very important when comparing the effect on climate change from plastic bags and paper bags.

In addition to the discussion above we notice that figure 6 and 8 (page 37 and 38 in the report) show a big difference between the results for fossil energy and GWP (fossil CO₂) as regards production of the materials. These two should be more or less corresponding as the main part of the CO₂ emissions derives from the fossil fuels. We can see two possible explanations to the difference.

1. Part of the plastic material production takes place in France. The electricity used contains a large amount of nuclear energy. Nuclear energy is characterised as fossil energy (due to the use of uranium ore) but does not cause emissions of fossil CO₂.
2. A large amount of the consumption of fossil energy in the material phase of the plastic bags is the material itself, feedstock based on fossil sources. The fossil carbon in the material will thus be emitted in the end-of-life phase. But 51% of the plastic bags go to landfill in the studied scenarios. As there is only a 100 year perspective on this scenario, main part of the plastic will stay unaffected in the landfill after this time. Thus, a large part of the fossil carbon that sooner or later will be emitted to air “disappears” from the calculation. The remaining emissions contributing to GWP will arise “outside” of the chosen time boundary.

2.2.4 Influence of national data for electricity production

In the case studied in the Carrefour report, the paper bags are produced in Italy while the disposable PE-bags are produced in France. As shown in table 12 on page 35 in the Carrefour report the electricity mix in Italy and France differs considerably. As an effect, the French electricity mix, which consists mainly of nuclear energy, has a lower impact on a number of the environmental impact categories presented in the report (fossil CO₂, acidification and formation of photochemical oxidants) than the Italian electricity mix consisting mainly of fossil fuels. The authors state in the report that replacing French electricity mix with European electricity mix in the studied cases would increase the atmospheric emissions corresponding to the mentioned environmental impact categories with more than 25%. The same relation applies if the French electricity mix is compared to Italian electricity mix. On the other hand, had the environmental impact categories radioactive waste and radioactive radiation been studied, the French electricity mix would have higher environmental impact than the European and Italian energy mixes due to the high amount of nuclear energy used in France.

The energy situation is unique for the systems studied and consequently general conclusions concerning plastic and paper bags can not be drawn from the results.

3 References

Ecobilan, *Évaluation des impacts environnementaux des sacs de caisse Carrefour*, February 2004

ESG (the European Paper Sack Research Group) / STFI-Packforsk AB, *Draft report - Life Cycle Inventory for Paper Sacks*, October 2005

GUA (Gesellschaft für umfassende Analysen), *The Contribution of Plastic Products to Resource Efficiency*, January 2005

Stenqvist AB, telephone contact, September 2005

