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Life Cycle Assessment of Packaging Systems for Beer and Soft Drinks

Aluminium Cans

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Life Cycle Assessment of Packaging Systems for Beer and Soft Drinks

Aluminium Cans
Technical Report 3

Anna Ryberg, Tomas Ekvall and Lisa Person
Chalmers Industriteknik

Bo Pedersen Weidema
Institute for Product Development

Ministry of Environment and Energy, Denmark
Danish Environmental Protection Agency

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Contents

Summary

This report

This report is part of a life cycle assessment comparing the potential environmental impacts associated with different packaging systems for beer and carbonated soft drinks filled and sold in Denmark. This report contains a short introduction, system descriptions, inventory analysis, impact assessment, and interpretation for packaging systems using aluminium cans.

Function / Functional unit

The function of the packaging systems is to facilitate distribution of beer and/or carbonated soft drinks from the breweries via retailers to the consumers. The functional unit in this report is the packaging of 1000 litres of beverage and the distribution of this beverage.

Processes included

The process tree is illustrated in Figure A.1 in annex A. Production of aluminium and aluminium cans is included in the assessment. Production of corrugated board, cardboard, low density polyethylene (LDPE) and planks used in secondary packaging and pallets is also included in the assessment. The system also includes the filling and distribution of the beverage, as well as the cooling of the packaging in the refrigerator of the consumer. Finally, it includes waste management and recycling processes. Excluded processes and flows are described in the Main report.

Inventory

A quantitative description of the investigated systems and the results from the inventory analysis is given in Chapter 3. Data and calculations on the environmental inputs and outputs of the processes in the process tree are presented in annex A and B. For data on the environmental inputs and outputs of electricity production and of transports, we refer to Technical report 7.

Impact assessment

The impact assessment method applied is the EDIP method (Wenzel *et al.* 1997). A short description can be found in the main report. Work environment and impacts from use and misuse of the products are not included in the study. This means also that the possible effects of littering and migration from the packaging to the beverage are not included. Impacts from noise, visual impacts and bodily harm due to accidents are not included in the study. Chapter 4 includes results from the impact assessment.

Interpretation

The interpretation of the LCA results includes a dominance analysis, sensitivity analyses, an assessment of data gaps and data quality, and conclusions from the LCA. It is reported in Chapter 5.

Important impacts

The packaging systems with aluminium cans contribute most to the following environmental impacts:

- Ecotoxicity, terrestrial, chronic (ETSC)
- Human toxicity, soil (HTS)
- Human toxicity, water (HTW)

Waste and resources

The aluminium can systems contribute a relatively large share (>100 mPET) of the target levels for generation of hazardous waste and nuclear waste. They

also contribute significantly (more than approximately 1 mPR) to the depletion of aluminium resources.

Important processes

The most important processes for the aluminium can system are:

- Electrolysis etc.
- Can production
- Distribution of beverage

Sensitivity Analyses

The following sensitivity analyses were performed:

- Can weight: +20%
- Distribution of beverage (light truck)
- Allocation methods
- Amount of inside coatings
- Electricity production (natural gas marginal, fragmented markets and European base load)
- Collection rate: 98.5%

The results from the sensitivity analysis shows that the weight of the can is significant.

It is clear from the results that the assumption regarding the mode of conveyance at the distribution is of minor importance, especially for CO_2 and SO_2.

The allocation method can be of great importance since the difference between the amounts of virgin aluminium and recycled aluminium is big in the assessment. The actual significance is difficult to quantify since no was available about the true amount of recycled aluminium in the aluminium cans.

The amount of inside coatings is of minor importance.

The electricity data used in the base case represent coal marginal. Three sensitivity analyses were performed for electricity production (natural gas marginal, long term base load at fragmented markets and European base load average). It is clear from the results that the assumption regarding the electricity production is important.

The assumption regarding the collection rate is important.

Data gaps and omissions

There are no known significant data gaps in the inventory analysis of this study. The most important omissions are:

- The most important non-elementary inflows are packaging material used at the strip rolling plant and washing chemicals used at the can production.
- Production of materials for secondary packaging and wooden pallets is included in the LCA, but the actual packaging production - conversion, nailing etc. - is not included.

- There are important data gaps in the characterisation of human toxicity in air and soil, as well as of chronic terrestrial and aquatic ecotoxicity.

Uncertainties

The most important processes in this LCA (the processes that gives the highest contributions to the environmental loadings) are electrolysis etc., can production and distribution of the beverage. The data used for electrolysis etc. are EAA data, with fair representativity, good completeness and medium uncertainty. For can production, plant specific data were used. They are estimated to be fairly representative and complete. The uncertainty of these data is estimated to be medium. The data used for distribution of the beverage are assessed to have medium uncertainty and good completeness and representativity.

The uncertainties in the normalisation of toxicity impacts are large. However, this does not affect the comparisons between the systems.

1 Introduction

The study

This report is part of a series of 8 reports from a life cycle assessment (LCA) comparing the potential environmental impacts associated with different packaging systems for beer and carbonated soft drinks filled and sold in Denmark.

Main report

Main report: Goal and scope definition, including description and discussions on methodology. Summary of the LCA of the different packaging systems. Comparisons of the different packaging systems. Comparison of the previous and the updated study.

Individual systems

Technical report 1: Refillable glass bottles: including description of the system, data, inventory analysis, impact assessment, and interpretation.

Technical report 2: Disposable glass bottles: including description of the system, data, inventory analysis, impact assessment, and interpretation.

Technical report 3: Aluminium cans: including description of the system, data, inventory analysis, impact assessment, and interpretation.

Technical report 4: Steel cans: including description of the system, data, inventory analysis, impact assessment, and interpretation.

Technical report 5: Refillable PET bottles: including description of the system, data, inventory analysis, impact assessment, and interpretation.

Technical report 6: Disposable PET bottles: including description of the system, data, inventory analysis, impact assessment, and interpretation.

Energy and transports

Technical report 7: Energy and transport scenarios, including energy and transport data, sensitivity analysis and data quality assessment.

Commissioner and practitioner

The study was financed by the Danish Environmental Protection Agency (DEPA). It was performed by Chalmers Industriteknik (CIT), Göteborg, Sweden and Institute for Product Development (IPU), Lyngby, Denmark.

Critical review

This report has been peer reviewed following the procedure outlined in the Main report, section 2.15.

Project framework

This report was produced during the period December 1997 to May 1998. The entire project was scheduled for May 1997 to May 1998.

Adherence to ISO

We adhere to the requirements of the standards ISO 14040 and ISO 14041. Several of the requirements and recommendations presented in the ISO documents need to be interpreted. We present our interpretations where applicable.

2 System descriptions

2.1 The system investigated

The packaging systems

In this report we present the LCA of packaging systems with 33 cl and 50 cl aluminium cans. The packaging systems include the life cycles of the primary packaging - the aluminium cans - and secondary packaging: corrugated trays, corrugated boxes, cardboard boxes and polyethylene hi-cones. The systems also include the life cycle of the wooden pallets used at the distribution of the beverage. The discussion below refers to the detailed process tree illustrated in annex A. In figure 3.1 a simplified process tree is presented.

Primary aluminium production

Primary aluminium production includes bauxite mining, salt mining, NaOH production, limestone mining, lime calcination, alumina (Al_2O_3) production, petroleum coke production, pitch production, anode production, cathode production, AlF_3 production, production of alloying metal, electrolysis, and casting. All of these processes are included in this LCA. In the primary aluminium used for cans, the alloying metal is manganese.

Strip rolling

At the strip rolling plant, the aluminium rolling ingots that are produced at the cast house are strip rolled into 0.25-0.26 mm thick sheets.

Primary packaging

The production of the primary packaging includes the production of over-varnishes, inside coatings and the can manufacturing.

Washing and filling

At the brewery, the cans are water-washed before they are filled.

Secondary packaging

The secondary packaging consists of cardboard boxes, corrugated board trays and boxes, and low density polyethylene (LDPE) foil and hi-cones. The production of boxes, trays, foil and hi-cones is not included in the study. The production of LDPE include all process steps from extraction of feedstock resources (crude oil and natural gas) to polymerisation. The production of cardboard and corrugated board covers all processes from wood harvesting to the board mill.

Wooden pallets

The production of wooden pallets is not included in the study, but the production of wood is included.

Aluminium recycling

A significant share of the aluminium cans are recycled into new cans (Nylin, 1997). In this study, we have assumed that all of the collected aluminium cans are recycled into new cans (see Main report, section 2.6.2 and 2.7.5). This has no effect on the LCA results since the alternative fate of the secondary aluminium is to be recycled into another aluminium products. It does not matter for the results whether the secondary aluminium replaces virgin aluminium in new cans or if it replaces virgin aluminium in other products.

Cardboard and corrugated

The system investigated was expanded to include the parts of other life *board recycling* cycles affected by the outflow of recycled cardboard and corrugated board from the packaging system. It was also expanded to include processes affected by the inflow of recycled fibres into corrugated board production (for further details, see Main report).

Distribution of beverage The distribution of the beverage covers the transport of all packaging (incl. beverage) from the brewery to the retailer, and the return transport of empty packagings.

Retailer The handling of the aluminium cans at the retailer is not included in the study.

Use The study does not include the consumption of the beverage, but only the cooling of cans in the refrigerator of the consumer.

Waste management The waste management includes incineration of wooden pallets and corrugated board layer pads discarded at the brewery as well as consumer waste (aluminium cans, cardboard boxes, corrugated board boxes and trays, and LDPE ligature and hi-cones).

The systems are expanded to include parts of other life cycles that are affected by the energy recovery at waste incineration. The recovered energy is assumed to replace a mix of light fuel oil and natural gas.

2.2 Allocation procedure

Adherence to ISO For a general description of the allocation procedure used in this project, see Main report.

Avoiding allocation As indicated above, we avoided allocation by system expansion in the following cases:

- Waste incineration with energy recovery
- Use of recycled fibres in production of corrugated board
- Recycling of cardboard boxes and corrugated trays and boxes after use

Closed-loop procedure A closed-loop procedure was used for the recycling of aluminium: the aluminium cans that are recycled after use is assumed to be used in the production of new aluminium cans.

Cut-off at recycling Corrugated board layer pads and LDPE ligature are recycled in smaller amounts (less than 1% of the weight of the aluminium can). These outflows are non-elementary outflows from the system. We have not credited the investigated systems any benefits for delivering these materials to recycling, nor have the investigated systems been allocated any part of the final waste handling. The effects of this on the total LCA results are clearly small. First, these non-elementary outflows are very small. Second, the system investigated does include primary production of corrugated board and LDPE. As stated above, it also includes recycling (incl. system expansion) of the larger amounts of corrugated board used in trays and boxes.

Aggregated data

Data on production of LDPE are literature data from Association of Plastics Manufacturers in Europe (APME; Boustead 1993). These are given as allocated data using allocation based on physical properties of the products (Boustead 1992) and not adequately disaggregated to allow recalculation according to the ISO procedure. In spite of this, we find it preferable to use these data than to use older, disaggregated data from other sources. The effects on the total LCA results are also likely to be small since the weight of the LDPE used in the system is less than 3% of the weight of the aluminium can.

2.3 Reporting

The report series

As stated above (chapter 1), this report is one out of a series of 8 from the LCA project.

Structure of this report

Each of the subsequent chapters deals with one of the LCA phases. Chapter 3 includes a quantitative description of the systems investigated and results from the inventory analysis. Data and calculations on the environmental inputs and outputs of the processes in the process tree are presented in annex A and B. For data on the environmental inputs and outputs of electricity production and transports, we refer to Technical report 7. Chapter 4 includes results from the impact assessment. Chapter 5, finally, includes an interpretation of the results and conclusions from the LCA.

Limitations for other applications

While some of the data in this study may also be useful for other purposes, the nature of the data needed when making a comparison is not necessarily identical to that needed for other applications such as environmental declarations or for identifying improvements options within the studied systems. In particular, it can be noted that the calculations on the distribution takes not only the packagings but also the beverage into account. Consequently, the results for the individual packaging systems should not be used to identify the main impacts in the life cycle of the packaging, without adjusting for the included beverage. In general, any conclusions of this study outside its original context should be avoided.

3 Inventory analysis

3.1 33 cl aluminium cans

The life cycle

The process tree of the packaging system is illustrated in Figure A.1 in annex A. A simplified process tree is presented in Figure 3.1. The 33 cl aluminium can is produced from 0.25 mm thick aluminium sheets. The sheets are strip-rolled from aluminium rolling ingots. The aluminium used in beverage cans contains 1.5% manganese as an alloy. To distribute 1000 litres of beverage 3030.3 33 cl aluminium cans (1000/0.33) are needed. The weight of one 33 cl aluminium can is 14.45 grams.

90% of the used aluminium cans are collected for recycling due to the scope of this study (see table 3.1 and Main report, section 2.5). The remaining 10% end up in waste incineration where energy is recovered.

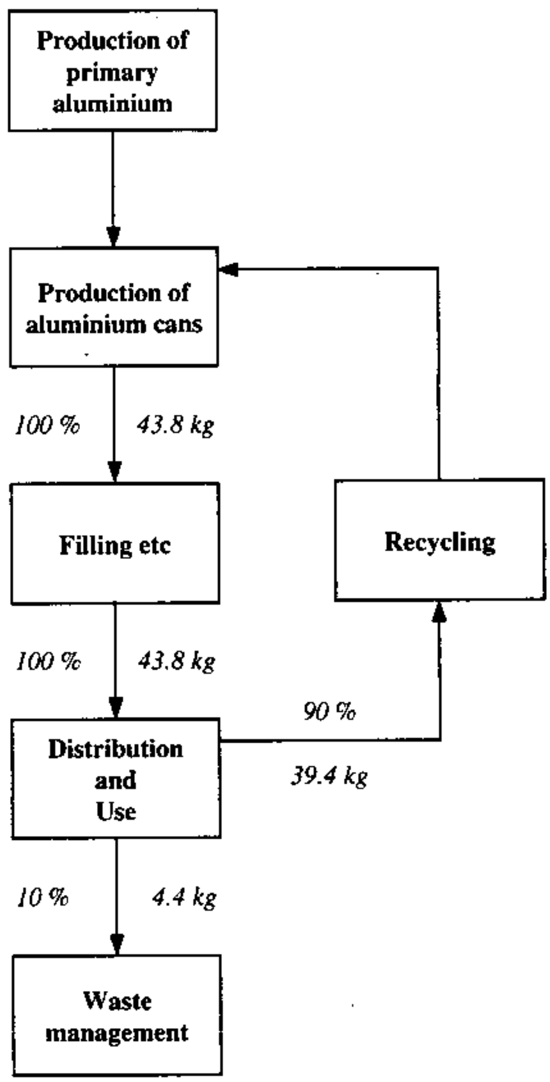

Figure 3.1
Flows of 33 cl aluminium cans per 1000 litres of beverage. (Flows of secondary packaging and transport packaging are not included).

Input data

The secondary packagings and transport packagings are quantitatively described by the system parameters in Table 3.1. Data and calculations on the environmental inputs and outputs of the processes in the process tree are presented in annex A. Data on the environmental inputs and outputs of transports and on the production of fuels and electricity are presented in Technical report 7.

Table 3.1

System parameters for the packaging system with 33 cl aluminium cans. The mass presented refers to the weight of a single item, i.e., one bottle or one tray. The market shares of the secondary packaging do not add up to 100% as they may be combined in different ways.

	Name	Mass [g]	Market share	Material	Degree of return	Degree of recycling	Degree of disposal
Primary packaging	Aluminium can (33 cl)	14.45	100 %	Aluminium	0 %	90 %	10 %
Secondary packaging	Tray (24 cans)	120	50 %	Corrugated board	0 %	20 %	80 %
	Foil for tray (24 cans)	20	33 %	LDPE	0 %	0 %	100 %
	Box (24 cans)	200	17 %	Corrugated board	0 %	20 %	80 %
	Box (6 cans)	50	25 %	Cardboard	0 %	20 %	80 %
	Hi-cone	3.4	25 %	LDPE	0 %	0 %	100 %
Transport packaging	Pallet (2376 cans)	22000	100 %	Wood	95 %	0 %	5 %
	Plastic ligature (2376 cans)	20	75 %	LDPE	0 %	70 %	30 %
	Glue	2	25 %	Casein/urea/H_2O	0 %	0 %	100 %

Table 3.2

Energy demand at final use for the packaging system with 33 cl aluminium cans. These energy flows are not flows across the system boundary but internal flows within the system. Functional unit: packaging and distribution of 1000 litres.

	Unit	Packaging system	Effects on other life cycles	Total
Electricity, total	kWh	3.02E+02	-1.66	3.01E+02
Electricity	*kWh*	*2.66*	*0*	*2.66*
Electricity, coal marginal	*kWh*	*2.99E+02*	*-1.66*	*2.98E+02*
Hydro power	*kWh*	*2.39E-01*	*0*	*2.39E-01*
Fossil fuel, total	MJ	1.39E+03	-4.05E+02	9.89E+02
Coal	*MJ*	*4.56*	*0*	*4.56*
Coal, feedstock	*MJ*	*1.28E-02*	*0*	*1.28E-02*
Diesel, heavy & medium truck (highway)	*MJ*	*1.86E+02*	*2.19*	*1.88E+02*
Diesel, heavy & medium truck (rural)	*MJ*	*1.03E+02*	*-6.48E-02*	*1.02E+02*
Diesel, heavy & medium truck (urban)	*MJ*	*7.40E+01*	*7.64*	*8.17E+01*
Diesel, ship (4-stroke)	*MJ*	*1.57E+01*	*1.01E+01*	*2.58E+01*
Fuel oil, ship (2-stroke)	*MJ*	*5.37E+01*	*0*	*5.37E+01*
Fuel, unspecified	*MJ*	*2.08E-03*	*-1.15E-05*	*2.07E-03*
Hard coal	*MJ*	*1.64*	*0*	*1.64*
LPG, forklift	*MJ*	*1.63E-01*	*-1.44E-01*	*1.89E-02*
LPG, thermal	*MJ*	*2.94E+01*	*0*	*2.94E+01*
Natural gas (>100 kW)	*MJ*	*6.44E+02*	*-1.94E+02*	*4.49E+02*
Natural gas	*MJ*	*2.57E+01*	*0*	*2.57E+01*
Natural gas, feedstock	*MJ*	*4.20E+01*	*0*	*4.20E+01*
Oil	*MJ*	*7.18*	*0*	*7.18*
Oil,, feedstock	*MJ*	*5.85E+01*	*0*	*5.85E+01*
Oil, heavy fuel	*MJ*	*1.05E+02*	*9.81*	*1.14E+02*
Oil, heavy, feedstock	*MJ*	*3.50E+01*	*0*	*3.50E+01*
Oil, light fuel	*MJ*	*3.64*	*-2.41E+02*	*-2.37E+02*
Peat	*MJ*	*6.63*	*5.29E-01*	*7.16*
Renewable fuel, total	MJ	1.11E+01	3.95	1.50E+01
Bark	*MJ*	*1.11E+01*	*3.95*	*1.50E+01*
Heat etc., total	MJ	-7.14	-1.63	-8.77
Heat	*MJ*	*-7.14*	*-1.63*	*-8.77*

Table 3.3
Inventory results for the packaging system with 33 cl aluminium cans. Functional unit: packaging and distribution of 1000 litres.

	Unit	Packaging system	Effects on other life cycles	Total
Resources				
Al	g	2.08E-01	-1.15E-03	2.07E-01
Bauxite	g	2.27E+04	0	2.27E+04
Biomass	g	6.95	2.95E-01	7.24
Brown coal	g	1.70E+03	-9.29E+01	1.61E+03
$CaCO_3$	g	3.65E-01	-2.02E-03	3.63E-01
Clay	g	1.17E-01	-4.25E-04	1.17E-01
Coal	g	3.74E+02	0	3.74E+02
Coal, feedstock	g	5.88E+02	0	5.88E+02
Crude oil	g	2.30E+04	-5.46E+03	1.76E+04
Crude oil, feedstock	g	4.25E+03	-9.80E-05	4.25E+03
Fe	g	2.16E-01	-1.20E-03	2.14E-01
Ferromanganese	g	1.61E-03	0	1.61E-03
Ground water	g	4.69E-03	-2.60E-05	4.66E-03
Hard coal	g	1.71E+05	-1.05E+03	1.70E+05
Hydro power-water	g	5.36E+09	-2.22E+09	3.14E+09
Iron ore	g	3.53E-01	0	3.53E-01
Land use	m^2*year	2.15E+02	1.83E+02	3.98E+02
Limestone	g	1.11E+03	0	1.11E+03
Mn	g	9.44E+01	-6.83E-06	9.44E+01
NaCl	g	4.94E+01	-2.01E-03	4.94E+01
Natural gas	g	1.55E+04	-4.24E+03	1.13E+04
Natural gas, feedstock	g	7.78E+02	0	7.78E+02
Oil, feedstock	g	3.93E+02	0	3.93E+02
Salt	g	3.43E+02	0	3.43E+02
Sand	g	1.29E-02	0	1.29E-02
Softwood	g	4.75E+01	-2.64E-01	4.72E+01
Surface water	g	9.57E-05	-5.28E-07	9.52E-05
Uranium (as pure U)	g	1.47E-01	-6.68E-03	1.40E-01
Water	g	3.29E+07	-1.82E+05	3.28E+07
Wood	g	9.66	-5.60	4.05
Non-elementary inflows				
Alum	g	3.56E+01	1.78E+01	5.34E+01
Aluminium hydroxide	g	7.36E+01	0	7.36E+01
Argon	g	1.75E+01	0	1.75E+01
Auxiliary materials	g	3.64E-01	0	3.64E-01

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	Unit	Packaging system	Effects on other life cycles	Total
Bark	g	6.53E+02	2.32E+02	8.85E+02
Biocides	g	3.29E-01	4.81E-02	3.77E-01
$Ca(OH)_2$	g	4.01E+02	0	4.01E+02
$CaCO_3$	g	2.98E+01	1.49E+01	4.47E+01
Calcium fluoride	g	1.60E+02	0	1.60E+02
CaO	g	7.92E+01	3.94E+01	1.19E+02
Carbon	g	1.93E+02	0	1.93E+02
Chlorine	g	1.05E+01	0	1.05E+01
Colorants	g	6.96	-6.69	2.76E-01
Defoamer	g	1.30E+01	5.29	1.83E+01
Explosives	g	3.78E-01	0	3.78E-01
Finish	g	9.38E+01	0	9.38E+01
Glue	g	6.31E+01	0	6.31E+01
H_2SO_4	g	1.27E+02	6.35E+01	1.91E+02
HCl	g	2.26	-6.76E-01	1.59
Lubricants	g	4.77	4.32E-01	5.20
MgO	g	1.33	0	1.33
Miscellaneous chemicals	g	8.12E-01	0	8.12E-01
Na_2SO_4	g	4.71E+01	2.36E+01	7.07E+01
Na_2CO_3	g	2.07E+01	8.17	2.89E+01
NaOH	g	8.87E+01	3.51E+01	1.24E+02
NH_3	g	1.48E+01	0	1.48E+01
Oil	g	4.43E+02	0	4.43E+02
Other additives	g	3.76	1.44	5.20
Packaging	g	1.67E+03	0	1.67E+03
Peat	g	3.16E+02	2.52E+01	3.41E+02
Phosphoric acid	g	7.02E-01	-6.76E-01	2.58E-02
Plastic ligature	g	1.91E+01	0	1.91E+01
Polyester for strips	g	2.03E+02	0	2.03E+02
Printing ink	g	1.12E+02	0	1.12E+02
Refractory materials	g	5.41E+01	0	5.41E+01
Retention agents	g	2.30E+01	8.17	3.12E+01
Sizing agents	g	7.33E+01	1.25E+01	8.58E+01
SO_2	g	1.46	0	1.46
Starch	g	3.11E+02	-1.19E+02	1.92E+02
Steel	g	3.84E+01	0	3.84E+01
Sulphur	g	1.61E+01	9.64E-01	1.71E+01
Sulphuric acid	g	1.85E+02	0	1.85E+02
Urea	g	6.01E-01	-5.76E-01	2.51E-02
Washing chemicals	g	4.39E+02	0	4.39E+02

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	Unit	Packaging system	Effects on other life cycles	Total
Emissions to air				
Acetaldehyde	g	5.00E-04	-1.60E-04	3.40E-04
Acetylene	g	2.56E-05	-9.65E-03	-9.62E-03
Al_2O_3	g	8.75E-01	0	8.75E-01
Aldehydes	g	4.65E-03	-1.80E-05	4.63E-03
Alkanes	g	5.18E-02	-2.41E-01	-1.89E-01
Alkenes	g	2.61E-03	-1.93E-02	-1.66E-02
Amylaclohol	g	5.15	0	5.15
Aromates (C9-C10)	g	6.05E-02	-1.96E-02	4.09E-02
As	g	4.40E-03	-1.11E-04	4.29E-03
B	g	3.92E-01	-2.17E-03	3.90E-01
Benzo(a)pyrene	g	1.18E-05	-1.63E-06	1.02E-05
Benzene	g	3.75E-01	-7.60E-02	2.99E-01
Butane	g	3.49E-01	-1.13E-01	2.37E-01
Butanol	g	2.09E+01	0	2.09E+01
Butydiglycole	g	9.05E-01	0	9.05E-01
Butylglycole	g	2.75E+01	0	2.75E+01
C_2F_6	g	2.52E-01	0	2.52E-01
Ca	g	6.82E-03	0	6.82E-03
Cd	g	3.79E-03	-1.81E-04	3.61E-03
CF_4	g	2.27	0	2.27
CH_4	g	1.36E+03	-1.38E+02	1.23E+03
Cl^-	g	1.40E-04	-3.87	-3.87
CN^-	g	1.76E-03	7.50E-05	1.84E-03
CO	g	6.57E+02	-1.83	6.55E+02
Co	g	3.97E-03	-6.52E-06	3.97E-03
CO_2 (bio)	g	4.11E+04	5.78E+03	4.68E+04
CO_2	g	3.68E+05	-3.13E+04	3.36E+05
COS	g	2.52E+01	0	2.52E+01
Cr	g	2.25E-03	-1.73E-04	2.07E-03
Cr^{3+}	g	2.42E-03	1.01E-06	2.42E-03
Cu	g	2.39E-02	6.83E-04	2.45E-02
Dioxin	g	3.00E-07	-1.84E-08	2.81E-07
Dust	g	1.01E+02	0	1.01E+02
Ethane	g	5.10E-05	-1.93E-02	-1.92E-02
Ethene	g	1.28E-04	-4.82E-02	-4.81E-02
Fe	g	1.53E-02	0	1.53E-02
Fluorides	g	6.04	0	6.04
Formaldehyde	g	8.81E-02	-2.19E-02	6.62E-02

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	Unit	Packaging system	Effects on other life cycles	Total
H_2O	g	1.09E+04	0	1.09E+04
H_2S	g	1.14	5.28E-01	1.67
HC	g	4.98E+01	-8.27E-02	4.97E+01
HCl	g	1.97E+01	-1.56E-01	1.96E+01
Heavy metals	g	1.27E-14	-7.15E-17	1.26E-14
HF	g	1.42E-01	-2.55E-03	1.39E-01
Hg	g	1.94E-02	-2.60E-04	1.92E-02
Metals	g	9.38E-03	-1.44E-05	9.37E-03
Mg	g	2.75E-01	-1.53E-03	2.73E-01
Mn	g	3.26E-03	-1.80E-05	3.24E-03
Mo	g	2.69E-03	-7.35E-06	2.68E-03
N_2O	g	3.10	-4.86E-03	3.09
Na	g	6.37E-02	0	6.37E-02
NH_3	g	9.78E-02	1.21E-04	9.79E-02
Ni	g	8.80E-02	-8.77E-03	7.92E-02
NMVOC	g	7.90E+01	-4.56E+01	3.34E+01
NMVOC, diesel engines	g	4.75E+01	1.99	4.95E+01
NMVOC, el-coal	g	5.00	-2.78E-02	4.97
NMVOC, natural gas combustion	g	1.03E-01	0	1.03E-01
NMVOC, oil combustion	g	5.15E+01	2.24	5.37E+01
NMVOC, petrol engines	g	9.71E-10	-5.40E-12	9.66E-10
NMVOC, power plants	g	2.42	-1.34E-02	2.40
NO_x	g	1.26E+03	-1.34E+01	1.25E+03
Organics	g	6.53E-03	-3.62E-05	6.50E-03
Other organics	g	1.50E-05	0	1.50E-05
PAH	g	3.20E-01	-1.71E-03	3.18E-01
Particulates	g	1.23E+02	-2.17E-01	1.23E+02
Pb	g	1.25E-02	-7.94E-04	1.17E-02
Pentane	g	5.99E-01	-1.93E-01	4.06E-01
Propane	g	1.03E-01	-6.11E-02	4.14E-02
Propene	g	5.10E-05	-1.93E-02	-1.92E-02
Radioactive emissions	kBq	1.07E+07	-6.40E+08	-6.30E+08
Rn-222	Bq	2.21E-02	0	2.21E-02
Sb	g	4.00E-04	-2.22E-06	3.98E-04
Se	g	2.99E-02	-1.56E-04	2.97E-02
Sn	g	4.50E-04	-2.51E-06	4.48E-04
SO_2	g	8.17E+02	-1.91E+01	7.98E+02
Sr	g	2.25E-03	-1.25E-05	2.24E-03
Th	g	2.01E-04	-1.12E-06	1.99E-04
Tl	g	1.00E-04	-5.61E-07	9.96E-05

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	Unit	Packaging system	Effects on other life cycles	Total
Toluene	g	1.02E-01	-4.18E-02	6.07E-02
Tot-P	g	2.01E-02	-1.12E-04	1.99E-02
U	g	1.50E-04	-8.35E-07	1.49E-04
V	g	2.24E-01	-1.59E-05	2.24E-01
VOC	g	2.28E+01	0	2.28E+01
VOC, coal combustion	g	1.30E-01	-7.29E-04	1.30E-01
VOC, diesel engines	g	3.60	-1.99E-02	3.58
VOC, natural gas combustion	g	1.02E-08	-5.63E-11	1.01E-08
Xylene	g	6.04E-01	0	6.04E-01
Zn	g	2.70E-02	2.59E-04	2.72E-02
Emissions to water				
Acid as H^+	g	1.96E-01	0	1.96E-01
Al	g	8.30E-01	-1.80E-01	6.51E-01
AOX	g	3.49E-03	0	3.49E-03
Aromates (C9-C10)	g	1.49E-02	-8.27E-05	1.48E-02
As	g	1.74E-03	-5.49E-04	1.19E-03
BOD	g	2.45E+01	-7.21E-05	2.45E+01
BOD-5	g	6.59E+01	2.82E+01	9.41E+01
Cd	g	9.14E-04	-3.09E-04	6.05E-04
Chloride	g	1.65E+01	0	1.65E+01
Cl^-	g	1.97E+03	-1.54E+02	1.81E+03
ClO_3^-	g	8.76E-01	-4.87E-03	8.71E-01
CN^-	g	2.37E-03	-1.37E-03	9.97E-04
Co	g	2.54E-02	1.55E-02	4.09E-02
COD	g	3.42E+02	7.67E+01	4.18E+02
Cr	g	7.44E-03	-4.31E-03	3.13E-03
Cr^{3+}	g	5.33E-03	2.31E-04	5.56E-03
Cu	g	3.10E-03	-1.76E-03	1.34E-03
Dissolved organics	g	9.06E-02	-3.82E-12	9.06E-02
Dissolved solids	g	1.04E+02	-5.74E-01	1.03E+02
F^-	g	3.96E-01	-5.05E-03	3.91E-01
Fe	g	2.07E-01	-1.15E-03	2.06E-01
Fluoride	g	2.12E+01	0	2.12E+01
H^+	g	7.80E-02	-4.25E-04	7.76E-02
H_2S	g	7.75E-05	-4.52E-05	3.23E-05
H_2SO_4	g	5.03	0	5.03
HC	g	2.02E-01	-2.89E-04	2.02E-01
Metals	g	3.54E-01	-7.21E-05	3.53E-01
Mn	g	1.03E-01	-5.76E-04	1.03E-01
Na^+	g	2.65E-01	0	2.65E-01

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	Unit	Packaging system	Effects on other life cycles	Total
NH_3	g	3.45E-02	0	3.45E-02
NH_4^+	g	6.37E-03	0	6.37E-03
NH_4-N	g	8.30E-02	-4.62E-04	8.25E-02
Ni	g	1.56E-02	-1.71E-03	1.38E-02
Nitrates	g	1.00E-02	0	1.00E-02
Nitrogen	g	3.35E-02	-1.85E-04	3.33E-02
NO_3^-	g	1.64E-01	-8.85E-02	7.55E-02
NO_3-N	g	7.57E-04	-4.19E-06	7.53E-04
Oil	g	2.19E+01	-5.02	1.68E+01
Organics	g	1.22E+01	-4.20	7.97
Other nitrogen	g	1.31E-02	0	1.31E-02
PAH	g	1.26E-01	0	1.26E-01
Pb	g	6.56E-03	-2.14E-03	4.42E-03
Phenol	g	2.67E-02	-9.45E-14	2.67E-02
Phosphate	g	6.23E-02	-2.86E-02	3.37E-02
PO_4^{3-}	g	1.78E-02	7.72E-04	1.86E-02
Radioactive emissions	kBq	1.01E+05	-6.02E+06	-5.92E+06
Salt	g	2.07E+01	-1.14E-01	2.06E+01
Sb	g	8.48E-06	-4.91E-06	3.56E-06
Sn	g	6.64E-01	-3.85E-01	2.79E-01
SO_4^{2-}	g	9.34E+01	-9.35	8.40E+01
Sr	g	5.18E-01	-2.87E-03	5.15E-01
Sulphur	g	7.48E-05	0	7.48E-05
Suspended solids	g	5.63E+01	9.89	6.62E+01
TOC	g	1.59E-04	-6.03E-02	-6.01E-02
Tot-F	g	6.29E-03	0	6.29E-03
Tot-N	g	3.09	-1.36	1.73
Totally extractible	g	5.15E+01	0	5.15E+01
V	g	1.99E-03	-1.15E-03	8.38E-04
Water to WWTP	g	5.53E+03	0	5.53E+03
Zn	g	4.02E-02	-6.24E-03	3.39E-02
Waste				
Bulk waste, total	g	1.03E+05	-1.21E+04	9.07E+04
Elementary waste, corrugated board	g	*0*	*-5.86E+02*	*-5.86E+02*
Waste	g	*1.54E+02*	*0*	*1.54E+02*
Waste, bulky	g	*5.44E+04*	*-3.02E+02*	*5.41E+04*
Waste, carbon	g	*4.78E+01*	*0*	*4.78E+01*
Waste, combustible	g	*6.08E+02*	*0*	*6.08E+02*
Waste, dross fines	g	*1.32E+01*	*0*	*1.32E+01*
Waste, industrial	g	*3.72E+04*	*-1.12E+04*	*2.60E+04*

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	Unit	Packaging system	Effects on other life cycles	Total
Waste, inert chemicals	g	*4.52E-01*	*0*	*4.52E-01*
Waste, inert residues	g	*6.80E+02*	*0*	*6.80E+02*
Waste, inorganic sludges	g	*1.59E+02*	*7.55E+01*	*2.35E+02*
Waste, mineral	g	*4.63E+01*	*-2.99E-02*	*4.63E+01*
Waste, non hazardous	g	*9.12E+02*	*0*	*9.12E+02*
Waste, non toxic chemicals	g	*1.05*	*0*	*1.05*
Waste, organic sludges	g	*4.49E+01*	*1.20E+01*	*5.69E+01*
Waste, other rejects	g	*3.71E+02*	*-8.61E+01*	*2.84E+02*
Waste, paper related	g	*8.22E+01*	*-4.62E+01*	*3.60E+01*
Waste, red mud	g	*6.58E+03*	*0*	*6.58E+03*
Waste, refractory	g	*7.17E+01*	*0*	*7.17E+01*
Waste, rubber	g	*6.33E-02*	*-3.48E-04*	*6.30E-02*
Waste, sludge	g	*7.23E+02*	*-2.42E-10*	*7.23E+02*
Waste, special	g	*9.60E-03*	*0*	*9.60E-03*
Waste, wood	g	*6.42E+02*	*0*	*6.42E+02*
Glue to waste water treatment plant	g	6.30E+01	0	6.30E+01
Hazardous waste, total	g	7.06E+03	-1.47E+03	5.59E+03
Waste, chemical	g	*4.18E-01*	*-2.32E-03*	*4.16E-01*
Waste, hazardous	g	*6.61E+03*	*-1.47E+03*	*5.14E+03*
Waste, ink	g	*3.03*	*0*	*3.03*
Waste, oil	g	*3.81E+02*	*0*	*3.81E+02*
Waste, regulated chemicals	g	*1.31E-03*	*0*	*1.31E-03*
Waste, solvent	g	*6.35E+01*	*0*	*6.35E+01*
Waste, toxic chemicals	g	*1.26E-01*	*0*	*1.26E-01*
Slags & ashes, total	g	1.52E+04	1.98E+01	1.52E+04
Waste, ashes	g	*5.09E+03*	*2.79E+01*	*5.12E+03*
Waste, slags & ashes (energy prod.)	g	*1.47E+03*	*-8.14*	*1.46E+03*
Waste, slags & ashes (waste incin.)	g	*8.09E-04*	*-4.47E-06*	*8.05E-04*
Waste, slags & ashes	g	*8.66E+03*	*0*	*8.66E+03*
Nuclear waste, total	g	1.66E+01	1.71E-01	1.68E+01
Waste, highly radioactive	g	*1.63E+01*	*1.72E-01*	*1.65E+01*
Waste, radioactive	g	*3.14E-01*	*-2.24E-04*	*3.14E-01*
Co-products				
Biogas	g	0	-5.51E+01	-5.51E+01
Carbon reused as fuel	g	1.04E+02	0	1.04E+02
Ethylene	g	3.92E+02	0	3.92E+02
Fuel gas	g	4.44E+02	0	4.44E+02

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	Unit	Packaging system	Effects on other life cycles	Total
Fuel Oil, Low Sulphur	g	6.18	0	6.18
Hydrogen	g	1.06E+02	0	1.06E+02
Isobutanol	g	2.28	0	2.28
Layer pads, CB	g	3.03E+02	0	3.03E+02
Plastic ligature	g	1.33E+01	0	1.33E+01
Recycled lubricants	g	5.01E-01	-4.82E-01	1.94E-02
Rejects incinerated + energy	g	5.52	-5.29	2.29E-01
Reused lubricants	g	1.00	-9.64E-01	3.80E-02
Skimmings and dross for recycling	g	7.55E+01	0	7.55E+01
Steel scrap	g	3.84E+01	0	3.84E+01
Synthetic gas (H_2:CO=2:1)	g	1.86E+03	0	1.86E+03

3.2 50 cl aluminium cans

The life cycle

The process tree of the packaging system is illustrated in Figure A.1 in annex A. A simplified process tree is presented in Figure 3.2. The 50 cl aluminium can is produced from 0.26 mm thick aluminium sheets. The sheets are strip-rolled from aluminium rolling ingots. The aluminium used in beverage cans contains 1.5% manganese as an alloy. To distribute 1000 litres of beverage 2000 50 cl aluminium cans (1000/0.50) are produced. The weight of one 50 cl aluminium can is 18.50 grams.

90% of the used aluminium cans are collected for recycling due to the scope of this study (see table 3.4 and Main report, section 2.5). The remaining 10% end up in waste incineration where energy is recovered.

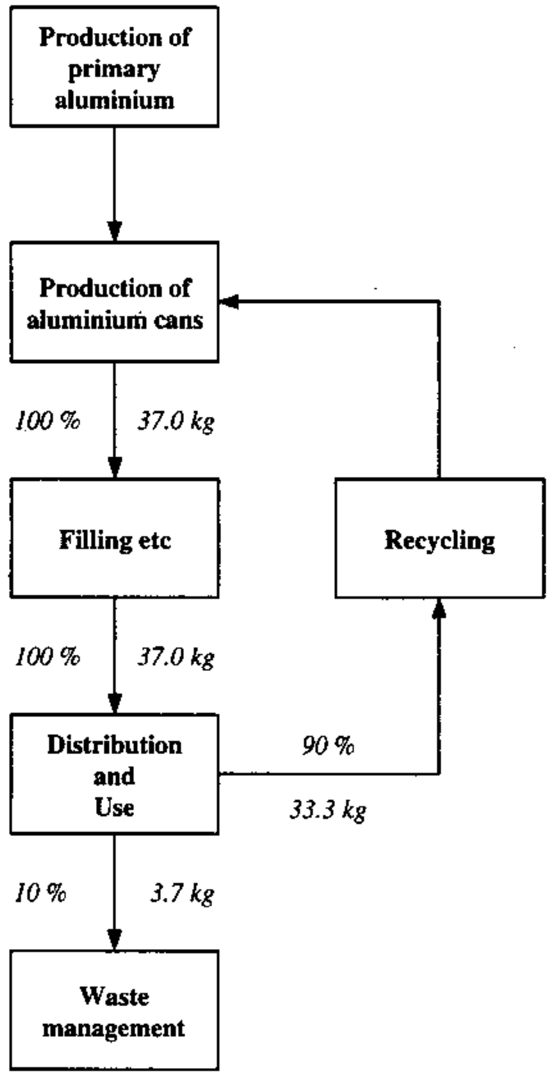

Figure 3.2
Flows of 50 cl aluminium cans per 1000 litres of beverage. (Flows of secondary packaging and transport packaging are not included).

Input data

The secondary packagings and transport packagings are quantitatively described by the system parameters in Table 3.3. Data and calculations on the environmental inputs and outputs of the processes in the process tree are presented in annex B. Data on the environmental inputs and outputs of transports and on the production of fuels and electricity are presented in Technical report 7.

Table 3.4

System parameters for the packaging system with 50 cl aluminium cans. The mass presented refers to the weight of a single item, i.e., one bottle or one tray. The market shares of the secondary packaging do not add up to 100% as they may be combined in different ways.

	Name	Mass [g]	Market share	Material	Degree of return	Degree of recycling	Degree of disposal
Primary packaging	Aluminium can (50 cl)	18.50	100 %	Aluminium	0 %	90 %	10 %
Secondary packaging	Tray (24 cans)	120	50 %	Corrugated board	0 %	20 %	80 %
	Foil for tray (24 cans)	20	33 %	LDPE	0 %	0 %	100 %
	Box (24 cans)	250	17 %	Corrugated board	0 %	20 %	80 %
	Box (6 cans)	60	25 %	Cardboard	0 %	20 %	80 %
	Hi-cone	3.4	25 %	LDPE	0 %	0 %	100 %
Transport packaging	Pallet (1848 cans)	22000	100 %	Wood	95 %	0 %	5 %
	Plastic ligature (1848 cans)	20	75 %	LDPE	0 %	70 %	30 %
	Glue	2	25 %	Casein/urea/H_2O	0 %	0 %	100 %

Table 3.5

Energy demand at final use for the packaging system with 50 cl aluminium cans. These energy flows are not flows across the system boundary but internal flows within the system. Functional unit: packaging and distribution of 1000 litres.

	Unit	Packaging system	Effects on other life cycles	Total
Electricity, total	kWh	2.35E+02	-1.43	2.33E+02
Electricity	*kWh*	*2.37*	*0*	*2.37*
Electricity, coal marginal	*kWh*	*2.32E+02*	*-1.43*	*2.31E+02*
Hydro power	*kWh*	*1.91E-01*	*0*	*1.91E-01*
Fossil fuel, total	MJ	1.19E+03	-3.12E+02	8.81E+02
Coal	*MJ*	*3.50*	*0*	*3.50*
Coal, feedstock	*MJ*	*9.52E-03*	*0*	*9.52E-03*
Diesel, heavy & medium truck (highway)	*MJ*	*1.66E+02*	*1.60*	*1.68E+02*
Diesel, heavy & medium truck (rural)	*MJ*	*9.75E+01*	*-4.76E-02*	*9.75E+01*
Diesel, heavy & medium truck (urban)	*MJ*	*7.09E+01*	*5.64*	*7.66E+01*
Diesel, ship (4-stroke)	*MJ*	*1.19E+01*	*7.35*	*1.93E+01*
Fuel oil, ship (2-stroke)	*MJ*	*4.18E+01*	*0*	*4.18E+01*
Fuel, unspecified	*MJ*	*1.61E-03*	*-9.96E-06*	*1.60E-03*
Hard coal	*MJ*	*1.23*	*0*	*1.23*
LPG, forklift	*MJ*	*1.20E-01*	*-1.05E-01*	*1.48E-02*
LPG, thermal	*MJ*	*2.46E+01*	*0*	*2.46E+01*
Natural gas (>100 kW)	*MJ*	*5.34E+02*	*-1.48E+02*	*3.86E+02*
Natural gas	*MJ*	*2.16E+01*	*0*	*2.16E+01*
Natural gas, feedstock	*MJ*	*3.13E+01*	*0*	*3.13E+01*
Oil	*MJ*	*5.94*	*0*	*5.94*
Oil, feedstock	*MJ*	*4.74E+01*	*0*	*4.74E+01*
Oil, heavy fuel	*MJ*	*9.33E+01*	*7.13*	*1.00E+02*
Oil, heavy, feedstock	*MJ*	*3.35E+01*	*0*	*3.35E+01*
Oil, light fuel	*MJ*	*2.72*	*-1.86E+02*	*-1.83E+02*
Peat	*MJ*	*4.87*	*3.85E-01*	*5.26*
Renewable fuel, total	MJ	8.46	2.87	1.13E+01
Bark	*MJ*	*8.46*	*2.87*	*1.13E+01*
Heat etc., total	MJ	-5.40	-1.19	-6.58
Heat	*MJ*	*-5.40*	*-1.19*	*-6.58*

Table 3.6
Inventory results for the packaging system with 50 cl aluminium cans. Functional unit: packaging and distribution of 1000 litres.

	Unit	Packaging system	Effects on other life cycles	Total
Resources				
Al	g	1.61E-01	-9.96E-04	1.60E-01
Bauxite	g	1.76E+04	0	1.76E+04
Biomass	g	6.05	2.15E-01	6.26
Brown coal	g	1.36E+03	-7.29E+01	1.28E+03
$CaCO_3$	g	2.83E-01	-1.74E-03	2.81E-01
Clay	g	9.30E-02	-3.72E-04	9.26E-02
Coal	g	3.21E+02	0	3.21E+02
Coal, feedstock	g	4.55E+02	0	4.55E+02
Crude oil	g	1.99E+04	-4.25E+03	1.56E+04
Crude oil, feedstock	g	3.35E+03	-8.34E-05	3.35E+03
Fe	g	1.67E-01	-1.03E-03	1.66E-01
Ferromanganese	g	1.29E-03	0	1.29E-03
Ground water	g	3.63E-03	-2.25E-05	3.61E-03
Hard coal	g	1.32E+05	-8.96E+02	1.32E+05
Hydro power-water	g	4.00E+09	-1.66E+09	2.34E+09
Iron ore	g	2.87E-01	0	2.87E-01
Land use [m^2*years]	m^2*year	1.62E+02	1.35E+02	2.97E+02
Limestone	g	8.67E+02	0	8.67E+02
Mn	g	7.30E+01	-5.85E-06	7.30E+01
NaCl	g	4.65E+01	-1.74E-03	4.65E+01
Natural gas	g	1.29E+04	-3.25E+03	9.63E+03
Natural gas, feedstock	g	5.80E+02	0	5.80E+02
Oil, feedstock	g	3.90E+02	0	3.90E+02
Salt	g	2.66E+02	0	2.66E+02
Sand	g	1.29E-02	0	1.29E-02
Softwood	g	3.68E+01	-2.26E-01	3.66E+01
Surface water	g	7.42E-05	-4.51E-07	7.38E-05
Uranium (as pure U)	g	1.19E-01	-5.24E-03	1.14E-01
Water	g	2.55E+07	-1.57E+05	2.54E+07
Wood	g	8.84	-4.34	4.50
Non-elementary inflows				
Alum	g	2.63E+01	1.29E+01	3.93E+01
Aluminium hydroxide	g	5.70E+01	0	5.70E+01
Argon	g	1.46E+01	0	1.46E+01
Auxiliary materials	g	2.67E-01	0	2.67E-01

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	Unit	Packaging system	Effects on other life cycles	Total
Bark	g	4.97E+02	1.68E+02	6.66E+02
Biocides	g	2.43E-01	3.49E-02	2.78E-01
$Ca(OH)_2$	g	3.07E+02	0	3.07E+02
$CaCO_3$	g	2.21E+01	1.08E+01	3.29E+01
Calcium fluoride	g	1.24E+02	0	1.24E+02
CaO	g	5.87E+01	2.87E+01	8.73E+01
Carbon	g	1.49E+02	0	1.49E+02
Chlorine	g	8.74	0	8.74
Colorants	g	5.11	-4.86	2.55E-01
Defoamer	g	9.65	3.84	1.35E+01
Explosives	g	2.92E-01	0	2.92E-01
Finish	g	7.53E+01	0	7.53E+01
Glue	g	4.18E+01	0	4.18E+01
H_2SO_4	g	9.42E+01	4.61E+01	1.40E+02
HCl	g	1.67	-4.92E-01	1.17
Lubricants	g	3.52	3.14E-01	3.83
MgO	g	9.79E-01	0	9.79E-01
Miscellaneous chemicals	g	8.08E-01	0	8.08E-01
Na_2SO_4	g	3.49E+01	1.71E+01	5.20E+01
Na_2CO_3	g	1.53E+01	5.94	2.12E+01
NaOH	g	6.56E+01	2.55E+01	9.11E+01
NH_3	g	1.09E+01	0	1.09E+01
Oil	g	4.25E+02	0	4.25E+02
Other additives	g	2.78	1.05	3.83
Packaging	g	1.38E+03	0	1.38E+03
Peat	g	2.32E+02	1.83E+01	2.50E+02
Phosphoric acid	g	5.15E-01	-4.92E-01	2.32E-02
Plastic ligature	g	1.63E+01	0	1.63E+01
Polyester for strips	g	1.35E+02	0	1.35E+02
Printing ink	g	1.27E+02	0	1.27E+02
Refractory materials	g	4.19E+01	0	4.19E+01
Retention agents	g	1.70E+01	5.94	2.30E+01
Sizing agents	g	5.42E+01	9.08	6.33E+01
SO_2	g	1.07	0	1.07
Starch	g	2.29E+02	-8.63E+01	1.42E+02
Steel	g	2.97E+01	0	2.97E+01
Sulphur	g	1.18E+01	7.01E-01	1.25E+01
Sulphuric acid	g	1.43E+02	0	1.43E+02
Urea	g	4.42E-01	-4.19E-01	2.32E-02
Washing chemicals	g	3.82E+02	0	3.82E+02

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... Table 3.6 continued from previous page.

	Unit	Packaging system	Effects on other life cycles	Total
Emissions to air				
Acetaldehyde	g	4.14E-04	-1.24E-04	2.90E-04
Acetylene	g	2.05E-05	-7.44E-03	-7.42E-03
Al_2O_3	g	7.43E-01	0	7.43E-01
Aldehydes	g	3.92E-03	-1.56E-05	3.90E-03
Alkanes	g	4.78E-02	-1.86E-01	-1.38E-01
Alkenes	g	2.41E-03	-1.48E-02	-1.24E-02
Amylaclohol	g	5.23	0	5.23
Aromates (C9-C10)	g	4.88E-02	-1.51E-02	3.37E-02
As	g	3.62E-03	-8.80E-05	3.53E-03
B	g	3.04E-01	-1.88E-03	3.03E-01
Benzo(a)pyrene	g	9.78E-06	-1.26E-06	8.52E-06
Benzene	g	3.18E-01	-5.89E-02	2.59E-01
Butane	g	2.89E-01	-8.67E-02	2.02E-01
Butanol	g	2.11E+01	0	2.11E+01
Butydiglycole	g	8.02E-01	0	8.02E-01
Butylglycole	g	2.75E+01	0	2.75E+01
C_2F_6	g	1.95E-01	0	1.95E-01
Ca	g	6.31E-03	0	6.31E-03
Cd	g	3.47E-03	-1.41E-04	3.32E-03
CF_4	g	1.75	0	1.75
CH_4	g	1.07E+03	-1.03E+02	9.64E+02
Cl^-	g	1.40E-04	-2.85	-2.85
CN^-	g	1.53E-03	5.45E-05	1.58E-03
CO	g	5.17E+02	-1.64	5.16E+02
Co	g	3.51E-03	-5.64E-06	3.50E-03
CO_2 (bio)	g	3.07E+04	4.20E+03	3.49E+04
CO_2	g	2.93E+05	-2.43E+04	2.68E+05
COS	g	1.95E+01	0	1.95E+01
Cr	g	2.06E-03	-1.35E-04	1.93E-03
Cr^{3+}	g	1.90E-03	-8.25E-07	1.90E-03
Cu	g	2.13E-02	4.95E-04	2.18E-02
Dioxin	g	2.38E-07	-1.43E-08	2.23E-07
Dust	g	7.85E+01	0	7.85E+01
Ethane	g	4.09E-05	-1.48E-02	-1.48E-02
Ethene	g	1.02E-04	-3.72E-02	-3.71E-02
Fe	g	1.42E-02	0	1.42E-02
Fluorides	g	4.67	0	4.67
Formaldehyde	g	7.67E-02	-1.68E-02	5.99E-02

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... Table 3.6 continued from previous page.

	Unit	Packaging system	Effects on other life cycles	Total
H_2O	g	8.04E+03	0	8.04E+03
H_2S	g	8.48E-01	3.84E-01	1.23
HC	g	3.95E+01	-7.12E-02	3.94E+01
HCl	g	1.53E+01	-1.30E-01	1.52E+01
Heavy metals	g	9.87E-15	-6.10E-17	9.81E-15
HF	g	1.23E-01	-2.18E-03	1.21E-01
Hg	g	1.51E-02	-2.10E-04	1.49E-02
Metals	g	7.19E-03	-1.24E-05	7.18E-03
Mg	g	2.13E-01	-1.30E-03	2.12E-01
Mn	g	2.52E-03	-1.56E-05	2.51E-03
Mo	g	2.29E-03	-6.30E-06	2.28E-03
N_2O	g	2.59	-7.49E-03	2.58
Na	g	5.91E-02	0	5.91E-02
NH_3	g	8.83E-02	3.06E-06	8.83E-02
Ni	g	8.02E-02	-6.82E-03	7.34E-02
NMVOC	g	7.22E+01	-3.53E+01	3.69E+01
NMVOC, diesel engines	g	4.24E+01	1.46	4.38E+01
NMVOC, el-coal	g	3.88	-2.39E-02	3.86
NMVOC, natural gas combustion	g	8.63E-02	0	8.63E-02
NMVOC, oil combustion	g	4.47E+01	1.63	4.63E+01
NMVOC, petrol engines	g	7.54E-10	-4.69E-12	7.49E-10
NMVOC, power plants	g	1.87	-1.16E-02	1.86
NO_x	g	1.03E+03	-1.16E+01	1.02E+03
Organics	g	5.06E-03	-3.12E-05	5.03E-03
Other organics	g	1.49E-05	0	1.49E-05
PAH	g	2.47E-01	-1.33E-03	2.46E-01
Particulates	g	1.00E+02	-6.40E-01	9.95E+01
Pb	g	1.08E-02	-6.21E-04	1.01E-02
Pentane	g	4.95E-01	-1.48E-01	3.47E-01
Propane	g	8.51E-02	-4.71E-02	3.80E-02
Propene	g	4.09E-05	-1.48E-02	-1.48E-02
Radioactive emissions	kBq	8.15E+06	-4.93E+08	-4.85E+08
Rn-222	Bq	2.19E-02	0	2.19E-02
Sb	g	3.10E-04	-1.91E-06	3.08E-04
Se	g	2.34E-02	-1.34E-04	2.32E-02
Sn	g	3.49E-04	-2.15E-06	3.47E-04
SO_2	g	6.45E+02	-1.52E+01	6.30E+02
Sr	g	1.75E-03	-1.07E-05	1.74E-03
Th	g	1.56E-04	-9.54E-07	1.55E-04
Tl	g	7.77E-05	-4.77E-07	7.72E-05
Toluene	g	8.51E-02	-3.22E-02	5.29E-02

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	Unit	Packaging system	Effects on other life cycles	Total
Tot-P	g	1.56E-02	-9.54E-05	1.55E-02
U	g	1.16E-04	-7.18E-07	1.15E-04
V	g	2.07E-01	-1.36E-05	2.07E-01
VOC	g	1.88E+01	0	1.88E+01
VOC, coal combustion	g	1.01E-01	-6.27E-04	1.01E-01
VOC, diesel engines	g	2.79	-1.71E-02	2.78
VOC, natural gas combustion	g	7.89E-09	-4.85E-11	7.84E-09
Xylene	g	6.05E-01	0	6.05E-01
Zn	g	2.26E-02	1.75E-04	2.28E-02
Emissions to water				
Acid as H^+	g	1.75E-01	0	1.75E-01
Al	g	7.14E-01	-1.39E-01	5.75E-01
AOX	g	2.56E-03	0	2.56E-03
Aromates (C9-C10)	g	1.15E-02	-7.12E-05	1.15E-02
As	g	1.56E-03	-4.27E-04	1.13E-03
BOD	g	2.43E+01	-6.12E-05	2.43E+01
BOD-5	g	4.87E+01	2.05E+01	6.92E+01
Cd	g	8.19E-04	-2.41E-04	5.79E-04
Chloride	g	1.28E+01	0	1.28E+01
Cl^-	g	1.58E+03	-1.20E+02	1.46E+03
ClO_3^-	g	6.80E-01	-4.16E-03	6.76E-01
CN-	g	2.17E-03	-1.06E-03	1.11E-03
Co	g	1.93E-02	1.13E-02	3.06E-02
COD	g	2.89E+02	5.57E+01	3.44E+02
Cr	g	6.81E-03	-3.34E-03	3.47E-03
Cr^{3+}	g	4.62E-03	1.67E-04	4.79E-03
Cu	g	2.72E-03	-1.35E-03	1.37E-03
Dissolved organics	g	8.37E-02	-3.26E-12	8.37E-02
Dissolved solids	g	8.06E+01	-4.94E-01	8.01E+01
F^-	g	3.15E-01	-4.21E-03	3.11E-01
Fe	g	1.61E-01	-9.81E-04	1.60E-01
Fluoride	g	2.21E+01	0	2.21E+01
H^+	g	6.05E-02	-3.72E-04	6.01E-02
H_2S	g	7.10E-05	-3.50E-05	3.60E-05
H_2SO_4	g	3.89	0	3.89
HC	g	1.58E-01	-2.49E-04	1.58E-01
Metals	g	2.69E-01	-6.12E-05	2.69E-01
Mn	g	8.02E-02	-4.95E-04	7.97E-02
Na^+	g	2.63E-01	0	2.63E-01
NH_3	g	2.53E-02	0	2.53E-02
NH_4^+	g	4.76E-03	0	4.76E-03

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	Unit	Packaging system	Effects on other life cycles	Total
NH_4-N	g	6.41E-02	-4.00E-04	6.37E-02
Ni	g	1.27E-02	-1.34E-03	1.14E-02
Nitrates	g	8.41E-03	0	8.41E-03
Nitrogen	g	2.59E-02	-1.59E-04	2.58E-02
NO_3^-	g	1.21E-01	-6.37E-02	5.73E-02
NO_3-N	g	5.88E-04	-3.62E-06	5.85E-04
Oil	g	2.02E+01	-3.90	1.63E+01
Organics	g	1.09E+01	-3.27	7.66
Other nitrogen	g	9.86E-03	0	9.86E-03
PAH	g	9.74E-02	0	9.74E-02
Pb	g	5.88E-03	-1.66E-03	4.22E-03
Phenol	g	2.65E-02	-8.14E-14	2.65E-02
Phosphate	g	5.01E-02	-2.14E-02	2.87E-02
PO_4^{3-}	g	1.55E-02	5.63E-04	1.60E-02
Radioactive emissions	kBq	7.71E+04	-4.65E+06	-4.57E+06
Salt	g	1.60E+01	-9.90E-02	1.59E+01
Sb	g	7.76E-06	-3.80E-06	3.95E-06
Sn	g	6.08E-01	-2.98E-01	3.10E-01
SO_4^{2-}	g	7.43E+01	-7.14	6.72E+01
Sr	g	4.02E-01	-2.47E-03	3.99E-01
Sulphur	g	7.43E-05	0	7.43E-05
Suspended solids	g	4.87E+01	7.19	5.59E+01
TOC	g	1.28E-04	-4.65E-02	-4.63E-02
Tot-F	g	4.87E-03	0	4.87E-03
Tot-N	g	2.75	-1.05	1.70
Totally extractible	g	5.22E+01	0	5.22E+01
V	g	1.82E-03	-8.92E-04	9.26E-04
Water to WWTP	g	4.23E+03	0	4.23E+03
Zn	g	3.22E-02	-4.79E-03	2.74E-02
Waste				
Bulk waste, total	g	8.11E+04	-9.26E+03	7.19E+04
Elementary waste, corrugated board	g	*0*	*-4.26E+02*	*-4.26E+02*
Waste	g	*1.03E+02*	*0*	*1.03E+02*
Waste, bulky	g	*4.22E+04*	*-2.60E+02*	*4.19E+04*
Waste, carbon	g	*3.70E+01*	*0*	*3.70E+01*
Waste, combustible	g	*4.04E+02*	*0*	*4.04E+02*
Waste, dross fines	g	*1.02E+01*	*0*	*1.02E+01*
Waste, industrial	g	*3.10E+04*	*-8.54E+03*	*2.24E+04*
Waste, inert chemicals	g	*4.50E-01*	*0*	*4.50E-01*
Waste, inert residues	g	*5.26E+02*	*0*	*5.26E+02*
Waste, inorganic sludges	g	*1.18E+02*	*5.49E+01*	*1.73E+02*

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... Table 3.6 continued from previous page.

	Unit	Packaging system	Effects on other life cycles	Total
Waste, mineral	g	*3.66E+01*	*-2.57E-02*	*3.66E+01*
Waste, non hazardous	g	*7.65E+02*	*0*	*7.65E+02*
Waste, non toxic chemicals	g	*7.92E-01*	*0*	*7.92E-01*
Waste, organic sludges	g	*3.31E+01*	*8.74*	*4.19E+01*
Waste, other rejects	g	*2.73E+02*	*-6.25E+01*	*2.10E+02*
Waste, paper related	g	*6.04E+01*	*-3.35E+01*	*2.68E+01*
Waste, red mud	g	*5.09E+03*	*0*	*5.09E+03*
Waste, refractory	g	*5.55E+01*	*0*	*5.55E+01*
Waste, rubber	g	*4.91E-02*	*-3.02E-04*	*4.88E-02*
Waste, sludge	g	*4.80E+02*	*-2.08E-10*	*4.80E+02*
Waste, special	g	*9.55E-03*	*0*	*9.55E-03*
Waste, wood	g	*4.26E+02*	*0*	*4.26E+02*
Glue to waste water treatment plant	g	*4.18E+01*	*0*	*4.18E+01*
Hazardous waste, total	g	5.73E+03	-1.13E+03	4.61E+03
Waste, chemical	g	*3.24E-01*	*-2.00E-03*	*3.22E-01*
Waste, hazardous	g	*5.40E+03*	*-1.13E+03*	*4.27E+03*
Waste, ink	g	*2.01*	*0*	*2.01*
Waste, oil	g	*2.89E+02*	*0*	*2.89E+02*
Waste, regulated chemicals	g	*1.30E-03*	*0*	*1.30E-03*
Waste, solvent	g	*4.22E+01*	*0*	*4.22E+01*
Waste, toxic chemicals	g	*9.37E-02*	*0*	*9.37E-02*
Slags & ashes, total	g	1.27E+04	1.33E+01	1.27E+04
Waste, ashes	g	*4.27E+03*	*2.03E+01*	*4.29E+03*
Waste, slags & ashes (energy prod.)	g	*1.14E+03*	*-7.00*	*1.13E+03*
Waste, slags & ashes (waste incin.)	g	*6.27E-04*	*-3.87E-06*	*6.23E-04*
Waste, slags & ashes	g	*7.31E+03*	*0*	*7.31E+03*
Nuclear waste, total	g	1.49E+01	1.24E-01	1.50E+01
Waste, highly radioactive	g	*1.46E+01*	*1.25E-01*	*1.47E+01*
Waste, radioactive	g	*2.46E-01*	*-3.70E-04*	*2.46E-01*
Co-products				
Biogas	g	0	-4.00E+01	-4.00E+01
Carbon reused as fuel	g	8.08E+01	0	8.08E+01
Ethylene	g	3.90E+02	0	3.90E+02
Fuel gas	g	4.41E+02	0	4.41E+02
Fuel Oil, Low Sulphur	g	6.14	0	6.14
Hydrogen	g	1.05E+02	0	1.05E+02
Isobutanol	g	2.26	0	2.26
Layer pads, CB	g	2.01E+02	0	2.01E+02

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	Unit	Packaging system	Effects on other life cycles	Total
Plastic ligature	g	1.15E+01	0	1.15E+01
Recycled lubricants	g	3.68E-01	-3.50E-01	1.81E-02
Rejects incinerated + energy	g	4.05	-3.84	2.11E-01
Reused lubricants	g	7.36E-01	-7.01E-01	3.53E-02
Skimmings and dross for recycling	g	5.84E+01	0	5.84E+01
Steel scrap	g	2.97E+01	0	2.97E+01
Synthetic gas (H_2:CO=2:1)	g	1.85E+03	0	1.85E+03

4 Impact assessment

4.1 Classification and characterisation

Table 4.1
Classification and characterisation for the packaging system with 33 cl aluminium cans. The unit of the characterisation factor is g equivalent per g emission. Functional unit: packaging and distribution of 1000 litres.

NP [kg NO_3^--equivalents]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to air				
NH_3	3.64 E-03	3.56E-04	4.41E-07	3.56E-04
NO_x	1.35 E-03	1.71	-1.81E-02	1.69
Emissions to water				
CN^-	2.38E-03	5.63E-06	-3.26E-06	2.37E-06
NH_3	3.64E-03	1.26E-04	0	1.26E-04
NH_4^+	3.44E-03	2.19E-05	0	2.19E-05
NH_4-N	4.42E-03	3.67E-04	-2.04E-06	3.65E-04
Nitrates	1.00E-03	1.00E-05	0	1.00E-05
NO_3-	1.00E-03	1.64E-04	-8.85E-05	7.55E-05
NO_3-N	4.43E-03	3.36E-06	-1.85E-08	3.34E-06
Phosphate	3.20E-02	2.00E-03	-9.17E-04	1.08E-03
PO_4^{3-}	1.05E-02	1.86E-04	8.07E-06	1.94E-04
Tot-N	4.43E-03	1.37E-02	-6.04E-03	7.66E-03
Total		**1.72**	**-2.52E-02**	**1.70**

POCP [kg C_2H_4-equivalents]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to air				
Acetylene	2.00E-04	5.12E-09	-1.93E-06	-1.92E-06
Aldehydes	5.00E-04	2.32E-06	-9.01E-09	2.31E-06
Alkanes	4.00E-04	2.07E-05	-9.65E-05	-7.58E-05
Alkenes	9.00E-04	2.35E-06	-1.73E-05	-1.50E-05
Aromates (C9-C10)	8.00E-04	4.84E-05	-1.57E-05	3.27E-05
Benzene	2.00E-04	7.50E-05	-1.52E-05	5.99E-05

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POCP [kg C_2H_4-equivalents]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Butanol	4.00E-04	8.36E-03	0	8.36E-03
CH_4	7.00E-06	9.55E-03	-9.68E-04	8.58E-03
CO	3.00E-05	1.97E-02	-5.49E-05	1.96E-02
Ethane	1.00E-04	5.10E-09	-1.93E-06	-1.92E-06
Ethene	1.00E-03	1.28E-07	-4.82E-05	-4.81E-05
Formaldehyde	4.00E-04	3.53E-05	-8.76E-06	2.65E-05
HC	6.00E-04	2.99E-02	-4.96E-05	2.98E-02
NMVOC	4.00E-04	3.16E-02	-1.82E-02	1.33E-02
NMVOC, diesel engines	6.00E-04	2.85E-02	1.19E-03	2.97E-02
NMVOC, el-coal	8.00E-04	4.00E-03	-2.23E-05	3.98E-03
NMVOC, natural gas combustion	4.00E-04	4.12E-05	0	4.12E-05
NMVOC, oil combustion	3.00E-04	1.54E-02	6.71E-04	1.61E-02
NMVOC, petrol engines	6.00E-04	5.83E-13	-3.24E-15	5.80E-13
NMVOC, power plants	5.00E-04	1.21E-03	-6.71E-06	1.20E-03
Pentane	4.00E-04	2.39E-04	-7.70E-05	1.62E-04
Propane	4.00E-04	4.10E-05	-2.44E-05	1.66E-05
Propene	1.00E-03	5.10E-08	-1.93E-05	-1.92E-05
Toluene	6.00E-04	6.15E-05	-2.51E-05	3.64E-05
VOC, coal combustion	5.00E-04	6.52E-05	-3.65E-07	6.49E-05
VOC, diesel engines	6.00E-04	2.16E-03	-1.19E-05	2.15E-03
VOC, natural gas combustion	2.00E-04	2.04E-12	-1.13E-14	2.02E-12
Xylene	9.00E-04	5.44E-04	0	5.44E-04
Total		**1.52E-01**	**-1.78E-02**	**1.34E-01**

AP [kg SO_2-equivalents]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to air				
H_2S	1.88E-03	2.15E-03	9.92E-04	3.14E-03
HCl	8.80E-04	1.73E-02	-1.38E-04	1.72E-02
HF	1.60E-03	2.27E-04	-4.08E-06	2.23E-04
NH_3	1.88E-03	1.84E-04	2.28E-07	1.84E-04
NO_x	7.00E-04	8.85E-01	-9.41E-03	8.75E-01
SO_2	1.00E-03	8.17E-01	-1.91E-02	7.98E-01

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... Table 4.1 continued from previous page.

AP [kg SO_2-equivalents]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to water				
Acid as H^+	3.20E-02	6.26E-03	0	6.26E-03
H^+	3.20E-02	2.50E-03	-1.36E-05	2.48E-03
H_2S	1.88E-03	1.46E-07	-8.50E-08	6.07E-08
H_2SO_4	6.50E-04	3.27E-03	0	3.27E-03
NH_3	1.88E-03	6.49E-05	0	6.49E-05
NH_4^+	3.56E-03	2.27E-05	0	2.27E-05
NH_4-N	4.58E-03	3.80E-04	-2.12E-06	3.78E-04
Total		**1.73**	**-2.77E-02**	**1.71**

GWP [kg CO_2-equivalents]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to air				
C_2F_6	1.25E-02	3.15E-03	0	3.15E-03
CF_4	6.30E-03	1.43E-02	0	1.43E-02
CH_4	2.50E-02	3.41E+01	-3.46	3.06E+01
CO	2.00E-03	1.31	-3.66E-03	1.31
CO_2	1.00E-03	3.68E+02	-3.13E+01	3.36E+02
COS	7.00E-04	1.76E-02	0	1.76E-02
HC	3.00E-03	1.49E-01	-2.48E-04	1.49E-01
N_2O	0.32	9.90E-01	-1.55E-03	9.89E-01
Total		**4.04E+02**	**-3.48E+01**	**3.70E+02**

HTA [m^3 air]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to air				
As	9.50E+06	4.18E+04	-1.05E+03	4.07E+04
Benzo(a)pyrene	5.00E+07	5.90E+02	-8.17E+01	5.08E+02
Benzene	1.00E+07	3.75E+06	-7.60E+05	2.99E+06
Butanol	1.30E+04	2.72E+05	0	2.72E+05
Cd	1.10E+08	4.17E+05	-1.99E+04	3.97E+05
CO	830	5.45E+05	-1.52E+03	5.44E+05
Co	9.5E+03	3.77E+1	-6.19E-02	3.77E+1
Cr	1.00E+06	2.25E+03	-1.73E+02	2.07E+03

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HTA [m^3 air]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Cr^{3+}	1.00E+06	2.42E+03	1.01	2.42E+03
Cu	570	1.36E+01	3.89E-01	1.40E+01
Dioxin	2.90E+10	8.69E+03	-5.35E+02	8.15E+03
Fe	3.70E+04	5.66E+02	0	5.66E+02
Fluorides	9.50E+04	5.74E+05	0	5.74E+05
Formaldehyde	1.30E+07	1.15E+06	-2.85E+05	8.61E+05
H_2S	1.10E+06	1.26E+06	5.81E+05	1.84E+06
Hg	6.70E+06	1.30E+05	-1.74E+03	1.28E+05
Mn	2.50E+06	8.14E+03	-4.51E+01	8.09E+03
Mo	1.00E+05	2.69E+02	-7.35E-01	2.68E+02
N_2O	2.00E+03	6.19E+03	-9.71	6.18E+03
Ni	6.70E+04	5.90E+03	-5.87E+02	5.31E+03
NMVOC, diesel engines	9.80E+05	4.65E+07	1.95E+06	4.85E+07
NMVOC, el-coal	3.80E+05	1.90E+06	-1.06E+04	1.89E+06
NOx	8.60E+03	1.09E+07	-1.16E+05	1.08E+07
Pb	1.00E+08	1.25E+06	-7.94E+04	1.17E+06
Sb	2.00E+04	8.00	-4.45E-02	7.96
Se	1.50E+06	4.48E+04	-2.34E+02	4.46E+04
SO2	1.30E+03	1.06E+06	-2.48E+04	1.04E+06
Tl	5.00E+05	5.01E+01	-2.80E-01	4.98E+01
Toluene	2.50E+03	2.56E+02	-1.05E+02	1.52E+02
V	1.40E+05	3.14E+04	-2.22	3.14E+04
Xylene	6.7E+03	4.05E+03	0	4.05E+03
Total		**6.99E+07**	**1.23E+06**	**7.11E+07**

ETWC [m^3 water]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to air				
As	380	1.67	-4.22E-02	1.63
Benzene	4.00	1.50	-3.04E-01	1.20
Butanol	1.00E-02	2.09E-01	0	2.09E-01
Cd	2.40E+04	9.10E+01	-4.35	8.67E+01
Co	400	1.59	-2.61E-03	1.59
Cr	130	2.92E-01	-2.25E-02	2.70E-01
Cr^{3+}	130	3.15E-01	1.31E-04	3.15E-01
Cu	2.50E+03	5.96E+01	1.71	6.14E+01
Dioxin	5.60E+08	1.68E+02	-1.03E+01	1.57E+02

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ETWC [m³ water]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Fe	20	3.06E-01	0	3.06E-01
Formaldehyde	24	2.12	-5.26E-01	1.59
Hg	4.00E+03	7.77E+01	-1.04	7.67E+01
Mn	71	2.31E-01	-1.28E-03	2.30E-01
Mo	400	1.07	-2.94E-03	1.07
Ni	130	1.14E+01	-1.14	1.03E+01
NMVOC, diesel engines	62	2.94E+03	1.23E+02	3.07E+03
NMVOC, el-coal	11.4	5.70E+01	-3.17E-01	5.67E+01
Pb	400	5.01	-3.18E-01	4.69
Se	4.00E+03	1.20E+02	-6.24E-01	1.19E+02
Sr	2.00E+03	4.51	-2.51E-02	4.48
Tl	670	6.71E-02	-3.76E-04	6.67E-02
Toluene	4.00	4.10E-01	-1.67E-01	2.43E-01
V	40	8.97	-6.35E-04	8.97
Xylene	4.00	2.42	0	2.42
Zn	200	5.39	5.17E-02	5.44
Emissions to water				
As	1.90E+03	3.30	-1.04	2.26
Cd	1.20E+05	1.10E+02	-3.71E+01	7.26E+01
Co	2.00E+03	5.08E+01	3.10E+01	8.18E+01
Cr	670	4.98	-2.89	2.09
Cr^{3+}	670	3.57	1.55E-01	3.73
Cu	1.30E+04	4.03E+01	-2.28E+01	1.74E+01
Fe	1.00E+02	2.07E+01	-1.15E-01	2.06E+01
H_2S	6.70E+03	5.19E-01	-3.03E-01	2.16E-01
Mn	360	3.73E+01	-2.07E-01	3.70E+01
Ni	670	1.04E+01	-1.15	9.27
Pb	2.00E+03	1.31E+01	-4.28	8.85
Phenol	44	1.17	-4.16E-12	1.17
Sr	1.00E+04	5.18E+03	-2.87E+01	5.15E+03
V	200	3.97E-01	-2.30E-01	1.68E-01
Zn	1.00E+03	4.02E+01	-6.24	3.39E+01
Total		**9.08E+03**	**3.19E+01**	**9.11E+03**

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... *Table 4.1 continued from previous page.*

HTW [m^3 water]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to air				
As	7.4	3.26E-02	-8.21E-04	3.17E-02
Benzene	2.3	8.63E-01	-1.75E-01	6.88E-01
Butanol	1.40E-03	2.93E-02	0	2.93E-02
Cd	560	2.12	-1.01E-01	2.02
Co	2.50E-03	9.93E-06	-1.63E-08	9.91E-6
Cr	3.6	8.09E-03	-6.22E-04	7.47E-03
Cr^{3+}	3.6	8.71E-03	3.63E-06	8.72E-03
Cu	3.4	8.11E-02	2.32E-03	8.34E-02
Dioxin	2.20E+08	6.59E+01	-4.06	6.19E+01
Fe	9.60E-03	1.47E-04	0	1.47E-04
Formaldehyde	2.20E-05	1.94E-06	-4.82E-07	1.46E-06
H_2S	8.10E-04	9.27E-04	4.28E-04	1.35E-03
Hg	1.10E+05	2.14E+03	-2.86E+01	2.11E+03
Mn	5.30E-03	1.73E-05	-9.55E-08	1.72E-05
Mo	5.30E-02	1.42E-04	-3.90E-07	1.42E-04
Ni	3.70E-03	3.26E-04	-3.24E-05	2.93E-04
NMVOC, diesel engines	4.60E-02	2.18	9.15E-02	2.28
NMVOC, el-coal	7.30E-04	3.65E-03	-2.03E-05	3.63E-03
Pb	53	6.64E-01	-4.21E-02	6.21E-01
Sb	64	2.56E-02	-1.42E-04	2.55E-02
Se	28	8.37E-01	-4.37E-03	8.33E-01
Tl	1.30E+04	1.30	-7.29E-03	1.29
Toluene	4.00E-03	4.10E-04	-1.67E-04	2.43E-04
V	3.70E-02	8.30E-03	-5.87E-07	8.30E-03
Xylene	1.10E-03	6.64E-04	0	6.64E-04
Emissions to water				
As	37	6.43E-02	-2.03E-02	4.40E-02
Cd	2.80E+03	2.56	-8.67E-01	1.69
Co	1.20E-02	3.05E-04	1.86E-04	4.91E-04
Cr	18	1.34E-01	-7.76E-02	5.63E-02
Cr^{3+}	18	9.59E-02	4.16E-03	1.00E-01
Cu	17	5.27E-02	-2.99E-02	2.28E-02
F	1.20E-02	4.75E-03	-6.06E-05	4.69E-03
Fe	4.80E-02	9.94E-03	-5.54E-05	9.88E-03
Fluoride	1.20E-02	2.54E-01	0	2.54E-01
H_2S	4.10E-03	3.18E-07	-1.85E-07	1.32E-07
Mn	2.70E-02	2.79E-03	-1.56E-05	2.78E-03
Ni	1.90E-02	2.96E-04	-3.25E-05	2.63E-04

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HTW [m^3 water]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Pb	260	1.71	-5.56E-01	1.15
Phenol	3.40E-02	9.08E-04	-3.21E-15	9.08E-04
Sb	3.20E+02	2.71E-03	-1.57E-03	1.14E-03
V	0.19	3.77E-04	-2.18E-04	1.59E-04
Total		**2.22E+03**	**-3.44E+01**	**2.18E+03**

ETSC [m^3 soil]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to air				
As	0.27	1.19E-03	-2.99E-05	1.16E-03
Benzene	3.6	1.35	-2.73E-01	1.08
Butanol	9.00E-02	1.88	0	1.88
Cd	1.8	6.83E-03	-3.26E-04	6.50E-03
Co	9.1	3.61E-02	-5.93E-05	3.60E-02
Cr	1.00E-02	2.25E-05	-1.73E-06	2.07E-05
Cr^{3+}	1.00E-02	2.42E-05	1.01E-08	2.42E-05
Cu	2.00E-02	4.77E-04	1.37E-05	4.91E-04
Dioxin	1.20E+04	3.60E-03	-2.21E-04	3.37E-03
Fe	0.53	8.11E-03	0	8.11E-03
Formaldehyde	2.00E+02	1.76E+01	-4.38	1.32E+01
Hg	5.3	1.03E-01	-1.38E-03	1.02E-01
Mn	1.9	6.19E-03	-3.42E-05	6.15E-03
Mo	3.9	1.05E-02	-2.87E-05	1.04E-02
Ni	5.00E-02	4.40E-03	-4.38E-04	3.96E-03
NMVOC, diesel engines	580	2.75E+04	1.15E+03	2.87E+04
NMVOC, el-coal	92	4.60E+02	-2.56	4.58E+02
Pb	1.00E-02	1.25E-04	-7.94E-06	1.17E-04
Se	106	3.17	-1.65E-02	3.15
Sr	53	1.19E-01	-6.65E-04	1.19E-01
Tl	17.7	1.77E-03	-9.93E-06	1.76E-03
Toluene	0.97	9.94E-02	-4.06E-02	5.88E-02
V	0.34	7.62E-02	-5.40E-06	7.62E-02
Xylene	0.4	2.42E-01	0	2.42E-01
Zn	5.00E-03	1.35E-04	1.29E-06	1.36E-04
Total		**2.80E+04**	**1.15E+03**	**2.92E+04**

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ETWA [m^3 water]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to water				
As	190	3.30E-01	-1.04E-01	2.26E-01
Cd	1.20E+04	1.10E+01	-3.71	7.26
Co	200			
Cr	67	4.98E-01	-2.89E-01	2.09E-01
Cr^{3+}	67	3.57E-01	1.55E-02	3.73E-01
Cu	1.30E+03	4.03	-2.28	1.74
Fe	10	2.07	-1.15E-02	2.06
H_2S	3.30E+03	2.56E-01	-1.49E-01	1.07E-01
Mn	36	3.73	-2.07E-02	3.70
Ni	67	1.04	-1.15E-01	9.27E-01
Pb	200	1.31	-4.28E-01	8.85E-01
Phenol	22	5.87E-01	-2.08E-12	5.87E-01
Sr	1.00E+03	5.18E+02	-2.87	5.15E+02
V	20	3.97E-02	-2.30E-02	1.68E-02
Zn	100	4.02	-6.24E-01	3.39
Total		**5.52E+02**	**-7.50**	**5.45E+02**

HTS [m^3 soil]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to air				
As	100	4.40E-01	-1.11E-02	4.29E-01
Benzene	14	5.25	-1.06	4.19
Butanol	0.14	2.93	0	2.93
Cd	4.5	1.71E-02	-8.15E-04	1.63E-02
Co	0.17	6.75E-04	-1.11E-06	6.74E-04
Cr	1.1	2.47E-03	-1.90E-04	2.28E-03
Cr^{3+}	1.1	2.66E-03	1.11E-06	2.66E-03
Cu	4.00E-03	9.54E-05	2.73E-06	9.82E-05
Dioxin	1.40E+04	4.19E-03	-2.58E-04	3.94E-03
Fe	0.77	1.18E-02	0	1.18E-02
Formaldehyde	5.80E-03	5.11E-04	-1.27E-04	3.84E-04
H_2S	0.26	2.98E-01	1.37E-01	4.35E-01
Hg	81	1.57	-2.10E-02	1.55
Mn	0.42	1.37E-03	-7.57E-06	1.36E-03
Mo	1.5	4.03E-03	-1.10E-05	4.02E-03

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HTS [m³ soil]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Ni	0.12	1.06E-02	-1.05E-03	9.51E-03
NMVOC, diesel engines	0.28	1.33E+01	5.57E-01	1.39E+01
NMVOC, el-coal	2.50E-04	1.25E-03	-6.95E-06	1.24E-03
Pb	8.30E-02	1.04E-03	-6.59E-05	9.73E-04
Sb	17	6.80E-03	-3.78E-05	6.77E-03
Se	4.40E-02	1.32E-03	-6.87E-06	1.31E-03
Tl	10	1.00E-03	-5.61E-06	9.96E-04
Toluene	1.00E-03	1.02E-04	-4.18E-05	6.07E-05
V	0.96	2.15E-01	-1.52E-05	2.15E-01
Xylene	6.70E-05	4.05E-05	0	4.05E-05
Total		**2.41E+01**	**-4.04E-01**	**2.37E+01**

Table 4.2

Classification and characterisation for the packaging system with 50 cl aluminium cans. The unit of the characterisation factor is g equivalent per g emission. Functional unit: packaging and distribution of 1000 litres.

NP [kg NO_3^--equivalents]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to air				
NH_3	3.64 E-03	3.21E-04	1.11E-08	3.21E-04
NO_x	1.35 E-03	1.39	-1.56E-02	1.37
Emissions to water				
CN^-	2.38E-03	5.16E-06	-2.52E-06	2.64E-06
NH_3	3.64E-03	9.21E-05	0	9.21E-05
NH_4^+	3.44E-03	1.64E-05	0	1.64E-05
NH_4-N	4.42E-03	2.84E-04	-1.77E-06	2.82E-04
Nitrates	1.00E-03	8.41E-06	0	8.41E-06
NO_3^-	1.00E-03	1.21E-04	-6.37E-05	5.73E-05
NO_3-N	4.43E-03	2.61E-06	-1.60E-08	2.59E-06
Phosphate	3.20E-02	1.60E-03	-6.87E-04	9.18E-04
PO_4^{3-}	1.05E-02	1.62E-04	5.88E-06	1.68E-04
Tot-N	4.43E-03	1.22E-02	-4.66E-03	7.53E-03
Total		**1.40**	**-2.10E-02**	**1.38**

POCP [kg C_2H_4-equivalents]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to air				
Acetylene	2.00E-04	4.09E-09	-1.49E-06	-1.48E-06
Aldehydes	5.00E-04	1.96E-06	-7.78E-09	1.95E-06
Alkanes	4.00E-04	1.91E-05	-7.44E-05	-5.52E-05
Alkenes	9.00E-04	2.17E-06	-1.33E-05	-1.12E-05
Aromates (C9-C10)	8.00E-04	3.91E-05	-1.21E-05	2.70E-05
Benzene	2.00E-04	6.36E-05	-1.18E-05	5.18E-05
Butanol	4.00E-04	8.44E-03	0	8.44E-03
CH_4	7.00E-06	7.46E-03	-7.18E-04	6.74E-03
CO	3.00E-05	1.55E-02	-4.93E-05	1.55E-02
Ethane	1.00E-04	4.09E-09	-1.48E-06	-1.48E-06
Ethene	1.00E-03	1.02E-07	-3.72E-05	-3.71E-05
Formaldehyde	4.00E-04	3.07E-05	-6.73E-06	2.40E-05
HC	6.00E-04	2.37E-02	-4.27E-05	2.36E-02

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POCP [kg C_2H_4-equivalents]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
NMVOC	4.00E-04	2.89E-02	-1.41E-02	1.48E-02
NMVOC, diesel engines	6.00E-04	2.54E-02	8.74E-04	2.63E-02
NMVOC, el-coal	8.00E-04	3.10E-03	-1.92E-05	3.08E-03
NMVOC, natural gas combustion	4.00E-04	3.45E-05	0	3.45E-05
NMVOC, oil combustion	3.00E-04	1.34E-02	4.88E-04	1.39E-02
NMVOC, petrol engines	6.00E-04	4.52E-13	-2.82E-15	4.50E-13
NMVOC, power plants	5.00E-04	9.37E-04	-5.78E-06	9.31E-04
Pentane	4.00E-04	1.98E-04	-5.93E-05	1.39E-04
Propane	4.00E-04	3.41E-05	-1.89E-05	1.52E-05
Propene	1.00E-03	4.09E-08	-1.48E-05	-1.48E-05
Toluene	6.00E-04	5.11E-05	-1.93E-05	3.17E-05
VOC, coal combustion	5.00E-04	5.06E-05	-3.14E-07	5.03E-05
VOC, diesel engines	6.00E-04	1.68E-03	-1.03E-05	1.67E-03
VOC, natural gas combustion	2.00E-04	1.58E-12	-9.71E-15	1.57E-12
Xylene	9.00E-04	5.45E-04	0	5.45E-04
Total		**1.30E-01**	**-1.39E-02**	**1.16E-01**

AP [kg SO_2-equivalents]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to air				
H_2S	1.88E-03	1.59E-03	7.22E-04	2.32E-03
HCl	8.80E-04	1.35E-02	-1.15E-04	1.34E-02
HF	1.60E-03	1.97E-04	-3.48E-06	1.93E-04
NH_3	1.88E-03	1.66E-04	5.75E-09	1.66E-04
NO_x	7.00E-04	7.21E-01	-8.11E-03	7.13E-01
SO_2	1.00E-03	6.45E-01	-1.52E-02	6.30E-01
Emissions to water				
Acid as H^+	3.20E-02	5.61E-03	0	5.61E-03
H^+	3.20E-02	1.94E-03	-1.19E-05	1.92E-03
H_2S	1.88E-03	1.33E-07	-6.58E-08	6.76E-08
H_2SO_4	6.50E-04	2.53E-03	0	2.53E-03
NH_3	1.88E-03	4.76E-05	0	4.76E-05
NH_4^+	3.56E-03	1.70E-05	0	1.70E-05
NH_4-N	4.58E-03	2.94E-04	-1.83E-06	2.92E-04
Total		**1.39**	**-2.27E-02**	**1.37**

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GWP [kg CO_2-equivalents]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to air				
C_2F_6	1.25E-02	2.44E-03	0	2.44E-03
CF_4	6.30E-03	1.10E-02	0	1.10E-02
CH_4	2.50E-02	2.67E+01	-2.56	2.41E+01
CO	2.00E-03	1.03	-3.29E-03	1.03
CO_2	1.00E-03	2.93E+02	-2.43E+01	2.68E+02
COS	7.00E-04	1.36E-02	0	1.36E-02
HC	3.00E-03	1.18E-01	-2.14E-04	1.18E-01
N_2O	0.32	8.28E-01	-2.40E-03	8.26E-01
Total		**3.21E+02**	**-2.68E+01**	**2.94E+02**

HTA [m^3 air]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to air				
As	9.50E+06	3.44E+04	-8.36E+02	3.35E+04
Benzo(a)pyrene	5.00E+07	4.89E+02	-6.30E+01	4.26E+02
Benzene	1.00E+07	3.18E+06	-5.89E+05	2.59E+06
Butanol	1.30E+04	2.74E+05	0	2.74E+05
Cd	1.10E+08	3.81E+05	-1.55E+04	3.66E+05
CO	830	4.29E+05	-1.36E+03	4.28E+05
Co	9.5E+03	3.33E+01	-5.36E-02	3.33E+01
Cr	1.00E+06	2.06E+03	-1.35E+02	1.93E+03
Cr^{3+}	1.00E+06	1.90E+03	-8.25E-01	1.90E+03
Cu	570	1.21E+01	2.82E-01	1.24E+01
Dioxin	2.90E+10	6.89E+03	-4.14E+02	6.47E+03
Fe	3.70E+04	5.25E+02	0	5.25E+02
Fluorides	9.50E+04	4.44E+05	0	4.44E+05
Formaldehyde	1.30E+07	9.97E+05	-2.19E+05	7.79E+05
H_2S	1.10E+06	9.32E+05	4.23E+05	1.35E+06
Hg	6.70E+06	1.01E+05	-1.40E+03	9.95E+04
Mn	2.50E+06	6.31E+03	-3.89E+01	6.27E+03
Mo	1.00E+05	2.29E+02	-6.30E-01	2.28E+02
N_2O	2.00E+03	5.18E+03	-1.50E+01	5.16E+03
Ni	6.70E+04	5.37E+03	-4.57E+02	4.92E+03
NMVOC, diesel engines	9.80E+05	4.15E+07	1.43E+06	4.30E+07
NMVOC, el-coal	3.80E+05	1.47E+06	-9.10E+03	1.46E+06
NOx	8.60E+03	8.86E+06	-9.96E+04	8.76E+06
Pb	1.00E+08	1.08E+06	-6.21E+04	1.01E+06

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HTA [m^3 air]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Sb	2.00E+04	6.20	-3.82E-02	6.16
Se	1.50E+06	3.51E+04	-2.01E+02	3.49E+04
SO_2	1.30E+03	8.38E+05	-1.98E+04	8.18E+05
Tl	5.00E+05	3.88E+01	-2.39E-01	3.86E+01
Toluene	2.50E+03	2.13E+02	-8.05E+01	1.32E+02
V	1.40E+05	2.90E+04	-1.91	2.90E+04
Xylene	6.7E+03	4.05E+03	0	4.05E+03
Total		**6.07E+07**	**8.32E+05**	**6.15E+07**

ETWC [m^3 water]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to air				
As	380	1.38	-3.34E-02	1.34
Benzene	4.00	1.27	-2.36E-01	1.04
Butanol	1.00E-02	2.11E-01	0	2.11E-01
Cd	2.40E+04	8.32E+01	-3.39	7.98E+01
Co	400	1.40	-2.26E-03	1.40
Cr	130	2.68E-01	-1.76E-02	2.50E-01
Cr^{3+}	130	2.47E-01	-1.07E-04	2.47E-01
Cu	2.50E+03	5.32E+01	1.24	5.45E+01
Dioxin	5.60E+08	1.33E+02	-8.00	1.25E+02
Fe	20	2.84E-01	0	2.84E-01
Formaldehyde	24	1.84	-4.04E-01	1.44
Hg	4.00E+03	6.02E+01	-8.38E-01	5.94E+01
Mn	71	1.79E-01	-1.11E-03	1.78E-01
Mo	400	9.15E-01	-2.52E-03	9.13E-01
Ni	130	1.04E+01	-8.87E-01	9.54
NMVOC, diesel engines	62	2.63E+03	9.04E+01	2.72E+03
NMVOC, el-coal	11.4	4.42E+01	-2.73E-01	4.39E+01
Pb	400	4.30	-2.48E-01	4.05
Se	4.00E+03	9.35E+01	-5.37E-01	9.29E+01
Sr	2.00E+03	3.50	-2.14E-02	3.47
Tl	670	5.20E-02	-3.20E-04	5.17E-02
Toluene	4.00	3.40E-01	-1.29E-01	2.12E-01
V	40	8.30	-5.45E-04	8.30
Xylene	4.00	2.42	0	2.42

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ETWC [m^3 water]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Zn	200	4.53	3.51E-02	4.56
Emissions to water				
As	1.90E+03	2.96	-8.12E-01	2.15
Cd	1.20E+05	9.83E+01	-2.89E+01	6.94E+01
Co	2000	7.02	-1.13E-02	7.01
Cr	670	4.56	-2.24	2.32
Cr^{3+}	670	3.10	1.12E-01	3.21
Cu	1.30E+04	3.54E+01	-1.75E+01	1.79E+01
Fe	1.00E+02	1.61E+01	-9.81E-02	1.60E+01
H_2S	6.70E+03	4.76E-01	-2.34E-01	2.41E-01
Mn	360	2.89E+01	-1.78E-01	2.87E+01
Ni	670	8.50	-8.95E-01	7.61
Pb	2.00E+03	1.18E+01	-3.32	8.44
Phenol	44	1.17	-3.58E-12	1.17
Sr	1.00E+04	4.02E+03	-2.47E+01	3.99E+03
V	200	3.64E-01	-1.78E-01	1.85E-01
Zn	1.00E+03	3.22E+01	-4.79	2.74E+01
Total		**7.41E+03**	**-7.12**	**7.40E+03**

HTW [m^3 water]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to air				
As	7.4	2.68E-02	-6.51E-04	2.61E-02
Benzene	2.3	7.31E-01	-1.35E-01	5.96E-01
Butanol	1.40E-03	2.95E-02	0	2.95E-02
Cd	560	1.94	-7.90E-02	1.86
Co	2.50E-03	8.78E-06	-1.41E-08	8.76E-06
Cr	3.6	7.42E-03	-4.87E-04	6.93E-03
Cr^{3+}	3.6	6.85E-03	-2.97E-06	6.85E-03
Cu	3.4	7.24E-02	1.68E-03	7.41E-02
Dioxin	2.20E+08	5.23E+01	-3.14	4.91E+01
Fe	9.60E-03	1.36E-04	0	1.36E-04
Formaldehyde	2.20E-05	1.69E-06	-3.70E-07	1.32E-06
H_2S	8.10E-04	6.87E-04	3.11E-04	9.98E-04
Hg	1.10E+05	1.66E+03	-2.31E+01	1.63E+03
Mn	5.30E-03	1.34E-05	-8.25E-08	1.33E-05
Mo	5.30E-02	1.21E-04	-3.34E-07	1.21E-04

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HTW [m^3 water]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Ni	3.70E-03	2.97E-04	-2.53E-05	2.71E-04
NMVOC, diesel engines	4.60E-02	1.95	6.70E-02	2.02
NMVOC, el-coal	7.30E-04	2.83E-03	-1.75E-05	2.81E-03
Pb	53	5.70E-01	-3.29E-02	5.37E-01
Sb	64	1.98E-02	-1.22E-04	1.97E-02
Se	28	6.54E-01	-3.76E-03	6.51E-01
Tl	1.30E+04	1.01	-6.20E-03	1.00
Toluene	4.00E-03	3.40E-04	-1.29E-04	2.12E-04
V	3.70E-02	7.67E-03	-5.04E-07	7.67E-03
Xylene	1.10E-03	6.66E-04	0	6.66E-04
Emissions to water				
As	37	5.76E-02	-1.58E-02	4.18E-02
Cd	2.80E+03	2.29	-6.74E-01	1.62
Co	1.20E-02	4.21E-05	-6.77E-08	4.21E-05
Cr	18	1.23E-01	-6.02E-02	6.24E-02
Cr^{3+}	18	8.32E-02	3.01E-03	8.62E-02
Cu	17	4.62E-02	-2.29E-02	2.34E-02
F	1.20E-02	3.78E-03	-5.06E-05	3.73E-03
Fe	4.80E-02	7.71E-03	-4.71E-05	7.67E-03
Fluoride	1.20E-02	2.65E-01	0	2.65E-01
H_2S	4.10E-03	2.91E-07	-1.43E-07	1.48E-07
Mn	2.70E-02	2.17E-03	-1.34E-05	2.15E-03
Ni	1.90E-02	2.41E-04	-2.54E-05	2.16E-04
Pb	260	1.53	-4.31E-01	1.10
Phenol	3.40E-02	9.01E-04	-2.77E-15	9.01E-04
Sb	3.20E+02	2.48E-03	-1.22E-03	1.27E-03
V	0.19	3.46E-04	-1.70E-04	1.76E-04
Total		**1.72E+03**	**-2.76E+01**	**1.69E+03**

ETSC [m^3 soil]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to air				
As	0.27	9.77E-04	-2.38E-05	9.53E-04
Benzene	3.6	1.14	-2.12E-01	9.33E-01
Butanol	9.00E-02	1.90	0	1.90
Cd	1.8	6.24E-03	-2.54E-04	5.98E-03
Co	9.1	3.19E-02	-5.13E-05	3.19E-02

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ETSC [m^3 soil]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Cr	1.00E-02	2.06E-05	-1.35E-06	1.93E-05
Cr^{3+}	1.00E-02	1.90E-05	-8.25E-09	1.90E-05
Cu	2.00E-02	4.26E-04	9.90E-06	4.36E-04
Dioxin	1.20E+04	2.85E-03	-1.71E-04	2.68E-03
Fe	0.53	7.52E-03	0	7.52E-03
Formaldehyde	2.00E+02	1.53E+01	-3.36	1.20E+01
Hg	5.3	7.98E-02	-1.11E-03	7.87E-02
Mn	1.9	4.80E-03	-2.96E-05	4.77E-03
Mo	3.9	8.93E-03	-2.46E-05	8.90E-03
Ni	5.00E-02	4.01E-03	-3.41E-04	3.67E-03
NMVOC, diesel engines	580	2.46E+04	8.45E+02	2.54E+04
NMVOC, el-coal	92	3.57E+02	-2.20	3.55E+02
Pb	1.00E-02	1.08E-04	-6.21E-06	1.01E-04
Se	106	2.48	-1.42E-02	2.46
Sr	53	9.26E-02	-5.68E-04	9.21E-02
Tl	17.7	1.37E-03	-8.44E-06	1.37E-03
Toluene	0.97	8.25E-02	-3.12E-02	5.13E-02
V	0.34	7.05E-02	-4.63E-06	7.05E-02
Xylene	0.4	2.42E-01	0	2.42E-01
Zn	5.00E-03	1.13E-04	8.77E-07	1.14E-04
Total		**2.50E+04**	**8.39E+02**	**2.58E+04**

ETWA [m^3 water]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to water				
As	190	2.96E-01	-8.12E-02	2.15E-01
Cd	1.20E+04	9.83	-2.89	6.94
Co	200	0.70	-1.13E-03	0.70
Cr	67	4.56E-01	-2.24E-01	2.32E-01
Cr^{3+}	67	3.10E-01	1.12E-02	3.21E-01
Cu	1.30E+03	3.54	-1.75	1.79
Fe	10	1.61	-9.81E-03	1.60
H_2S	3.30E+03	2.34E-01	-1.15E-01	1.19E-01
Mn	36	2.89	-1.78E-02	2.87
Ni	67	8.50E-01	-8.95E-02	7.61E-01
Pb	200	1.18	-3.32E-01	8.44E-01
Phenol	22	5.83E-01	-1.79E-12	5.83E-01

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ETWA [m^3 water]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Sr	1.00E+03	4.02E+02	-2.47	3.99E+02
V	20	3.64E-02	-1.78E-02	1.85E-02
Zn	100	3.22	-4.79E-01	2.74
Total		**4.27E+02**	**-8.46**	**4.18E+02**

HTS [m^3 soil]	Charact-erisation factor	Packaging system	Effects on other life cycles	Total
Emissions to air				
As	100	3.62E-01	-8.80E-03	3.53E-01
Benzene	14	4.45	-8.24E-01	3.63
Butanol	0.14	2.95	0	2.95
Cd	4.5	1.56E-02	-6.35E-04	1.50E-02
Co	0.17	5.97E-04	-9.59E-07	5.96E-04
Cr	1.1	2.27E-03	-1.49E-04	2.12E-03
Cr^{3+}	1.1	2.09E-03	-9.08E-07	2.09E-03
Cu	4.00E-03	8.52E-05	1.98E-06	8.72E-05
Dioxin	1.40E+04	3.33E-03	-2.00E-04	3.13E-03
Fe	0.77	1.09E-02	0	1.09E-02
Formaldehyde	5.80E-03	4.45E-04	-9.76E-05	3.47E-04
H_2S	0.26	2.20E-01	9.99E-02	3.20E-01
Hg	81	1.22	-1.70E-02	1.20
Mn	0.42	1.06E-03	-6.54E-06	1.05E-03
Mo	1.5	3.43E-03	-9.46E-06	3.42E-03
Ni	0.12	9.62E-03	-8.19E-04	8.80E-03
NMVOC, diesel engines	0.28	1.19E+01	4.08E-01	1.23E+01
NMVOC, el-coal	2.50E-04	9.70E-04	-5.99E-06	9.64E-04
Pb	8.30E-02	8.93E-04	-5.16E-05	8.41E-04
Sb	17	5.27E-03	-3.25E-05	5.24E-03
Se	4.40E-02	1.03E-03	-5.91E-06	1.02E-03
Tl	10	7.77E-04	-4.77E-06	7.72E-04
Toluene	1.00E-03	8.51E-05	-3.22E-05	5.29E-05
V	0.96	1.99E-01	-1.31E-05	1.99E-01
Xylene	6.70E-05	4.05E-05	0	4.05E-05
Total		**2.13E+01**	**-3.44E-01**	**2.10E+01**

4.2 Normalisation

Table 4.3

Normalisation results for the packaging system with 33 cl aluminium cans. Functional unit: packaging and distribution of 1000 litres.

Normalisation: Environmental impact categories	Normalisation reference (1)	Packaging system [PE_{WDK90}] (2)	Effects on other life cycles [PE_{WDK90}] (2)	Total [PE_{WDK90}] (2)
Environmental impacts				
Global warming (GWP)	8700	4.65E-02	-4.00E-03	4.25E-02
Photochemical ozone formation (POCP)	20	7.58E-03	-8.92E-04	6.69E-03
Acidification (AP)	124	1.40E-02	-2.23E-04	1.38E-02
Nutrient enrichment (NP)	298	5.78E-03	-8.45E-05	5.70E-03
Human toxicity, water (HTW)	59000	3.76E-02	-5.84E-04	3.70E-02
Human toxicity, soil (HTS)	310	7.76E-02	-1.30E-03	7.63E-02
Ecotoxicity, aquatic, chronic (ETWC)	470000	1.92E-02	1.86E-06	1.92E-02
Ecotoxicity, terrestrial, chronic (ETSC)	30000	9.34E-01	3.82E-02	9.73E-01
Ecotoxicity, aquatic, acute (ETWA)	48000	1.14E-02	-2.21E-04	1.12E-02
Human toxicity, air (HTA)	9.20E+09	7.60E-03	1.34E-04	7.73E-03
Waste				
Bulk waste (non-hazardous)	1350	7.61E-02	-8.97E-03	6.71E-02
Hazardous waste	20.7	3.41E-01	-7.12E-02	2.70E-01
Slag and ashes	320	4.35E-02	5.64E-05	4.35E-02
Nuclear waste	0.159	1.05E-01	1.08E-03	1.06E-01
Resources				
Oil	590	4.69E-02	-9.26E-03	3.77E-02
Coal	570	1.84E-01	-1.12E-03	1.83E-01
Brown coal	250	6.81E-03	-3.72E-04	6.44E-03
Natural gas	310	5.27E-02	-1.37E-02	3.90E-02
Aluminium	3.1	1.84	-3.40E-07	1.84
Lead	0.64	0	0	0
Iron	100	2.26E-06	-1.20E-08	2.25E-06
Copper	1.7	0	0	0
Manganese	1.8	5.24E-02	-3.80E-09	5.24E-02
Nickel	0.18	0	0	0
Tin	0.04	0	0	0
Zinc	1.4	0	0	0

(1) The normalisation references have the following units: characterisation equivalent/pers/year (for environmental impacts), kg/pers/year (for waste) m^3/pers/year (for wood) and kg/pers/year (for other resources).

(2) PE_{WDK90}: person equivalent based on emission levels, waste levels and resource demand in the year 1990.

Table 4.4
Normalisation results for the packaging system with 50 cl aluminium cans. Functional unit: packaging and distribution of 1000 litres.

Normalisation: Environmental impact categories	Normalisation reference (1)	Packaging system [PE_{WDK90}] (2)	Effects on other life cycles [PE_{WDK90}] (2)	Total [PE_{WDK90}] (2)
Environmental impacts				
Global warming (GWP)	8700	3.69E-02	-3.09E-03	3.38E-02
Photochemical ozone formation (POCP)	20	6.48E-03	-6.94E-04	5.79E-03
Acidification (AP)	124	1.12E-02	-1.83E-04	1.10E-02
Nutrient enrichment (NP)	298	4.71E-03	-7.06E-05	4.64E-03
Human toxicity, water (HTW)	59000	2.92E-02	-4.68E-04	2.87E-02
Human toxicity, soil (HTS)	310	6.88E-02	-1.11E-03	6.77E-02
Ecotoxicity, aquatic, chronic (ETWC)	470000	1.57E-02	-1.51E-05	1.57E-02
Ecotoxicity, terrestrial, chronic (ETSC)	30000	8.32E-01	2.80E-02	8.60E-01
Ecotoxicity, aquatic, acute (ETWA)	48000	8.89E-03	-1.76E-04	8.72E-03
Human toxicity, air (HTA)	9.20E+09	6.59E-03	9.04E-05	6.68E-03
Waste				
Bulk waste (non-hazardous)	1350	6.04E-02	-6.86E-03	5.36E-02
Hazardous waste	20.7	2.77E-01	-5.45E-02	2.22E-01
Slag and ashes	320	3.64E-02	3.79E-05	3.64E-02
Nuclear waste	0.159	9.34E-02	7.82E-04	9.42E-02
Resources				
Oil	590	4.00E-02	-7.20E-03	3.28E-02
Coal	570	1.43E-01	-9.62E-04	1.42E-01
Brown coal	250	5.42E-03	-2.92E-04	5.13E-03
Natural gas	310	4.34E-02	-1.05E-02	3.29E-02
Aluminium	3.1	1.43	-2.93E-07	1.43
Lead	0.64	0	0	0
Iron	100	1.76E-06	-1.03E-08	1.75E-06
Copper	1.7	0	0	0
Manganese	1.8	4.06E-02	-3.25E-09	4.06E-02
Nickel	0.18	0	0	0
Tin	0.04	0	0	0
Zinc	1.4	0	0	0

(1) The normalisation references have the following units: characterisation equivalent/pers/year (for environmental impacts), kg/pers/year (for waste) m^3/pers/year (for wood) and kg/pers/year (for other resources).

(2) PE_{WDK90}: person equivalent based on emission levels, waste levels and resource demand in the year 1990.

4.3 Weighting

Table 4.5

Weighting results for the packaging system with 33 cl aluminium cans.
Functional unit: packaging and distribution of 1000 litres.

Weighting: Environmental impact categories	Weighting factor	Packaging system	Effects on other life cycles	Total
Environmental impacts	[$PET_{WDK2000}$ /PE_{WDK90}] (1)	[$PET_{WDK2000}$]	[$PET_{WDK2000}$]	[$PET_{WDK2000}$]
Global warming (GWP)	1.3	6.04E-02	-5.20E-03	5.52E-02
Photochemical ozone formation (POCP)	1.2	9.09E-03	-1.07E-03	8.02E-03
Acidification (AP)	1.3	1.82E-02	-2.90E-04	1.79E-02
Nutrient enrichment (NP)	1.2	6.94E-03	-1.01E-04	6.84E-03
Human toxicity, water (HTW)	3.1	1.16E-01	-1.81E-03	1.15E-01
Human toxicity, soil (HTS)	2.3	1.79E-01	-3.00E-03	1.76E-01
Ecotoxicity, aquatic, chronic (ETWC)	2.6	4.99E-02	4.84E-06	4.99E-02
Ecotoxicity, terrestrial, chronic (ETSC)	1.9	1.78	7.26E-02	1.85
Ecotoxicity, aquatic, acute (ETWA)	2.6	2.96E-02	-5.75E-04	2.91E-02
Human toxicity, air (HTA)	2.8	2.13E-02	3.74E-04	2.16E-02
Waste	[$PET_{WDK2000}$/PE_{WDK90}]	[$PET_{WDK2000}$]	[$PET_{WDK2000}$]	[$PET_{WDK2000}$]
Bulk waste (non-hazardous)	1.1	8.37E-02	-9.86E-03	7.38E-02
Hazardous waste	1.1	3.75E-01	-7.83E-02	2.97E-01
Slag and ashes	1.1	4.78E-02	6.21E-05	4.79E-02
Nuclear waste	1.1	1.15E-01	1.19E-03	1.16E-01
Resources	[PR_{W90}/PE_{WDK90}]	[PR_{W90}] (2)	[PR_{W90}]	[PR_{W90}]
Oil	2.30E-02	1.08E-03	-2.13E-04	8.66E-04
Coal	5.80E-03	1.07E-03	-6.51E-06	1.06E-03
Brown coal	2.60E-03	1.77E-05	-9.66E-07	1.67E-05
Natural gas	1.60E-02	8.43E-04	-2.19E-04	6.24E-04
Aluminium	5.10E-03	9.39E-03	-1.73E-09	9.39E-03
Lead	4.80E-02	0	0	0
Iron	8.50E-03	1.92E-08	-1.02E-10	1.91E-08
Copper	2.80E-02	0	0	0
Manganese	1.20E-02	6.29E-04	-4.55E-11	6.29E-04
Nickel	1.90E-02	0	0	0
Tin	3.70E-02	0	0	0
Zinc	5.00E-02	0	0	0

(1) PETWDK2000: person equivalent based on target emissions in the year 2000.
PEWDK90: person equivalent based on emission levels in the year 1990.

(2) PR_{W90}: person-reserve, *i.e.*, the fraction of known global reserves per person, in 1990.

Table 4.6

Weighting results for the packaging system with 50 cl aluminium cans. Functional unit: packaging and distribution of 1000 litres.

Weighting: Environmental impact categories	Weighting factor	Packaging system	Effects on other life cycles	Total
Environmental impacts	$[PET_{WDK2000}$ $/PE_{WDK90}]$ (1)	$[PET_{WDK2000}]$	$[PET_{WDK2000}]$	$[PET_{WDK2000}]$
Global warming (GWP)	1.3	4.80E-02	-4.01E-03	4.40E-02
Photochemical ozone formation (POCP)	1.2	7.78E-03	-8.33E-04	6.94E-03
Acidification (AP)	1.3	1.46E-02	-2.38E-04	1.43E-02
Nutrient enrichment (NP)	1.2	5.66E-03	-8.47E-05	5.57E-03
Human toxicity, water (HTW)	3.1	9.04E-02	-1.45E-03	8.89E-02
Human toxicity, soil (HTS)	2.3	1.58E-01	-2.55E-03	1.56E-01
Ecotoxicity, aquatic, chronic (ETWC)	2.6	4.09E-02	-3.93E-05	4.09E-02
Ecotoxicity, terrestrial, chronic (ETSC)	1.9	1.58	5.32E-02	1.63
Ecotoxicity, aquatic, acute (ETWA)	2.6	2.31E-02	-4.58E-04	2.27E-02
Human toxicity, air (HTA)	2.8	1.85E-02	2.53E-04	1.87E-02
Waste	$[PET_{WDK2000}/PE_{WDK90}]$	$[PET_{WDK2000}]$	$[PET_{WDK2000}]$	$[PET_{WDK2000}]$
Bulk waste (non-hazardous)	1.1	6.65E-02	-7.55E-03	5.89E-02
Hazardous waste	1.1	3.05E-01	-5.99E-02	2.45E-01
Slag and ashes	1.1	4.00E-02	4.17E-05	4.00E-02
Nuclear waste	1.1	1.03E-01	8.60E-04	1.04E-01
Resources	$[PR_{W90}/PE_{WDK90}]$	$[PR_{W90}]$ (2)	$[PR_{W90}]$	$[PR_{W90}]$
Oil	2.30E-02	9.21E-04	-1.65E-04	7.55E-04
Coal	5.80E-03	8.30E-04	-5.58E-06	8.24E-04
Brown coal	2.60E-03	1.41E-05	-7.59E-07	1.33E-05
Natural gas	1.60E-02	6.95E-04	-1.68E-04	5.27E-04
Aluminium	5.10E-03	7.28E-03	-1.49E-09	7.28E-03
Lead	4.80E-02	0.00	0.00	0.00
Iron	8.50E-03	1.49E-08	-8.78E-11	1.49E-08
Copper	2.80E-02	0.00	0.00	0.00
Manganese	1.20E-02	4.87E-04	-3.90E-11	4.87E-04
Nickel	1.90E-02	0	0.	0
Tin	3.70E-02	0	0	0
Zinc	5.00E-02	0	0	0

(1) $PET_{WDK2000}$: person equivalent based on target emissions in the year 2000.
PE_{WDK90}: person equivalent based on emission levels in the year 1990.

(2) PR_{W90}: person-reserve, *i.e.*, the fraction of known global reserves per person, in 1990.

5 Interpretation

5.1 Dominance Analysis

Important impacts

The normalisation and weighting results indicate that the packaging systems with aluminium cans contribute most to the following environmental impacts (see Tables 4.3-4.6):

- Ecotoxicity, terrestrial, chronic (ETSC)
- Human toxicity, soil (HTS)
- Human toxicity, water (HTW)

However, the uncertainties in the normalisation and weighting results for toxicity and ecotoxicity impacts are very large. There are large uncertainties and possibly important data gaps in the inventory results regarding toxic emissions (see, *e.g.*, sections 2.1 and 3.3 in Technical report 7). There are large data gaps in the characterisation of toxicity and ecotoxicity impacts (see section 5.3 below). Furthermore, there are large uncertainties in the reference flows used in the normalisation of these impacts (see section 5.4.3).

It should also be noted that the fact that an environmental impact gets a high score in the normalisation and weighting does not necessarily imply that the impact is important. The normalisation and weighting results shows how much the packaging system contributes to an environmental impact, compared to current impact levels or targets levels. But the normalisation and weighting do not take into account the fact that different target levels may not be equally important.

Waste and resources

The aluminium can systems contribute a relatively large share (>100 mPET) of the target levels for generation of hazardous waste and nuclear waste. They also contribute significantly (more than approximately 1 mPR) to the depletion of aluminium resources.

Important processes

The processes contributing most to the environmental impacts of the 33cl can system are identified in Table 5.1. This table also presents processes or parts of the system investigated were the packaging system results in significant environmental gains. Such gains can be caused by, *e.g.*, the use of recycled material from the packaging system.

The results of a dominance analysis of the 50 cl bottle system would be similar to the results presented in Table 5.1. The reason is that the structure of the two systems is quite similar.

Table 5.1
The processes most important for the environmental impacts of the 33cl refillable glass bottle system. The figures are given in % of the net total potential environmental impact.

	GWP	POCP	AP	NP	HTW	HTS	ETWC	ETSC	ETWA	HTA
5. Electrolysis etc.	27	15	22	16	29		20		30	
8. Strip rolling	13				14		10		14	
11. Can production	23	14	14	15	25	21	17		26	
30. LDPE production		12								
44. Remelting	14		10	10	17		12		17	
46. Distribution of beverage		25		14		28	17	47		35
67. Alternative energy production		-14								

Electrolysis etc.

The largest contributions to GWP, AP, NP, HTW, ETWC and ETWA are caused by the processes included in electrolysis etc., *i.e.* electrolysis, casting, anode production, petroleum coke production, pitch production, cathode production and AlF_3 production (in annex A, all these processes are aggregated in the process-card *cast house*). The main contributing parameters are CO_2 (GWP), SO_2 (AP), NO_x (AP and NP), mercury emissions to air (HTW) and strontium emissions to water (ETWC and ETWA). We estimate the uncertainty in the Hg and Sr emissions to be high.

Can production

The production of aluminium cans mainly contributes to GWP, HTW, HTS and ETWA caused by carbon dioxide emission (GWP), mercury emissions to air (HTW), butanole emissions to air (HTS) and strontium emissions to water (ETWA).

Distribution of beverage

The largest contributions to POCP, HTS, ETSC and HTA are caused by emissions of NMVOC (POCP) and NMVOC from diesel engines (POCP, HTS, ETSC and HTA) arising from the distribution of beverage.

Waste generation

The hazardous waste consists mainly of oil and unspecified hazardous waste. The oil is generated at strip rolling and at can production. The unspecified hazardous waste is generated at production of epoxy resins (used as inside coatings), at strip rolling and at can production.

Resource demand

The depletion of aluminium (*i.e.* the resource bauxite) arises from the bauxite mining.

Electricity production

The electricity production is important for the results of this LCA. In the base-case scenario, electricity production is responsible for more than half of the net CO_2 emissions and approximately half of the SO_2 and NO_x emissions. The mercury (Hg) emissions originate from the electricity production.

Coal extraction

The strontium (Sr) emissions are emitted at coal extraction and at other processes associated with electricity production.

5.2 Sensitivity Analysis

5.2.1 Non-elementary inflows

Refining boundaries

Non-elementary inflows are auxilliary materials and other material flows that are not traced back all the way to the boundary between technosphere and nature. After initial calculations we performed a sensitivity analysis to estimate the environmental significance of the non-elementary inflows. As a result of this sensitivity analysis we decided to include the production of inside coatings and over-varnishes.

Amounts

Many non-elementary inflows remain in this LCA (see Tables 3.2 and 3.4) but they are all relatively small. The total amount of non-elementary inflows to the 33 cl system is 6.4 kg per 1000 litres (the inflows to the 50 cl system are smaller). This corresponds to approx. 7% of the weight of the total packaging. The largest non-elementary inflows are:

- packaging material used at the strip rolling plant: 1.7 kg/1000 litres,
- bark which is used as a fuel in the production of planks, cardboard, corrugated board and kraftliner: 0.9 kg/1000 litres, and
- washing chemicals used at the can production: 0.4 kg/1000litres.

Environmental significance

We have performed an assessment to estimate the environmental significance of the cut-offs made in this LCA. This evaluation of inflows not accounted for in the inventory is based upon expert judgement concerning the production and the toxic effects of the items listed. Most of the auxiliary chemicals do not constitute significant hazards by themselves or in their production or are only used in insignificant amounts.

Packaging materials

The production of packaging used at the strip rolling plant is likely to be negligible compared to the production of other, various packaging materials used by the system, which are included in the assessment.

Washing chemicals

The composition of the washing chemicals used in the can production is unknown. The production of these chemicals may contribute significantly to the total LCA results.

5.2.1 Non-elementary outflows

Co-products

Non-elementary outflows are waste and co-products that are not traced all the way to the boundary between technosphere and nature. The non-elementary outflows are documented in Tables 3.3 and 3.6. The effects of the co-products depend on for what purpose the co-products are used, and what, if anything, they can replace. However, we estimate the effects to be relatively minor since these outflows are all small. The total amount of non-elementary co-product outflows from the 33 cl system is 3.3 kg per 1000 litres (the outflows from the 50 cl system are smaller). This corresponds to approx. 4 % of the weight of the total packaging.

Bulk waste

The total non-elementary waste flows from the 33 cl system amount to 112 kg. However, most of this waste is bulk waste (industrial waste from the production of natural gas and unspecified bulk waste from the production of coal). The energy demanded for management of bulk waste is small (Tillman *et al.* 1992). We also estimate most of this waste to cause little environmental impacts in the landfill because it is relatively inert.

Hazardous waste

The amount of hazardous waste from the 33 cl system is 5.6 kg. It mainly consists of unspecified hazardous waste from the production of natural gas and electricity. The environmental impacts of the management of this waste are unknown, *i.e.*, no information has been available within the project.

5.2.1 Excluded processes

As stated above (section 2.1), production of materials for secondary packagings (trays, boxes etc.) and pallets is included in the LCA, but the actual packaging production - conversion, nailing etc. - is not included. The retailer is not included as well.

Pallet production

Since 95% of the pallets are reused, the demand for new pallets is only 0.06 pieces per 1000 litres (for the 33 cl can). The energy demand for pallet production has been given as 7 kWh electricity and 0.3 kg oil per 25 kg pallet (IDEMAT database 1995 referred to by RDC 1997). This means the energy demand for pallet production is well below 1% of total energy demand in the packaging system.

Pallet production also causes emissions of approximately 130 g sawdust per 1000 litres (IDEMAT 1995 via RDC 1997). This is the same order of magnitude as the emissions of particulates from the packaging system, but the sawdust is estimated to be much less environmentally hazardous. However, the emissions of sawdust may have an impact on the work environment. The impacts on work environment are not included in this study, see Main report, section 2.2.

Plastic ligature production

The amount of plastic ligature corresponds to 0.04 % of the primary packaging weight. The production of plastic ligature could therefore be considered as negligible.

Retailer

In the base case the retailer was excluded. When including these data in the base case for refillable PET-bottles the emissions of CO_2, NO_x, SO_2 and total VOC increases by about 1 % for each of these emissions. For aluminium cans, the retailer is of less importance than for the refillable PET-bottles since the collected aluminium cans are less bulky than the refillable PET bottles and therefore need less space for storing.

Consumer transports

Transports between retailer and the residence of the consumer are also excluded from the analysis. The effect of the beverage packaging on the fuel demand for this transport is estimated to be approximately 0.4 MJ per 1000 litres (see Technical report 7). This is clearly insignificant for the total energy demand of the packaging system.

5.2.2 Other factors

Table 5.2
Results of sensitivity analyses.

Parameters	Base case [g/1000 l beverage]	Can weight (+ 20 %) [% of base case]	Distribution (light truck) [% of base case]	El, Natural gas marginal [% of base case]	El, fragmented markets [% of base case]	El, Europan base load [% of base case]	98.5% collection rate [% of base case]
CO_2	3,36E+05	120	104	72	87	68	87
SO_2	7,98E+02	123	102	48	76	189	74
NO_x	1,25E+03	118	110	68	86	79	86
VOC, total	2,77E+02	113	113	89	95	115	100

Can weight

The can weight is 14.45 grams in the base case. This could be compared to 15.00 grams in the previous study. A sensitivity scenario corresponding to an increase of the can weight by 20 % (17.34 g) was performed. The results for some important inventory parameters are shown in table 5.2. The results are increased between 13 and 23%.

Distribution of beverage

The transport data used in the distribution of beverage represent a mix of different modes of conveyance. A sensitivity analysis regarding the distribution of beverage was performed using data for distribution by light trucks. The mode of conveyance appeared to be of minor importance, especially for CO_2 and SO_2 (table 5.2).

Allocation methods

The allocation method can be of great importance since the difference between the amounts of virgin aluminium and recycled aluminium is large in the assessment. The actual significance is difficult to quantify since no data are available about the true amount of recycled aluminium in the aluminium cans.

Use of recycled aluminium

Since we use a closed-loop approach for aluminium cans, the inflow of secondary material in our calculations depends on the recycling rate of used aluminium cans. The alternative fate of the secondary aluminium is to be recycled into another aluminium product (see Main report, section 2.7.5). Hence, the share of recycled aluminium in the packaging systems has no effect on the LCA results.

Amount of inside

The amount of inside coatings differs between the cans that are used for *coatings* beer and for those that are used for soft drinks (the amount is larger in the soft-drink cans). A sensitivity analysis regarding this amount was performed for the steel can, where the amount of inside coatings was increased to the amount used for soft-drink cans. The amount of inside coatings appeared to be of minor importance (see Technical report 4, table 5.2).

Electricity production

The electricity data used in the base case is coal marginal. Three sensitivity analyses were performed for electricity production (natural gas marginal, long term base load at fragmented markets and European base load average). It is clear from the results (table 5.2) that the assumption regarding the electricity production is important.

Collection rate

The collection rate is 90 % in the base case. A sensitivity analysis regarding the collection rate was performed. The collection rate was increased from 90% (as in the base-case) to 98.5 %. The results for some of the important inventory parameters are shown in table 5.2.

5.3 Assessment of data gaps

Inventory

There are no known significant data gaps in the inventory analysis of this study.

Characterisation

There are no known data gaps in the characterisation of global warming, photochemical ozone formation, acidification and nutrification. However, it should be noted that emissions measured as BOD or COD are not considered in the characterisation. These emissions have oxygen depleting impacts similar to those of nutrifying chemicals, but they do not contribute significantly to nutrification or any other environmental impact considered in this study.

There are large data gaps in the characterisation of most toxicity impacts since a large share of the hydrocarbon and NMVOC emissions have an unspecified composition. The characterisation indicates that hydrocarbons and NMVOCs are important for human toxicity in air and soil, and for chronic terrestrial and aquatic ecotoxicity. No characterisation factors were available for the unspecified emissions.

Normalisation

Reference values for the normalisation are available for all environmental impact categories covered by this LCA. Reference values are missing for the depletion of some of the resources, *e.g.*, dolomite, feldspar and uranium. We estimate the effects of these data gaps on the conclusions of the LCA to be small. The demand for uranium is small in this LCA, since the nuclear share of electricity production is small. It should really be zero. The reason why any uranium demand is reported in the LCA is that we have not used marginal data for electricity that is used in production of plastics and fuel.

Weighting

The data gaps in the weighting are similar to those in the normalisation.

5.4 Assessment of data quality

5.4.1 Overview

In order to assess the environmental consequences of choosing a packaging system with aluminium cans, we should ideally have used data representing the specific processes and transports actually affected by such a choice. As stated in the main report (section 2.9), the ideal data should be recent and relevant for actual or potential Danish packaging systems. They should reflect the technologies actually affected by a change in the packaging systems. For many processes, this is the long-term marginal technology.

In practice, we used specific data for the production of aluminium cans, for the distribution of the beverage and for alumium recycling. We explicitly used long-term marginal data for electricity production and for waste management. Marginal thinking was also applied to the transports between retailer and consumer residence, and to the refrigeration of the beverage container. For most other processes and transports, marginal data were not available and average or site specific data were used instead. This reduces the quality of these data with respect to the goal of this study.

5.4.2 Specific processes

Quality aspects

The data quality of the most important processes is summarised in Table 5.3. The uncertainty, completeness and representativity of the data are considered. The data uncertainty includes uncertainties in measurements, calculations and estimations. The uncertainty is estimated to be small, medium or large compared to what is common in LCAs.

The assessment of data completeness includes considerations of how large share of the relevant industries etc. that are presented in the data. It also includes considerations of whether the data reflects yearly averages or single measurements. The completeness is estimated to be good, fair or poor compared to what is common in LCAs.

The representativity reflects an assessment of how well the data set represents the industries etc. that are really relevant for the study. The representativity assessment also includes considerations of the time-related, geographical and technological representativity of the data. The completeness is estimated to be good, fair or poor compared to what is common in LCAs.

Table 5.3
Assessment of the data quality for the most important processes.

	Uncertainty	Completeness	Representativity
5. Electrolysis etc.	Medium	Good	Fair
8. Strip rolling	Medium	Good	Fair
11. Can production	Medium	Fair	Fair
30. LDPE production	Small	Good	Fair
44. Remelting	Medium	Fair	Fair
46. Distribution of beverage	Medium	Good	Good
67. Alternative energy production	Large	Good	Fair

Electrolysis etc.

These data includes data for electrolysis, anode production, petroleum coke production, pitch production, cathode production, AlF_3 production and casting. The data used are EAA data, which represent a large share of the total aluminium producers, why we estimate the completeness to be good. However, they are average data and no information about if they represent the marginal technology or not was provided, why the representativity is assessed to be fair. For the electricity production, standardised emission factors has been used. The uncertainty for these emission factors is small for CO_2, medium for hydrocarbons, SO_2 and NO_x and large for the emissions that contributes to the toxic effects, why we estimate the total uncertainty to be medium.

Strip rolling

Also for the strip rolling, EAA data has been used. These data represent a large share of the total strip rolling plants, why we estimate the completeness to be good. However, they are average data and no information about if they represent the marginal technology or not was provided, why the representativity is assessed to be fair. For the electricity production, standardised emission factors has been used, see *electrolysis etc.*

Can production

For the can production, specific data received by PLM has been used. We estimate that PLM covers a fair share of the aluminium can producers. No information about if the production technology represents the marginal technology or not was provided, why the representativity is assessed to be fair. For the electricity production, standardised emission factors has been used, see *electrolysis etc.*

LDPE production

For LDPE production, we used APME data. They represent a large share of the LDPE producers. However, they are average data and calculated using a different allocation procedure than the one required by ISO. As indicated above (section 2.5), the effects on the total LCA results are likely to be small since the amount of LDPE is less than 3% of the can weight.

Remelting

For the remelting of the recycled aluminium cans, modern, specific data has been used (the supplier is confidential). We estimate that this remelting plant covers a fair share of the existing remelting plants. No information about if the production technology represents the marginal technology or not was provided, why the representativity is assessed to be fair. For the electricity production, standardised emission factors has been used, see *electrolysis etc.*

Distribution of beverage

Data on distribution represent the transport activities affected by a choice of packaging system. We used data on actual transport distances and truck sizes (Jacobsen 1997). The fuel demand is based on data on the relevant vehicles from Volvo (Rydberg 1997). Most of the emissions are calculated using standardised emission factors from CORINAIR (1996). Hence, there is a significant uncertainty in the emissions. For further details, see Technical report 7.

5.5 Known errors

There are no known errors in this LCA.

6 References

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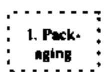
Annex A:

Description of the input data in annex A and B

Detailed process trees

The detailed process tree of the two systems are presented in figure A.1 in annex A. The systems (33 cl and 50 cl) are identical, which is why there is no process tree in annex B.



In some cases the boxes with dotted lines represent processes for which we have no data. However, in many cases these boxes do not represent any processes. These are only modules used to facilitate the calculations.

Transports are represented by an arrow containing an oval and "Trp X".

Input data

The input data of the life cycle systems are presented in printouts from the LCA software *LCA inventory Tool (LCAiT).*

Annex A contains the input data for the 33 cl system. Annex B, which contains the input data for the 50 cl system, has been reduced to contain only data that is not identical to the 33 cl system.

The data presentation is explained in the beginning of the annex A printout.

The processes and transports have the same number in the process tree as in the data printout.

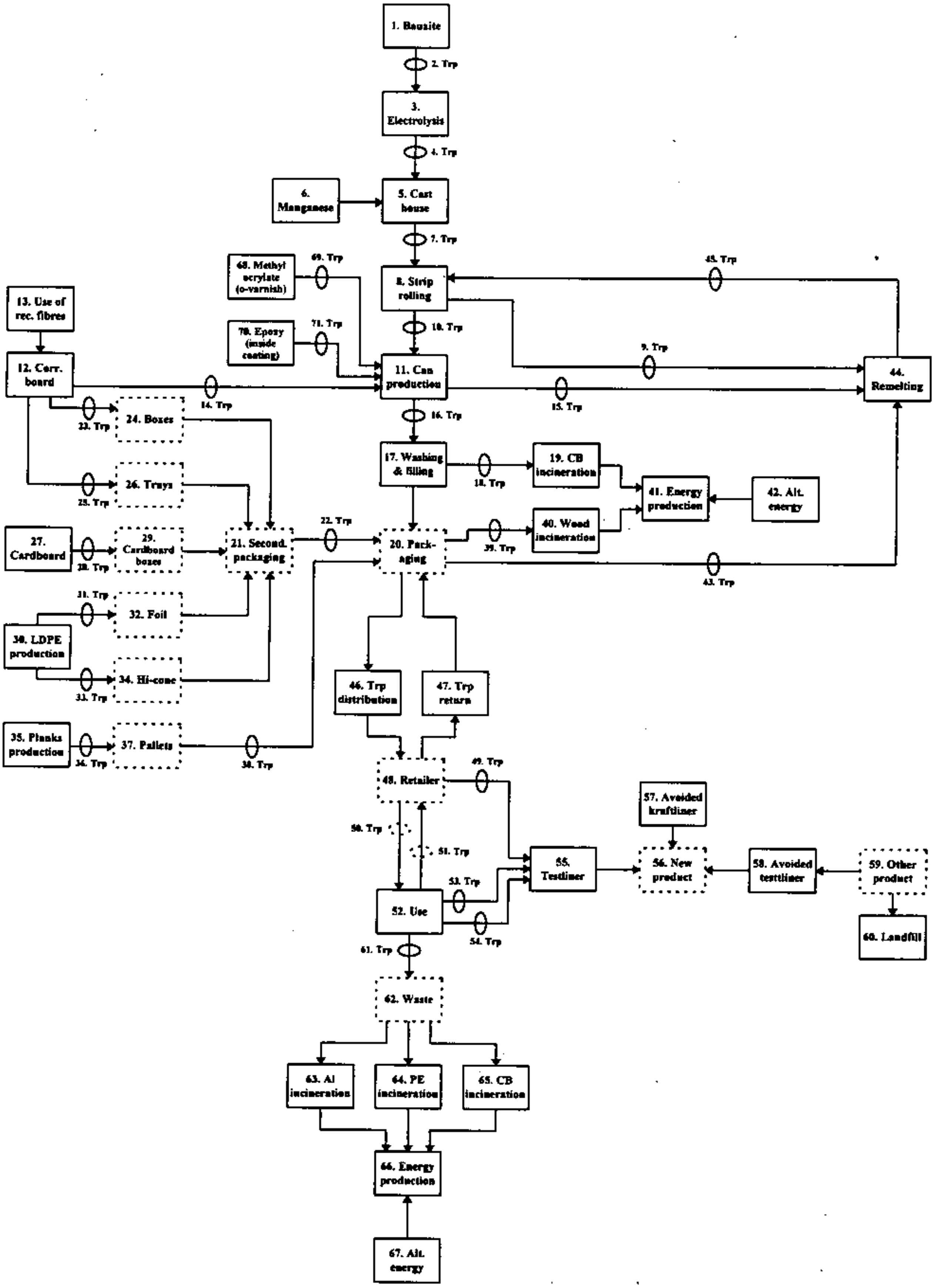


Figure A.1

Process tree for the 33 and 50 cl aluminium can system.

33 cl Aluminium can

File: 33CL-AL.LCA **Printed:** Fri 98-05-29 10:40

Energy carrier:
All energy demand presented under the heading "Energy carrier" describes energy at final use in the processes and transports of the system. Mos of these parameters are internal parameters, i.e. they describe flows that do not cross the boundary of the system investigated. They make it possible to calculated, e.g., how much electricity is used in the system.

Parameter names:
Some parameters appear in both of the two categories air- and water emissions. To be able to separate these parameters in the inventory profile, the emissions to water have been given the name: parameter (aq) e.g. Cu (aq). Resources have in the same way been called resource (r) e.g. crud oil (r). Non-elementary inflows and outflows have been given the name parameter (in) and (out) respectively.

Calculation procedures - process cards:
The data are entered in most process cards as g or MJ per kg total outflow from the process card. In some cases, the data are entered as g or MJ per kg of total inflow to the process card. Whether the data refer to the outflow or inflow is stated immediately below the data. The magnitude o the total outflow (or inflow) is also stated here. The magnitude of the flows have been calculated by the software when the system was solved.

In some processes, data on emissions etc. from the combustion of a fuel are missing. When the system is solved, estimates for the combustion emissions per kg outflow (inflow) from the process card are calculated through multiplying the fuel demand entered under the heading "Energy carrier" with emission factors for final use in our energy database (see Technical report 7). This calculation is reported through the use of the letters FU under the heading "E Factor". In many cases, the data entered in the process card do not include emissions etc. from the production c fuels and electricity used in the process. These emissions are calculated through multiplying the fuel and electricity demand with the corresponding emission factors for extraction etc. in the energy database (see Technical report 7). This calculation is reported through the use o the letters "Ex" under the heading "Energy carriers".

When the system is solved, the environmental inputs and outputs of the whole system are calculated. For each process, the data estimated through the use of emission factors are added to the data entered under the heading "Emissions, waste and resources". The totals are multiplied by the total outflow (or inflow, when applicable) to obtain the total resource demand, emissions etc. of the process.

Calculation procedures - transport cards:
Data on transport modes and distances are entered in the transport cards. When the system is solved, the distances are multiplied by the output flow from the transport card to obtain the transport volume measured as kg-km per functional unit. For each transport mode, this volume is multiplied by the fuel demand factors in our transport database (see Technical report 7). The emissions and resource demand are calculated through multiplying the fuel demand by the emission factors for fuel production and final use in the energy database.

Process Card: 68. Methyl acrylate (Data Base)

Outflows	**Percent**	**Massflow [kg]**
Overvarnish		0.923

Emissions, waste and resources	[g]	**Reference**
CO2	6.01e+003	
CO	1.845	
NOx	22.241	
SO2	23.001	
NMVOC, oil combustion	9.209	
CH4	5.419	
Benzene	3.15e-002	
Dioxin	4.66e-009	
NH3	4.47e-004	
N2O	0.196	
HCl	8.66e-002	
H2S	3.97e-004	
HF	2.25e-002	
Particulates	4.276	
Radioactive emissions [kBq]	160.901	
As	5.49e-004	
Cd	1.38e-003	
Cr3+	5.30e-005	
Hg	1.30e-005	
Ni	2.83e-002	
Pb	2.48e-003	
CN-	3.15e-004	
Tot-N (aq)	0.131	
PO43- (aq)	3.19e-003	
Oil (aq)	1.183	
Organics (aq)	0.817	
Radioactive emissions [kBq] (aq)	1.507	
As (aq)	1.32e-004	
Cd (aq)	6.38e-005	
Cr3+ (aq)	9.53e-004	
Ni (aq)	3.93e-004	
Pb (aq)	4.78e-004	
F- (aq)	1.32e-002	
Cl- (aq)	33.503	
SO42- (aq)	1.495	
Waste, industrial	540.319	

--- To be continued ---

Waste, hazardous	59.488
Waste, radioactive	5.59e-003
Crude oil (r)	1.34e+003
Natural gas (r)	343.852
Hard coal (r)	31.253
Brown coal (r)	25.592
Biomass (r)	1.360
Uranium (as pure U) (r)	2.00e-003
Hydro power-water (r)	1.63e+004
Propane	1.20e-003
Alkanes	2.39e-002
Alkenes	1.20e-003
PAH	1.99e-005
Toluene	1.20e-003
Benzo(a)pyrene	1.20e-006
Aromates (C9-C10)	5.98e-003
Formaldehyde	1.79e-002
Aldehydes	1.51e-003
Ca	3.19e-003
Co	1.31e-003
Cr	6.37e-004
Cu	1.95e-003
Fe	7.17e-003
Mo	6.37e-004
Na	2.99e-002
Se	4.78e-004
V	0.104
Zn	1.59e-003
Miscellaneous chemicals (in)	0.880
Uranium (as pure U) (r)	8.97e-004
Hydro power [MJel] (r)	0.196
Coal (r)	179.757
Iron ore (r)	0.109
Limestone (r)	0.811
NaCl (r)	42.170
Sand (r)	1.40e-002
Water (r)	1.36e+003
HC	8.249
Metals	5.25e-004
COD (aq)	4.55e-002
BOD (aq)	4.36e-003
Acid as H+ (aq)	0.130
Suspended solids (aq)	0.258
Dissolved solids (aq)	5.89e-002
Metals (aq)	2.77e-002
Na+ (aq)	0.287
Waste, mineral	8.801
Waste, ashes	25.953
Waste, inert chemicals	0.490
Waste, regulated chemicals	1.42e-003
Waste, highly radioactive [cm3]	2.98e-003
Waste, medium radioactive [cm3]	3.24e-002
Waste, low radioactive [cm3]	5.74e-003
Rn-222 [Bq]	2.39e-002
NH3 (aq)	7.64e-006
Phenol (aq)	2.89e-002
Hydrogen (out)	114.580
Nitrates (aq)	4.05e-003
HC (aq)	2.61e-002
Other nitrogen (aq)	5.29e-004
Waste, non toxic chemicals	4.57e-002
Bauxite (r)	1.562
Clay (r)	1.50e-002
Ferromanganese (r)	3.83e-004
Crude oil, feedstock (r)	440.448
Oil, feedstock (r)	425.322
Fuel Oil, Low Sulfur (out)	6.690
Isobutanol (out)	2.465
Natural gas, feedstock (r)	8.576
Coal, feedstock (r)	5.95e-003
Other organics	1.62e-005
Dissolved organics (aq)	7.08e-002
NH4+ (aq)	8.10e-005
Sulphur (aq)	8.10e-005

--- To be continued ---

Cl-	1.52e-004		
Waste	0.156		
Uranium (as pure U) (r)	1.37e-002		
Waste, special	1.04e-002		
Ethylene (out)	425.065		
Fuel gas (out)	480.508		
Synthetic gas (H2:CO=2:1) (out)	2.02e+003		
NMVOC	1.32e-002		
Dust	8.90e-002		
Waste, slags & ashes	0.133		
NMVOC, petrol engines	2.36e-014		
NMVOC, diesel engines	1.63e-004		
NMVOC, power plants	6.67e-005		
VOC, diesel engines	8.74e-005		
VOC, coal combustion	3.72e-006		
VOC, natural gas combustion	2.46e-013		
Organics	1.86e-007		
Dissolved organics (aq)	1.65e-014		
NO3-N (aq)	1.55e-008		
NH4-N (aq)	2.00e-006		
Nitrogen (aq)	9.11e-007		
H+ (aq)	1.80e-006		
Aromates (C9-C10) (aq)	4.12e-007		
Al (aq)	2.51e-006		
Fe (aq)	5.01e-006		
Mn (aq)	2.51e-006		
Sr (aq)	1.25e-005		
Zn (aq)	7.79e-007		
Salt (aq)	2.51e-004		
Waste, slags & ashes (waste incin.)	1.96e-008		
Waste, slags & ashes (energy prod.)	7.34e-003		
Waste, bulky	1.358		
Waste, sludge	1.05e-012		
Waste, rubber	1.53e-006		
Waste, chemical	1.01e-005		
Softwood (r)	1.31e-003		
Fuel, unspecified [MJ] (r)	1.40e-008		
CaCO3 (r)	8.41e-006		
Al (r)	4.80e-006		
Fe (r)	5.03e-006		
Mn (r)	2.97e-008		
Ground water (r)	1.14e-007		
Surface water (r)	2.32e-009		
Energy carrier	**[MJ]**	**E Factor**	**Reference**
Oil, heavy fuel	39.865	None	
Electricity	6.093	None	
Nuclear power [MJel]	0.197	None	
Hydro power [MJel]	7.87e-002	None	
Oil	2.595	None	
Natural gas	10.917	None	
Coal	0.461	None	
Oil, feedstock	17.088	None	
Natural gas, feedstock	0.383	None	
Coal, feedstock	1.62e-004	None	
Natural gas (>100 kW)	7.746	None	
Hard coal	7.34e-002	None	

The sum of output flow(s) (0.923 kg) is used to calculate emissions and energies

Notes

Production of 1 kg Methyl acrylate.

The data are imported from a database file (Meacryl.lca).

General comments concerning the PWMI Eco-profile report series:
- In the PWMI-reports, the results for the cradle to gate life cycle are aggregated. This means that emissions from combustion of fuels and fı the production of electricity are already included in the process emissions and that resources from the production of electricity are included energy demand (fuels). The fuel "other" (in the PWMI-report) mainly consists of oil and gas and has therefore been added to the value for o

References:
- Rudd et al., Petrochemical Technology Assessment, John Wiley & Sons, 1981.
- Frischknecht et al., ENET, Zurich 1994. Environmental Life-Cycle Inventories for energy systems.
- Eco-profiles report 2, PWMI, table 6, page 5 and table 7, page 6.
- Eco-profile report 6, PWMI, table 19 page 15.

--- To be continued ---

Transport Card: 69. Trp

Inflows	Percent	Massflow [kg]	
Overvarnish		0.923	
Outflows			
Overvarnish		0.923	
Modes of conveyance	**[km]**		**Reference**
Truck, heavy (highway, 70%)	1.40e+003		(1)
Ship, coaster	50.000		(1)

The sum of output flow(s) (0.923 kg) is used to calculate emissions and energies

Process Card: 70. Epoxy resins

Outflows	Percent	Massflow [kg]	
Inside coatings		2.302	
Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	25.270	Ex	(1)
Oil, heavy, feedstock	15.200	FU/Ex	(1)
Oil, heavy fuel	13.290	FU/Ex	(1)
Natural gas (>100 kW)	26.440	Ex	(1) As feedstock
Natural gas (>100 kW)	61.540	FU/Ex	(1)

The sum of output flow(s) (2.302 kg) is used to calculate emissions and energies

Notes

Reference:

(1) Boustead I., Eco-profiles of the European plastics industry, Report 12: Liquid epoxy resins.

Transport Card: 71. Trp

Inflows	Percent	Massflow [kg]	
Inside coatings		2.302	
Outflows			
Inside coatings		2.302	
Modes of conveyance	**[km]**		**Reference**
Truck, heavy (highway, 70%)	450.000		(1)
Ship, coaster	1.00e+003		(1)

The sum of output flow(s) (2.302 kg) is used to calculate emissions and energies

Notes

Transport of

Process Card: 1. Bauxite mining - Alumina production

Outflows	Percent	Massflow [kg]	
Alumina, Al2O3		11.828	
Emissions, waste and resources	**[g]**		**Reference**
SO2	9.194		(1) Air
NOx	2.246		(1)
CO2	920.942		(1)
VOC	0.314		(1)
Dust	7.623		(1)
Suspended solids (aq)	6.80e-002		(1) Water
COD (aq)	9.95e-003		(1)
Chloride (aq)	1.387		(1)
Waste, red mud	555.916		(1) Waste
Waste, inert residues	30.366		(1)
Bauxite (r)	1.92e+003		(1) Resource
Limestone (r)	89.005		(1)
Salt (r)	28.272		(1)
Crude oil (r)	266.440		(1)
Coal (r)	3.455		(1)
Natural gas (r)	36.545		(1)
Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	1.109	Ex	(1)

The sum of output flow(s) (11.828 kg) is used to calculate emissions and energies

Notes

Production of alumina (Al_2O_3) from bauxite in the Bayer chemical process in alumina refineries.
The aluminium oxide is released from the other substances in bauxite in a caustic soda solution, which is filtered to remove all insoluble particles. The aluminium hydroxide is then precipitated from the soda solution, washed and dried while the soda solution is recycled. After

--- To be continued ---

calcination, the end-product, aluminium oxide, is a fine grained white powder. About 1.91 kg of alumina are needed to produce 1 kg of pure aluminium (1).

This process also includes data for bauxite mining, production of sodium hydroxide, salt mining, lime calcination and limestone mining.

References:
(1) Ecological Profile Report for the European Aluminium Industry, European Aluminium Association (EAA), 1996.

Data were entered by Anna Ryberg, CIT.

Process Card: 2. Trp

Inflows	**Percent**	**Massflow [kg]**	
Alumina, Al2O3		11.828	
Outflows			
Alumina, Al2O3		11.828	
Energy carrier	**[MJ]**	**E Factor**	**Reference**
Diesel, heavy & medium truck (highway)	4.70e-002	FU/Ex	(1)(2)
Fuel oil, ship (2-stroke)	3.171	FU/Ex	(1)(2)

The sum of output flow(s) (11.828 kg) is used to calculate emissions and energies

Notes

This transport includes the transport of bauxite from the mining site to the bayer process, the transports of salt from salt mining to NaOH-production, the transports of limestone from limestone mining to lime calcination and the transport of alumina (Al2O3) from the Bayer process to the electrolysis.

EAA's LCI (1) does not include information on transport distances or modes of conveyance, but only the transport energy resources and the transport emissions. This is the reason why we use a process card rather than a transport card for this transport.

The emissions associated with this transport have been calculated using EAA data on fuel demand and our own emission factors.

Reference and comments:
(1) Ecological Profile Report for the European Aluminium Industry, European Aluminium Association (EAA), 1996.
(2) The heat values used are:
- oil: 42.5 MJ/kg
- diesel: 42.95 MJ/kg.

Data were entered by Anna Ryberg, CIT.

Process Card: 3. Electrolysis (prebake)

Inflows	**Percent**	**Massflow [kg]**	
Alumina, Al2O3		11.828	
Outflows			
Aluminium (l)		6.198	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (6.198 kg) is used to calculate emissions and energies
Mass change factor 0.524

Notes

The environmental load from the electrolysis is included in the cast house.

The mass change factor is based on the fact that 1.91 kg of alumina is needed to produce 1 kg of pure aluminium (1). This gives the mass cha factor 1/1.91=0.524.

Primary aluminium is produced in reduction plants, where pure aluminium is extracted from alumina by the Hall-Heroult process. The reduc of alumina into liquid aluminium is operated at around 950 degrees Celcius in a fluorinated bath under high intensity electrical current. This process takes place in electrolytic cells (or "pots"), where carbon cathodes form the bottom of the pot and acts as the negative electrode. Anc (positive electrodes) are held at the top of the pot and are consumed during the process when they react with the oxygen coming from the alumina. There are two types of anodes currently in use. All potlines built since the early 1970s use the prebake anode technology, where the anodes, manufactured from a mixture of petroleum coke and coal tar pitch (acting as a binder), are "pre-baked" in separate anode plants. In t Söderberg technology, the carbonaceous mixture is fed directly into the top part of the pot, where "self-baking" anodes are produced using tl heat released by the electrolytic process. The EAA data (1) are based on the pre-bake technology since this technology is the most common making up approximately 80% of the total European production and the Söderberg technology being gradually phased out.

The overall chemical reaction for the production of primary aluminium is: $2\ Al_2O_3\ (aq) + 3\ C\ (s) = 4\ Al\ (l) + 3\ CO_2\ (g)$.

Reference:
(1) Ecological Profile Report for the European Aluminium Industry, European Aluminium Association (EAA), 1996.

Process Card: 4. Trp

Inflows	**Percent**	**Massflow [kg]**
Aluminium (l)		6.198

--- To be continued ---

Outflows

Aluminium (l)		6.198	

Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	1.38e-002	Ex	(1)
Diesel, heavy & medium truck (highway)	0.112	FU/Ex	(1)(2)
Fuel oil, ship (2-stroke)	1.904	FU/Ex	(1)(2)

The sum of output flow(s) (6.198 kg) is used to calculate emissions and energies

Notes

This transport includes the transport of petroleum coke, pitch and filling materials from the different production sites to the anode production, the transport of anodes, cathodes and aluminium fluoride to the electrolysis, and the transport of liquid aluminium from electrolysis to the cast house.

EAA's LCI (1) does not include information on transport distances or modes of conveyance, but only the transport energy resources and the transport emissions. This is the reason why we use a process card rather than a transport card for this transport.

The emissions associated with this transport have been calculated using EAA data on fuel demand and our own emission factors.

Reference and comments:
(1) Ecological Profile Report for the European Aluminium Industry, European Aluminium Association (EAA), 1996.
(2) The heat values used are:
- oil: 42.5 MJ/kg
- diesel: 42.95 MJ/kg.

Data were entered by Anna Ryberg, CIT.

Process Card: 5. Cast house

Inflows	**Percent**	**Massflow [kg]**
Aluminium (l)		6.198
Manganese	1.500 %	9.44e-002

Outflows

Al rolling ingots		6.292

Emissions, waste and resources	**[g]**	**Reference**
Dust	1.780	(1) Air
Fluorides	0.960	(1)
SO2	15.380	(1)
PAH	5.00e-002	(1)
NOx	0.690	(1)
CO2	2.36e+003	(1)
CO	60.000	(1)
VOC	2.00e-002	(1)
CF4	0.360	(1)
C2F6	4.00e-002	(1)
Suspended solids (aq)	0.600	(1)
Organics (aq)	2.00e-003	(1)
PAH (aq)	2.00e-002	(1)
Tot-F (aq)	1.00e-003	(1)
H2SO4 (aq)	0.800	(1)
Chloride (aq)	2.00e-002	(1)
Waste, carbon	7.600	(1)
Waste, refractory	11.400	(1)
Waste, inert residues	51.000	(1)
Waste, dross fines	2.100	(1)
Water (r)	8.62e+003	(1) Resource
Crude oil (r)	46.800	(1)
Coal (r)	3.100	(1)
Natural gas (r)	85.000	(1)
Crude oil, feedstock (r)	452.000	(1)
Coal, feedstock (r)	93.400	(1)
Aluminium hydroxide (in)	11.700	(1) Non-elementary inflow
Calcium fluoride (in)	25.400	(1)
Sulphuric acid (in)	29.400	(1)
Refractory materials (in)	8.600	(1)
Steel (in)	6.100	(1)
Carbon (in)	30.700	(1)
Carbon reused as fuel (out)	16.600	(1) Non-elementary outflow
Skimmings and dross for recycling (out)	12.000	(1)
Steel scrap (out)	6.100	(1)
COS	4.000	(2) Air

Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	51.679	Ex	(1)(3)

The sum of output flow(s) (6.292 kg) is used to calculate emissions and energies

--- To be continued ---

Notes

Casting of aluminium ingots.
This process card also includes data for electrolysis, anode production, petroleum coke production, pitch production, cathode production and AlF3 production.
Molten aluminium tapped from the pots (see Electrolysis) is transported to the cast house where it is alloyed in holding furnaces by the addition of manganese, purified from oxides and gases, and then cast into rolling ingots. The content of manganese in the ingots is about 1.5%, according to reference 4. World-wide, production plants are mainly located where suitable electrical energy sources are available.

References:
(1) Ecological Profile Report for the European Aluminium Industry, European Aluminium Association, 1996.
(2) Jochen Harnisch, Reinhard Borchers, Peter Fabian; COS, CS2 and SO2 in Aluminium Smelter exhaust - The Contribution of Aluminium Production to the Global COS Budget, ESPR -Environ. Sci. & Pollut. Res. 2 (4) 229-232 (1995).
(3) The electricity demand is multiplied by a factor 0.91/0.96 to account for the fact that the grid loss is less than 9%. The average grid loss is estimated to be 4%.
(4) Bernard de Gélas, European Aluminium Association, personal communication, 1997.

Data were entered by Anna Ryberg, CIT.

Process Card: 6. Manganese production

Outflows	**Percent**	**Massflow [kg]**	
Manganese		9.44e-002	
Emissions, waste and resources	**[g]**		**Reference**
Mn (r)	1.00e+003		(1)
Explosives (in)	4.000		(1)
Energy carrier	**[MJ]**	**E Factor**	**Reference**
Diesel, heavy & medium truck (urban)	0.960	FU/Ex	(1)
Electricity, coal marginal	35.824	Ex	(1)
Heat	-35.824	FU/Ex	(1)

The sum of output flow(s) (9.44e-002 kg) is used to calculate emissions and energies

Notes

Production of manganese.

The content of manganese in the ingots is about 1.5%, according to reference 2.
Reference:
(1) R. Frischknecht, P. Hofstetter, I. Knoepfel, R. Dones, E. Zollinger, Ökoinventare f•r Energiesysteme, Abhang A, Swiss Federal Institute o Technology, Zurich 1994.
(2) Bernard de Gélas, European Aluminium Association, personal communication, 1997.

Data were entered by Anna Ryberg, CIT.

Transport Card: 7. Trp

Inflows	**Percent**	**Massflow [kg]**	
Al rolling ingots		6.292	
Outflows			
Al rolling ingots		6.292	
Modes of conveyance	**[km]**		**Reference**
Truck, heavy (highway, 70%)	550.000		Estimated
Ship, container	20.000		Estimated

The sum of output flow(s) (6.292 kg) is used to calculate emissions and energies

Notes

Transport of aluminium rolling ingots to strip rolling.

Since EAA's data has been used for the aluminium production, there is no information about the exact location of the aluminium production. has been assumed that the primary aluminium is produced in Switzerland (1). The strip rolling takes place at a number of different places in Europe (2). The exact location of these places is confidential information, and therefore not mentioned here. The transport distances have bee calculated as the average distances between Switzerland and these different strip rolling sites.
Transport modes and distances:
- Average distance, body, truck: 450 km.
- Average distance, lid, truck: 850 km.
Weighted distance, truck: 0.79*450 + 0.21*850 = 550 km. (3)
- Average distance, body, ship: 0 km
- Average distance, lid, ship: 75 km
Weighted distance, ship: 0.79*0 + 0.21* 75 = 20 km. (3)

References and comments:
(1) Pommer K., Wesnaes M.S. and Madsen C., Miljømaessig kortlaegning af emballager til øl og laeskedrikke, Delrapport 3: Aluminiumsd
Arbeidsrapport fra Miljøstyrelsen., nr. 72
(2) Göte Nylin, PLM Beverage Can Division, Malmö, Sweden.

--- To be continued ---

(3) The raw material input for one aluminium body is 13.077 g and for one lid 3.448 g, totally 16.525 g (2). Hence, the body makes 79% of the input material and the lid makes 21% of the input material.

Process Card: 8. Strip rolling

Inflows	**Percent**	**Massflow [kg]**	
Al rolling ingots		6.292	
Remelted aluminium		44.481	
Outflows			
Scraps, strip roll.	0.990 %	0.500	
Rolled Al. sheets		50.019	
Emissions, waste and resources	**[g]**		**Reference**
VOC	0.376		(1) Air
COD (aq)	2.77e-002		(1) Water
Waste, non hazardous	1.416		(1) Waste
Waste, hazardous	2.644		(1)
Waste, oil	4.248		(1)
Water (r)	138.614		(1) Resource
Salt (r)	0.168		(1)
Limestone (r)	1.228		(1)
Oil (in)	5.050		(1) Non-elementary inflow
Chlorine (in)	0.208		(1)
Argon (in)	0.347		(1)
Packaging (in)	32.970		(1)
Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	3.108	Ex	(1)
Natural gas (>100 kW)	2.544	FU/Ex	(1)(2)

The sum of output flow(s) (50.519 kg) is used to calculate emissions and energies
Mass change factor 0.995

Notes

Strip rolling of aluminium ingots.

Material balance per can:
Material inputs:
- Aluminium rolling ingots from primary aluminium: 2.0763 g.
- Aluminium rolling ingots from secondary aluminium: 14.6966 g.

Total input: 16.7729 g.
Outputs:
- Rolled aluminium sheets: 16.525 g
- Process scraps from strip rolling: 0.1653 g.

Total outputs: 16.6903 g.
Mass change factor (out/in): 16.6903/16.7729 = 0.995.

Energy data:
The production of natural gas and electricity is not included in the data from reference 1. Therefore the emission factors (extraction/Ex) from the database have been used.

Emissions:
The emissions associated with the combustion of natural gas are not included. Therefore the emission factors (final use/FU) from the database have been used.

Data-gaps:
The production of chemicals, additives etc. are not included in the data from reference 1. These materials have therefore been accounted for as inflows not traced back to the cradle (non-elementary inflows to the system). The landfill disposal of waste is not included in the LCA. Hence, the waste flows are non-elementary outflows.

References:
(1) Bernard de Gélas, European Aluminium Association.
(2) A furnace size larger than 100 kW has been assumed.

Data were entered by Anna Ryberg, CIT.

Transport Card: 9. Trp

Inflows	**Percent**	**Massflow [kg]**	
Scraps, strip roll.		0.500	
Outflows			
Scraps, strip roll.		0.500	
Modes of conveyance	**[km]**		**Reference**
Truck, heavy (highway, 70%)	1.25e+003		
Ship, container	150.000		

The sum of output flow(s) (0.500 kg) is used to calculate emissions and energies

--- To be continued ---

Notes

Transport of scraps from strip rolling to remelting plant.

Both the different strip rolling sites and the site of remelting are confidential and therefor not mentioned here. The distances have been calculated as the average distance between the different strip rolling plants and the remelting plant.

Transport Card: 10. Trp

Inflows	Percent	Massflow [kg]	
Rolled Al. sheets		50.019	
Outflows			
Rolled Al. sheets		50.019	
Modes of conveyance	**[km]**		**Reference**
Truck, heavy (highway, 70%)	1.20e+003		(2)
Ship, container	155.000		(2)

The sum of output flow(s) (50.019 kg) is used to calculate emissions and energies

Notes

Transport of rolled aluminium sheets to can production at PLM, Malmö.

The rolled aluminium sheets are transported from the different strip rolling plants (in Europe) to PLM, Malmö. The exact location of the strip rolling plants is confidential information and therefore not mentioned here. The transport distances have been calculated as the average distance between Malmö, Sweden and these different strip rolling sites.

Transport modes and distances:
- Average distance, body, truck: 1200 km.
- Average distance, lid, truck: 1200 km.

Weighted distance, truck: 0.79*1200 + 0.21* 1200 = 1200 km (1).
- Average distance, body, ship: 50 km.
- Average distance, lid, ship: 550 km.

Weighted distance, ship: 0.79*50 + 0.21*550 = 155 km (1).

References and comments:
(1) The input material for one aluminium body is 13.077 g and for one lid 3.448 g, totally 16.525 g (2). So the body makes 79% of the input material and the lid makes 21% of the input material.
(2) Göte Nylin, PLM Beverage Can Division, Malmö, Sweden.

Data were entered by Anna Ryberg, CIT.

Process Card: 11. Can production

Inflows	Percent	Massflow [kg]	
Rolled Al. sheets		50.019	
Layer pads, CB	2.764 %	1.514	
Inside coatings	4.204 %	2.302	
Overvarnish	1.686 %	0.923	
Outflows			
Scraps, can prod.	17.526 %	9.616	
Cans+ layer pads		45.251	
Emissions, waste and resources	**[g]**		**Reference**
CO2	171.011		(1) Air
CO	0.552		(1)
NOx	0.221		(1)
Butanol	0.381		(1)
Butylglycole	0.502		(1)
Amylaclohol	9.38e-002		(1)
Xylene	1.10e-002		(1)
Butydiglycole	1.65e-002		(1)
COD (aq)	2.538		(1) Water
BOD (aq)	0.441		(1)
Oil (aq)	0.110		(1)
Suspended solids (aq)	0.386		(1)
Totally extractible (aq)	0.938		(1)
Waste, oil	3.034		(1) Waste
Waste, solvent	1.158		(1)
Waste, ink	5.52e-002		(1)
Waste, sludge	13.184		(1)
Waste, combustible	11.088		(1)
Waste, wood	11.695		(1)
Waste	2.813		(1)
Oil (in)	3.420		(1) Non-elementary inflow
Washing chemicals (in)	7.999		(1)
Finish (in)	1.710		(1)
Polyester for strips (in)	3.696		(1)

--- To be continued ---

SO2	1.55e-003		(2) Air
CH4	6.20e-003		(2)
Propane	6.20e-004		(2)
Butane	2.17e-003		(2)
Pentane	3.72e-003		(2)
PAH	3.10e-005		(2)
Benzene	1.24e-003		(2)
Toluene	6.20e-004		(2)
Benzo(a)pyrene	3.10e-008		(2)
Formaldehyde	3.10e-004		(2)
Acetaldehyde	3.10e-006		(2)
N2O	3.10e-004		(2)
Particulates	6.20e-004		(2)
Hg	1.70e-007		(2)
Printing ink (in)	2.041		(1)
Fluoride (aq)	0.386		(1) Water
Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	5.120	Ex	(1)
Natural gas (>100 kW)	3.098	Ex	(1)

The sum of output flow(s) (54.867 kg) is used to calculate emissions and energies
Mass change factor 1.002

Notes
Production of 33 cl aluminium can.

Material balance per can:
Inputs:
- Rolled aluminium sheets: 16.525 g (1).
- Layer pads, corrugated board: 0.5 g (1).
- Over varnish: 0.305 g (1).
- Inside coatings: 0.7605 g (1) *.
Total input: 18.0905 g.
Outputs
- Scraps, can production: 3.177 g (1).
- Can and layer pads: 14.4505 + 0.5 = 14.9505 g (1).
Total outputs: 18.1275 g.

Mass change factor (out/in): 18.1275/18.0905 = 1.002.

Energy data:
The production of natural gas and electricity is not included in the data from reference 1. Therefore the emission factors (extraction/Ex) from the database are used.

Emissions.
The emissions of CO2, CO and NOx arise from the combustion of natural gas.
As a complement to the air emissions in reference 1, emissions from the combustion of natural gas have been calculated using emission factors from the database and inserted manually in the process card.

Data-gaps:
The production of chemicals, additives etc. are not included in the data from reference 1. These materials have therefore been accounted for as non-elementary inflows. The landfill disposal of waste from the process is not included in the LCA.

Reference and comments:
(1) Göte Nylin, PLM Beverage Can Division AB, Malmö.
(2) Calculated from the emission factors (final use) for natural gas (as a complement to the air emissions from reference 1.

* The amount of inside coatings is higher in the soft drink cans than in the beer cans. In this study, we have used the average amount of inside coating

Data were entered by Anna Ryberg, CIT.

Process Card: 12. Corrugated board (Database)

Inflows	**Percent**	**Massflow [kg]**	
Recycled fibres		10.187	
Outflows			
Corrugated board		1.514	
Corrugated board		4.287	
Corrugated board		7.565	
Emissions, waste and resources	**[g]**		**Reference**
Land use [m2*years] (r)	5.608		
Particulates	0.655		
CO2 (bio)	384.953		
CO2	650.227		
CO	0.337		

--- To be continued ---

33 cl Aluminium can

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NOx	2.176
SO2	1.527
H2S	3.36e-002
COD (aq)	6.911
BOD-5 (aq)	2.146
AOX (aq)	2.61e-004
Suspended solids (aq)	0.827
Tot-N (aq)	3.17e-002
NH3 (aq)	2.58e-003
NO3- (aq)	1.23e-002
Phosphate (aq)	2.50e-003
Cu (aq)	5.61e-005
Zn (aq)	2.01e-004
Cl- (aq)	2.564
SO42- (aq)	0.491
Waste, ashes	3.531
Waste, inorganic sludges	4.504
Waste, paper related	6.150
Waste, other rejects	22.632
Waste, organic sludges	2.133
Rejects incinerated + energy (out)	0.413
Recycled lubricants (out)	3.75e-002
Reused lubricants (out)	7.50e-002
NaOH (in)	2.959
HCl (in)	0.141
Colorants (in)	0.521
Starch (in)	22.516
Sizing agents (in)	2.702
Retention agents (in)	0.779
Defoamer (in)	0.410
Biocides (in)	1.52e-002
Lubricants (in)	0.234
Urea (in)	4.50e-002
Phosphoric acid (in)	5.25e-002
Na2CO3 (in)	0.748
CaCO3 (in)	0.769
CaO (in)	2.061
Na2SO4 (in)	1.216
H2SO4 (in)	3.293
Sulphur (in)	1.110
Alum (in)	0.918
MgO (in)	9.97e-002
NH3 (in)	1.106
SO2 (in)	0.109
Other additives (in)	0.140
Auxiliary materials (in)	2.72e-002
NMVOC	0.232
CH4	0.402
Dioxin	3.11e-010
NH3	1.24e-004
N2O	5.78e-003
HCl	2.93e-003
HF	9.91e-004
Radioactive emissions [kBq]	6.40e+005
As	1.91e-005
Cd	4.77e-005
Cr	2.31e-005
Hg	6.88e-007
Ni	1.02e-003
Pb	8.89e-005
CN-	1.45e-005
H2S (aq)	2.22e-007
Oil (aq)	7.51e-002
Organics (aq)	5.94e-002
Radioactive emissions [kBq] (aq)	6.02e+003
Al (aq)	8.84e-004
As (aq)	8.93e-006
Cd (aq)	4.54e-006
Co (aq)	6.00e-004
Cr (aq)	2.13e-005
Ni (aq)	2.71e-005
Pb (aq)	3.32e-005
Sb (aq)	2.42e-008
Sn (aq)	1.90e-003

--- To be continued ---

V (aq)	5.67e-006
F- (aq)	6.51e-004
CN- (aq)	6.76e-006
Waste, industrial	326.006
Waste, hazardous	44.090
Waste, highly radioactive	1.51e-002
Crude oil (r)	82.242
Natural gas (r)	124.373
Hard coal (r)	8.567
Brown coal (r)	1.690
Wood (r)	2.76e-002
Uranium (as pure U) (r)	1.29e-004
Hydro power-water (r)	1.06e+003
NMVOC, oil combustion	0.425
Benzene	1.63e-003
Cr3+	2.44e-006
PO43- (aq)	1.47e-004
Cr3+ (aq)	4.39e-005
Waste, radioactive	2.70e-004
Biomass (r)	5.63e-002
NMVOC, diesel engines	8.22e-002
Zn	7.18e-005
Se	1.60e-005
Cu	9.77e-005
Peat (in)	21.144
Bark (in)	16.225
VOC, natural gas combustion	3.95e-013
VOC, coal combustion	5.97e-006
VOC, diesel engines	1.40e-004
NMVOC, power plants	1.07e-004
NMVOC, petrol engines	3.78e-014
HC	6.15e-004
PAH	5.17e-006
Benzo(a)pyrene	4.43e-008
Aromates (C9-C10)	2.02e-004
Aldehydes	1.50e-007
Organics	2.98e-007
V	3.43e-003
Metals	9.64e-008
BOD (aq)	4.82e-007
Dissolved organics (aq)	2.65e-014
Dissolved solids (aq)	4.02e-003
NO3-N (aq)	2.49e-008
NH4-N (aq)	3.22e-006
Nitrogen (aq)	1.46e-006
H+ (aq)	2.89e-006
HC (aq)	1.93e-006
Phenol (aq)	6.62e-016
Aromates (C9-C10) (aq)	6.62e-007
Fe (aq)	8.04e-006
Mn (aq)	4.02e-006
Sr (aq)	2.01e-005
Metals (aq)	4.82e-007
Salt (aq)	4.02e-004
Waste, mineral	2.10e-004
Waste, slags & ashes (waste incin.)	3.15e-008
Waste, slags & ashes (energy prod.)	1.18e-002
Waste, bulky	2.180
Waste, sludge	1.69e-012
Waste, rubber	2.46e-006
Waste, chemical	1.62e-005
Crude oil, feedstock (r)	6.84e-007
Softwood (r)	2.11e-003
Fuel, unspecified [MJ] (r)	2.25e-008
NaCl (r)	1.35e-005
Clay (r)	2.89e-006
CaCO3 (r)	1.35e-005
Al (r)	7.71e-006
Fe (r)	8.08e-006
Mn (r)	4.77e-008
Water (r)	1.45e+003
Ground water (r)	1.82e-007
Surface water (r)	3.72e-009
Ethane	1.60e-006

--- To be continued ---

Propane	1.32e-004
Alkanes	8.12e-004
Ethene	4.00e-006
Acetylene	8.00e-007
Propene	1.60e-006
Alkenes	4.12e-005
Toluene	1.30e-004
Formaldehyde	6.39e-004
Ca	1.06e-004
Co	4.36e-005
Fe	2.38e-004
Mo	2.11e-005
Na	9.90e-004
TOC (aq)	5.00e-006
Butane	3.15e-004
Pentane	5.40e-004
Acetaldehyde	4.50e-007

Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	1.495	Ex	
Oil, heavy fuel	1.826	None	
Oil, light fuel	0.240	None	
Natural gas (>100 kW)	5.842	None	
LPG, forklift	1.22e-002	None	
Diesel, heavy & medium truck (urban)	0.299	None	
Hard coal	0.118	None	
Peat	0.444	None	
Bark	0.276	None	
Heat	-0.121	None	
Diesel, heavy & medium truck (highway)	0.172	None	
Diesel, ship (4-stroke)	0.379	None	

The sum of output flow(s) (13.365 kg) is used to calculate emissions and energies
Mass change factor 1.312

Notes
Production of 1 kg of corrugated board.

The data are imported from a database file (corr-brd.lca). The file includes data on wood harvesting, production of kraftliner, testliner, wellenstoff, semi-chemical fluting and corrugated board, and associated transports. The effects on other systems of the use of recycled fibres the packaging system are documented in a separate file (corr-b-r.lca; see the process "Use of recycled fibres").

Data for most transports and for production of kraftliner, testliner, wellenstoff, semi-chemical fluting and corrugated board are adapted from FEFCO (1). Data for wood harvesting are adapted from reference 2.

The data above include emissions etc. from fuel production. These have been calculated by using emission factors from our energy database. emission factors take into account emissions etc. for production of the electricity that is used for fuel production. However, the data above dc include emissions etc. for production of the electricity that is used in production of kraftliner, testliner, fluting, wellenstoff and corrugated bc When the total emissions profile of the packaging system is calculated, these emissions etc. are included through the use of emission factors extraction etc. as is denoted above (E Factor: Ex).

Material balance:
- There is 0.762 kg of recovered paper per kg of corrugated board.
- Mass change factor (out/in) = 1/0.762 = 1.3112.

References:
(1) European Database for Corrugated Board Life Cycle Studies, FEFCO, Groupement Ondulé, KRAFT Institute, 1996/1.
(2) Örjan Hedenberg, Birgit Backlund Jacobson, Tiina Pajula, Lisa Person, Helena Wessman; Use of agro fibre for paper production from a: environmental point of view. NordPap DP2/54, Scan Forskrapport 682, Nordic Industrial Fund, Oslo, 1997.
(3) Sundqvist J-O et al, Life Cycle Assessment and Solid Waste, AFR, Stockholm, 1994, page 78.

The data were entered by Lisa Person, CIT. The notes were revised by Tomas Ekvall, CIT, 98-01-06.

Process Card: 13. Use of recycled fibres (Database)

Outflows	**Percent**	**Massflow [kg]**
Recycled fibres		10.187

Emissions, waste and resources	**[g]**	**Reference**
Crude oil (r)	98.305	
Natural gas (r)	-101.857	
Hard coal (r)	2.075	
Brown coal (r)	1.841	
Uranium (as pure U) (r)	1.39e-004	
Hydro power-water (r)	1.21e+003	
Wood (r)	5.50e-002	
Biomass (r)	4.51e-002	

--- To be continued ---

33 cl Aluminium can

File: 33CL-AL.LCA **Printed:** Fri 98-05-29 10:40

Land use [m2*years] (r)	13.255
Particulates	1.487
CO2 (bio)	882.018
CO2	6.222
CO	0.562
NOx	2.633
SO2	0.825
CH4	-16.214
H2S	8.07e-002
Cl-	-0.349
NMVOC	0.435
NMVOC, diesel engines	0.190
NMVOC, oil combustion	0.341
Dioxin	3.63e-010
NH3	2.02e-004
N2O	8.52e-003
HCl	1.12e-003
HF	6.77e-004
Radioactive emissions [kBq]	2.41e+004
Benzene	1.16e-003
As	2.16e-006
Cd	4.83e-006
Cu	8.63e-005
Cr	4.52e-006
Cr3+	1.96e-006
Hg	4.99e-007
Se	4.96e-007
Ni	1.83e-004
Pb	1.57e-005
Zn	4.96e-005
CN-	1.17e-005
COD (aq)	11.834
BOD-5 (aq)	4.299
Tot-N (aq)	-5.32e-003
NO3- (aq)	-1.34e-002
Phosphate (aq)	-2.14e-003
H2S (aq)	4.41e-007
Oil (aq)	9.11e-002
Organics (aq)	7.35e-002
Suspended solids (aq)	1.511
Radioactive emissions [kBq] (aq)	226.094
Al (aq)	1.75e-003
Cu (aq)	-3.74e-005
As (aq)	1.06e-005
Cd (aq)	5.53e-006
Co (aq)	2.13e-003
Cr (aq)	4.24e-005
Zn (aq)	-1.36e-004
Ni (aq)	3.17e-005
Pb (aq)	3.98e-005
Sb (aq)	4.82e-008
Sn (aq)	3.78e-003
V (aq)	1.13e-005
F- (aq)	5.50e-004
SO42- (aq)	-0.377
Cl- (aq)	2.676
CN- (aq)	1.35e-005
PO43- (aq)	1.18e-004
Cr3+ (aq)	3.52e-005
Waste, ashes	4.255
Waste, inorganic sludges	11.518
Waste, paper related	-7.043
Waste, other rejects	-13.131
Waste, organic sludges	1.834
Rejects incinerated + energy (out)	-0.807
Recycled lubricants (out)	-7.34e-002
Reused lubricants (out)	-0.147
Waste, industrial	-267.120
Waste, hazardous	-38.396
Waste, highly radioactive	2.37e-002
Waste, radioactive	2.06e-004
Elementary waste, corrugated board	-89.400
NaOH (in)	5.355
HCl (in)	-0.103

--- To be continued ---

Colorants (in)	-1.020		
Sizing agents (in)	1.907		
Starch (in)	-18.120		
Retention agents (in)	1.247		
Defoamer (in)	0.807		
Lubricants (in)	6.60e-002		
Biocides (in)	7.34e-003		
Phosphoric acid (in)	-0.103		
Na2CO3 (in)	1.247		
CaCO3 (in)	2.274		
Na2SO4 (in)	3.595		
Urea (in)	-8.80e-002		
Sulphur (in)	0.147		
CaO (in)	6.016		
H2SO4 (in)	9.684		
Other additives (in)	0.220		
Alum (in)	2.714		
Peat (in)	3.841		
Bark (in)	35.371		
Biogas (out)	-8.400		
Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	1.801	Ex	
Oil, heavy fuel	1.497	None	
Oil, light fuel	6.90e-003	None	
Diesel, heavy & medium truck (highway)	0.269	None	
Diesel, heavy & medium truck (rural)	-6.36e-003	None	
Diesel, heavy & medium truck (urban)	0.553	None	
Diesel, ship (4-stroke)	1.350	None	
Natural gas (>100 kW)	-5.121	None	
LPG, forklift	-2.20e-002	None	
Peat	8.07e-002	None	
Bark	0.602	None	
Heat	-0.249	None	

The sum of output flow(s) (10.187 kg) is used to calculate emissions and energies

Notes

Effects on other life cycles of the use of 1 kg of recovered paper in production of corrugated board for the packaging system. The data are imported from a database file (corr-b-r.lca). Data for the actual production of liner, fluting and corrugated board are documented in another fi (corr-brd.lca; see the process "Corrugated board").

The use of 1 kg of recovered paper in the packaging system is assumed to result in a reduction in landfilling by 0.2 kg and a reduction in the of recovered paper in production of testliner for other systems by 0.8 kg. The latter is assumed to result in an increase in the use of kraftliner other systems by nearly 0.8 kg. See Main report for a discussion on these assumptions.

The file corr-b-r.lca contains data on the reduction in landfilling and testliner production for other systems. It also includes data on the extra production of kraftliner for other systems. Data for most transports and for production of kraftliner and testliner are adapted from FEFCO (1) Data for wood harvesting are adapted from reference 2. Data for avoided landfilling are adapted from reference 3.

The data above include emissions etc. from fuel production. These have been calculated by using emission factors from our energy database. emission factors take into account emissions etc. for production of the electricity that is used for fuel production. However, the data above dc include emissions etc. for production of the electricity that is used in kraftliner production, testliner production, and landfilling. When the tot emissions profile of the packaging system is calculated, these emissions etc. are included through the use of emission factors for extraction e as is denoted above (E Factor: Ex).

References:
(1) European Database for Corrugated Board Life Cycle Studies, FEFCO, Groupement Ondulé, KRAFT Institute, 1996/1.
(2) Örjan Hedenberg, Birgit Backlund Jacobson, Tiina Pajula, Lisa Person, Helena Wessman; Use of agro fibre for paper production from ar environmental point of view, NordPap DP2/54, Scan Forskrapport 682, Nordic Industrial Fund, Oslo, 1997.
(3) Sundqvist J-O et al, Life Cycle Assessment and Solid Waste, AFR, Stockholm, 1994, page 78.

The data were entered by Lisa Person, CIT. The notes were revised by Tomas Ekvall, CIT, 98-01-06.

Transport Card: 14. Trp

Inflows	**Percent**	**Massflow [kg]**	
Corrugated board		1.514	
Outflows			
Corrugated board		1.514	
Modes of conveyance	**[km]**		**Reference**
Truck, heavy (highway, 70%)	550.000		See notes
Ship, coaster	25.000		See notes

The sum of output flow(s) (1.514 kg) is used to calculate emissions and energies

Notes

--- To be continued ---

Transport of corrugated board.

The board is produced in Sweden and in Germany according to reference (1). The distances are estimated.

Reference:
(1) Göte Nylin, PLM Beverage Can Division.

Transport Card: 15. Trp

Inflows	**Percent**	**Massflow [kg]**	
Scraps, can prod.		9.616	
Outflows			
Scraps, can prod.		9.616	
Modes of conveyance	**[km]**		**Reference**
Truck, heavy (highway, 70%)	500.000		See notes

The sum of output flow(s) (9.616 kg) is used to calculate emissions and energies

Notes
Transport of scraps from can production, PLM Malmö, to remelting plant. The site of the remelting plant is confidential information and therefor not mentioned here.

Transport Card: 16. Trp

Inflows	**Percent**	**Massflow [kg]**	
Cans+ layer pads		45.251	
Outflows			
Cans+ layer pads		45.251	
Modes of conveyance	**[km]**		**Reference**
Truck, medium (rural, 40%)	200.000		(1)
Ship, coaster	25.000		(1)

The sum of output flow(s) (45.251 kg) is used to calculate emissions and energies

Notes
Transport of aluminium can from PLM, Malmö to brewery.

The cans are transported from PLM, Malmö to the brewery (confidential).

Reference:
(1) The transport distances are estimated and based on figures received by Bryggeriforeningen.

Process Card: 17. Washing & filling

Inflows	**Percent**	**Massflow [kg]**	
Cans+ layer pads		45.251	
Outflows			
80% of layer pads	0.116 %	1.211	
Can + beverage		1.04e+003	
Emissions, waste and resources	**[g]**		**Reference**
Water (r)	42.966		
Layer pads, CB (out)	0.290		Non-elementary outflow
Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	7.27e-003	Ex	
Natural gas (>100 kW)	5.07e-002	FU/Ex	

The sum of output flow(s) (1.04e+003 kg) is used to calculate emissions and energies
Mass change factor 23.066

Notes
Washing and filling of 33 cl aluminium cans for beer and soft drinks in the brewery (1).

20% of the corrugated board spacer is assumed to be recycled into other materials (5). We do not expand system boundaries to deal with this recycling, since the outflow is less than 1% of the primary packaging. Instead, the outflow of corrugated board to recycling is a non-elementary outflow from the system. This has little effect on the total LCA results. The system has other, larger outflows of board to recycling, and there the system is expanded.

The amount of heat (provided by the data supplier) has been recalculated into primary fuel assuming an efficiency of 80 % (2). The fuel used is natural gas according to the supplier, but no information about the furnace size was provided. A furnace size larger than 100 kW has been assumed.

Material balance per can:
Inflows:
- Can + layer pads (corrugated board): 14.9505 g (3).

Outflows:

--- To be continued ---

- Can + beverage: 14.4505 + 330 = 344.4505 g (4).
- 80% of layer pads (CB) to incineration = 0.4 g (5).

Total outflows: 344.8505 g.

Mass change factor (out/in): 344.8505/14.9505 = 23.066.

Data gaps:
Pasteurisation of beer and soft drink is associated with the beverage. Thus energy use associated with the pasteurisation procedure is not included. Cleaning agents are used in quite small amounts and have not been accounted for. Aquatic emissions of e.g. COD, BOD, N and P are subject to efficient cleaning procedures in municipal waste water treatment plants and emissions to the environment are assumed to be negligibl Energy use at the waste water treatment plant is estimated to be only a few percent of the total energy use for tapping. The fate of organic cleaning agents in municipal waste water treatment plants as well as their eventual impact in the environment have not been quantified due to lack of data, and potential environmental impacts are unknown.

References and comments:
(1) The brewery (confidential).
(2) O'Callaghan, P. (1993): Energy management. A comprehensive guide to reducing costs by efficient energy use. McGraw-Hill Book Company. London. United Kingdom.
(3) Göte Nylin, PLM Beverage Can Division, Malmö, Sweden.
(4) The amount of beverage is 33 cl, which corresponds to 330 g.
(5) Bryggeriforeningen via Jan Jacobsen, Logisys, 1997.

Transport Card: 18. Trp

Inflows	**Percent**	**Massflow [kg]**	
80% of layer pads		1.211	
Outflows			
80% of layer pads		1.211	
Modes of conveyance	**[km]**		**Reference**
Truck, medium (rural, 40%)	20.000		(1)

The sum of output flow(s) (1.211 kg) is used to calculate emissions and energies

Notes
Transport of 80% of used layer pads (corrugated board) to incineration plant.

Reference:
(1) Bryggeriforeningen via Jan Jacobsen, Logisys, 1997.

Process Card: 19. Corrugated board incin.

Inflows	**Percent**	**Massflow [kg]**	
80% of layer pads		1.211	
Outflows			
Energy, CB		14.372	
Emissions, waste and resources	**[g]**		**Reference**
Ca(OH)2 (in)	17.600		(1)(2) Non-elementary inflow
Water (r)	243.000		(1)(2)
CO2 (bio)	1.59e+003		(1) Air
CO	5.000		(1)
NOx	1.200		(1)
Dioxin	1.00e-008		(1)
H2O	544.000		(1)
Water to WWTP	243.000		(1) Water
Waste, slags & ashes	20.000		(1) Waste
Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	0.180	Ex	(1)

The sum of input flow(s) (1.211 kg) is used to calculate emissions and energies
Mass change factor 11.870

Notes
Incineration of corrugated board (CB) used in layer pads.
Data used for cardboard and corrugated board were found in the EDIP unit process database (1), and calculated as cellulose, except data for amount of heat and electricity produced in the process. These were calculated based on energy production in Danish waste incineration plan 1992 (3). The incineration plants' own energy consumption was subtracted from the production, to yield the energy exported from the plant. (lower) heat value used for cardboard and corrugated board was 15 MJ/kg (3). For further details, see Technical report 7..

Energy production:
The heat produced in waste incineration is 11.3 MJ/kg waste and the electricity produced is 0.57 MJ/kg waste (3).

The outflow of energy from this process is not a mass flow, despite what is indicated above. Instead it is an energy flow, measured in MJ.

"Mass change factor":

--- To be continued ---

The mass change factor in the LCAiT software is generally defined as the total outflow [kg]/total inflow [kg]. Since the outflow from this process is energy, the "mass change factor" is in this case the energy outflow[MJ]/the waste inflow [kg] = 11.87 MJ produced energy/kg waste.

References and comments:
(1) Frees N and Pedersen M A (1996): EDIP unit database.
(2) Used for flue gas cleaning.
(3) SK energi (1994): Opgørelse af affaldsressourcer i Danmark. Elsam/Elkraft. Styregruppe 4 for biomasse.

Process Card: 20. Packaging

Inflows	**Percent**	**Massflow [kg]**	
Can + beverage		1.04e+003	
Return		67.389	
5% of pallets	0.124 %	1.402	
Seckondary packagin	1.717 %	19.415	
Outflows			
90% of can (recyc.)	3.481 %	39.362	
5% of pallet	0.124 %	1.402	
Beverage distrib.		1.09e+003	
Emissions, waste and resources	**[g]**		**Reference**
Plastic ligature (in)	1.69e-002		Non-elementary inflow
Glue (in)	5.58e-002		
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (1.13e+003 kg) is used to calculate emissions and energies

Notes
Packaging of the beverage cans in the brewery.

The environmental impact of the actual packaging process is not included in the LCA. It is likely to be negligible.

When packing the corrugated board boxes on the pallet, LDPE ligature or glue is used for holding the boxes together. On 75% of the pallets, 20 g of ligature is used (1). This means the amount of ligature is: 20/2376*0.75=0.0063 g/can or 0.0169 g/kg outflow.

Glue is used on 25% of the pallets. Our data indicate that the amount of glue is 2 g (1), but we assume that this amount is used for each box. This means the amount of glue is 0.25*2/24=0.0208 g/can or 0.0557 g/kg outflow.

The glue and ligature are non-elementary inflows, i.e. they are not followed from the cradle.

Material balance per can:
Inflows:
- Can + beverage: 344.4505 g.
- Secondary packaging: 6.4164 g.
- 5% of pallet (The pallet is reused in 95% of the cases, why it only needs to be replaced in 5% of the cases. Each life cycle should therefore hold 5% of the environmental loadings caused by the pallet): 0.4630 g.
- Return: 90% of the (used) cans for recycling, pallet (distribution flow): 22.2647 g.

Total inflows: 373.5946 g.

Outflows:
- Beverage distribution: Can + beverage, secondary packaging, pallet (distribution flow), plastic ligature and glue: 360.1533 g.
- 5% of the pallet to waste incineration: 0.4630 g.
- 90% of the can for recycling: 13.0054 g.

Total outflows: 373.6217 g.

Mass change factor (out/in):= 1.000.

Reference: Bryggeriforeningen via Jan Jacobsen, Logisys, 1997.

Process Card: 21. Secondary packaging

Inflows	**Percent**	**Massflow [kg]**	
Tray, CB		7.565	
CB box (24 cans)	22.079 %	4.287	
Foil, LDPE	4.286 %	0.832	
Hi-cone, LDPE	2.208 %	0.429	
CB box (6 cans)	32.464 %	6.303	
Outflows			
Secondary packaging		19.415	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (19.415 kg) is used to calculate emissions and energies

Notes
Secondary packaging:

--- To be continued ---

33 cl Aluminium can

File: 33CL-AL.LCA **Printed:** Fri 98-05-29 10:40

- Tray, corrugated board (24 cans): 120/24*0.5 = 2.5 g/can.
- Cardboard box (6 cans): 50/6*0.25 = 2.083 g/can.
- Foil for cardboard, LDPE (24 cans): 20/24*0.33 = 0.275 g/can.
- Corrugated board box (24 cans): 200/24*0.17 = 200/24*0.17 = 1.4167 g/can.
- Hi-cone, LDPE (6 cans): 3.4/6*0.25 = 0.1417 g/can.

Total, secondary packaging: 6.4164 g/can.

Reference: Bryggeriforeningen via Jan Jacobsen, Logisys, 1997.

Transport Card: 22. Trp

Inflows	**Percent**	**Massflow [kg]**	
Secondary packaging		19.415	
Outflows			
Secondary packaging		19.415	
Modes of conveyance	**[km]**		**Reference**
Truck, medium (rural, 40%)	100.000		Estimated

The sum of output flow(s) (19.415 kg) is used to calculate emissions and energies

Transport Card: 23. Trp

Inflows	**Percent**	**Massflow [kg]**	
Corrugated board		4.287	
Outflows			
Corrugated board		4.287	
Modes of conveyance	**[km]**		**Reference**
Truck, heavy (highway, 70%)	300.000		Estimated

The sum of output flow(s) (4.287 kg) is used to calculate emissions and energies

Process Card: 24. Box

Inflows	**Percent**	**Massflow [kg]**	
Corrugated board		4.287	
Outflows			
CB box (24 cans)		4.287	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (4.287 kg) is used to calculate emissions and energies

Notes
Datagap: No data for box production have been available. The effect of this data gap on total LCA results is likely to be negligible.

Transport Card: 25. Trp

Inflows	**Percent**	**Massflow [kg]**	
Corrugated board		7.565	
Outflows			
Corrugated board		7.565	
Modes of conveyance	**[km]**		**Reference**
Truck, heavy (highway, 70%)	300.000		Estimated

The sum of output flow(s) (7.565 kg) is used to calculate emissions and energies

Process Card: 26. Tray

Inflows	**Percent**	**Massflow [kg]**	
Corrugated board		7.565	
Outflows			
Tray, CB		7.565	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (7.565 kg) is used to calculate emissions and energies

Notes
Datagap: No data for tray production have been available. The effect of this data gap on total LCA results is likely to be negligible.

Process Card: 27. Cardboard (Database)

Outflows	**Percent**	**Massflow [kg]**	
Cardboard		6.303	
Emissions, waste and resources	**[g]**		**Reference**
Land use [m2*years] (r)	18.069		
Particulates	1.959		
CO2 (bio)	1.33e+003		

--- To be continued ---

33 cl Aluminium can

File: 33CL-AL.LCA **Printed:** Fri 98-05-29 10:40

CO2	456.176
NOx	3.782
SO2	1.194
H2S	0.110
COD (aq)	16.710
BOD-5 (aq)	5.900
Suspended solids (aq)	2.100
Waste, ashes	5.800
Waste, inorganic sludges	15.700
Waste, other rejects	10.800
Waste, organic sludges	2.600
NaOH (in)	7.800
HCl (in)	6.00e-002
Starch (in)	1.600
Sizing agents (in)	5.900
Retention agents (in)	2.000
Defoamer (in)	1.200
Biocides (in)	2.00e-002
Lubricants (in)	0.260
Na2CO3 (in)	1.700
CaCO3 (in)	3.100
CaO (in)	8.200
Na2SO4 (in)	4.900
H2SO4 (in)	13.200
Sulphur (in)	0.200
Alum (in)	3.700
Other additives (in)	0.300
CO	0.722
NMVOC	0.510
CH4	0.499
Dioxin	4.58e-010
NH3	2.65e-004
N2O	9.65e-003
HCl	1.42e-003
HF	9.23e-004
Radioactive emissions [kBq]	3.32e+004
As	2.75e-006
Cd	6.10e-006
Cr	5.16e-006
Hg	6.34e-007
Ni	2.31e-004
Pb	1.99e-005
CN-	1.61e-005
Tot-N (aq)	2.01e-002
Phosphate (aq)	1.54e-004
H2S (aq)	5.07e-007
Oil (aq)	0.114
Organics (aq)	9.15e-002
Radioactive emissions [kBq] (aq)	311.600
Al (aq)	2.01e-003
As (aq)	1.33e-005
Cd (aq)	6.91e-006
Co (aq)	2.18e-003
Cr (aq)	4.87e-005
Cu (aq)	1.60e-005
Ni (aq)	3.98e-005
Pb (aq)	4.99e-005
Sb (aq)	5.54e-008
Sn (aq)	4.34e-003
V (aq)	1.30e-005
Zn (aq)	5.47e-005
F- (aq)	7.47e-004
Cl- (aq)	3.347
SO42- (aq)	0.131
CN- (aq)	1.55e-005
Waste, industrial	51.055
Waste, hazardous	5.326
Waste, highly radioactive	2.86e-002
Crude oil (r)	123.652
Natural gas (r)	19.466
Hard coal (r)	2.619
Brown coal (r)	2.336
Wood (r)	6.31e-002
Uranium (as pure U) (r)	1.77e-004

--- To be continued ---

Hydro power-water (r)	8.34e+008
NMVOC, diesel engines	0.232
Zn	5.65e-005
Se	5.65e-007
Cu	9.82e-005
NMVOC, oil combustion	0.471
Benzene	1.61e-003
Cr3+	2.71e-006
PO43- (aq)	1.63e-004
Cr3+ (aq)	4.88e-005
Waste, radioactive	2.86e-004
Biomass (r)	6.24e-002
Peat (in)	5.236
Bark (in)	48.216

Energy carrier	**[MJ]**	**E Factor**	**Reference**
Oil, heavy fuel	2.040	None	
Oil, light fuel	1.00e-002	None	
Natural gas (>100 kW)	0.690	None	
Diesel, heavy & medium truck (urban)	0.784	None	
Peat	0.110	None	
Bark	0.820	None	
Heat	-0.340	None	
Electricity, coal marginal	2.600	Ex	
Diesel, heavy & medium truck (highway)	0.325	None	
Diesel, ship (4-stroke)	1.377	None	

The sum of output flow(s) (6.303 kg) is used to calculate emissions and energies

Notes

Production of 1 kg of cardboard (1). The data are imported from a database file (card-b.lca).

Production of cardboard has been approximated with data for production of kraftliner. This approximation has been validated through a comparison with confidential actual cardboard data.

The file includes data on wood harvesting, wood transport and production of kraftliner. Data on wood transport and on kraftliner production ar adapted from FEFCO (1). Data on wood harvesting are adapted from reference 2.

The data above include emissions etc. from fuel production. These have been calculated by using emission factors from our energy database. T emission factors take into account emissions etc. for production of the electricity that is used for fuel production. However, the data above do r include emissions etc. for production of the electricity that is used in production of kraftliner. When the total emissions profile of the packagin system is calculated, these emissions etc. are included through the use of emission factors for extraction etc. as is denoted above (E Factor: Ex

References:
(1) European Database for Corrugated Board Life Cycle Studies, FEFCO, Groupement Ondulé, KRAFT Institute, 1996/1.
(2) Örjan Hedenberg, Birgit Backlund Jacobson, Tiina Pajula, Lisa Person, Helena Wessman; Use of agro fibre for paper production from an environmental point of view, NordPap DP2/54, Scan Forskrapport 682, Nordic Industrial Fund, Oslo, 1997.

Transport Card: 28. Trp

Inflows	**Percent**	**Massflow [kg]**
Cardboard		6.303
Outflows		
Cardboard		6.303

Modes of conveyance	**[km]**	**Reference**
Truck, heavy (highway, 70%)	300.000	Estimated

The sum of output flow(s) (6.303 kg) is used to calculate emissions and energies

Notes

Process Card: 29. Cardboard box

Inflows	**Percent**	**Massflow [kg]**
Cardboard		6.303
Outflows		
CB box (6 cans)		6.303

Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (6.303 kg) is used to calculate emissions and energies

Notes

Datagap: No data for box production have been available. The effect of this data gap on total LCA results is likely to be negligible.

Process Card: 30. LDPE

Outflows	**Percent**	**Massflow [kg]**

--- To be continued ---

LDPE		0.429	
LDPE		0.832	

Emissions, waste and resources	[g]	Reference
Particulates	3.000	Air
CO2	1.25e+003	
CO	0.900	
SO2	9.000	
NOx	12.000	
HCl	7.00e-002	
HF	5.00e-003	
HC	21.000	
Metals	5.00e-003	
COD (aq)	1.500	Water
BOD (aq)	0.200	
Acid as H+ (aq)	6.00e-002	
Nitrates (aq)	5.00e-003	
Metals (aq)	0.250	
NH4+ (aq)	5.00e-003	
Cl- (aq)	0.130	
Dissolved organics (aq)	2.00e-002	
Suspended solids (aq)	0.500	
Oil (aq)	0.200	
HC (aq)	0.100	
Dissolved solids (aq)	0.300	
Phosphate (aq)	5.00e-003	
Other nitrogen (aq)	1.00e-002	
Waste, industrial	3.500	Waste
Waste, mineral	26.000	
Waste, ashes	9.000	
Waste, toxic chemicals	0.100	
Waste, non toxic chemicals	0.800	
Iron ore (r)	0.200	Resource
Limestone (r)	0.150	
Water (r)	2.40e+004	
Bauxite (r)	0.300	
NaCl (r)	8.000	
Clay (r)	2.00e-002	
Ferromanganese (r)	1.00e-003	
Crude oil (r)	88.760	(1) Fuel resource
Natural gas (r)	228.800	(1) Fuel resource
Coal (r)	117.100	(1) Fuel resource
Crude oil, feedstock (r)	793.200	(1) Feedstock resource
Natural gas, feedstock (r)	610.400	(1) Feedstock resource
Coal, feedstock (r)	0.357	(1) Feedstock resource
Hydropower [MJel] (r)	0.540	(2) Electricity resource
Uranium (as pure U) (r)	1.27e-002	(3) Electricity resource
Waste, highly radioactive	3.50e-002	(4) Waste

Energy carrier	[MJ]	E Factor	Reference
Oil	3.790	None	(5) Fuel
Natural gas	12.380	None	(5) Fuel
Coal	3.280	None	(5) Fuel
Oil, feedstock	33.870	None	(5) Feedstock
Natural gas, feedstock	33.020	None	(5) Feedstock
Coal, feedstock	1.00e-002	None	(5) Feedstock
Electricity	3.140	None	(6)
Nuclear power [MJel]	1.670	None	(8)
Hydro power [MJel]	0.540	None	(7)

The sum of output flow(s) (1.261 kg) is used to calculate emissions and energies

Notes

Production of 1 kg of low density polyethylene (LDPE) from virgin feedstock (ethylene). The data includes all process steps from extraction of feedstock resources (crude oil and natural gas) to polymerisation.

General comments concerning the APME Eco-profile report series:
- In the APME-reports, the results for the cradle to gate life cycle are aggregated. This means that emissions from combustion of fuels and from the production of electricity are already included in the process emissions and that resources from the production of electricity are included in the energy demand (fuels). The fuel "other" (in the APME-report) mainly consists of oil and gas and has therefore been added to the value for oil.

Main reference: Boustead, Ian, Eco-profiles of the European plastics industry, Report 3: Polyethylene and Polypropylene, A report for The European Centre for Plastics in the Environment (PWMI/APME), Brussels, May 1993, table 17, page 11.

Other references and comments:

--- To be continued ---

(1) The fuels and feedstocks in the Eco-profile report correspond to primary resources (MJ). The MJ-figure has been converted to g by using the higher heat value (9).
(2) Hydro power has been accounted for as a resource in MJ electricity. Since LCAiT does not handle other units than g, the MJel is put in the na
(3) The consumption of uranium has been calculated based on the original figure for nuclear power given as MJ electricity. 1 MJ of electricity from nuclear power corresponds to 0.00758 g of uranium (as pure U) (10).
(4) The generation of radioactive waste has been calculated based on the original figure for nuclear power given as MJ electricity. 1 MJ of electricity from nuclear power corresponds to 0.021 g of highly radioactive waste (10).
(5) The original figure is an internal parameter because the environmental load associated with the production and combustion is included in the emissions and resource consumption above. Therefore it would not be correct to use the emission factors from the database.
(6) The original figure is an internal parameter because the environmental load associated with the production is included in the emissions and resource consumption above. Therefore it would not be correct to use any emission factors for electricity production from the database.
(7) The original figure corresponds to MJ consumed electricity from hydro power. This parameter is internal because the environmental load associated with the production is included in the emissions and resource consumption above.
(8) The original figure corresponds to MJ consumed electricity from nuclear power. This parameter is internal because the environmental load associated with the production is included in the emissions and resource consumption above.
(9) The Eco-profile reports from APME have been carried out by Boustead Consulting (Ian Boustead). The heat values used in these studies wer provided by William Dove, Boustead Consulting, UK.
- Oil: 42.7 MJ/kg.
- Natural gas: 54.1 MJ/kg.
- Coal: 28 MJ/kg.
(10) Livscykelanalys av Vattenfalls Elproduktion, Sammanfattande rapport, Stockholm, Sweden, 1996, page 70-71.

Transport Card: 31. Trp

Inflows	Percent	Massflow [kg]	
LDPE		0.832	
Outflows			
LDPE		0.832	
Modes of conveyance	**[km]**		**Reference**
Truck, heavy (highway, 70%)	300.000		Estimated

The sum of output flow(s) (0.832 kg) is used to calculate emissions and energies

Process Card: 32. Foil

Inflows	Percent	Massflow [kg]	
LDPE		0.832	
Outflows			
Foil, LDPE		0.832	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (0.832 kg) is used to calculate emissions and energies

Notes
Datagap: No data for foil production have been available. The effect of this data gap on total LCA results is likely to be negligible.

Transport Card: 33. Trp

Inflows	Percent	Massflow [kg]	
LDPE		0.429	
Outflows			
LDPE		0.429	
Modes of conveyance	**[km]**		**Reference**
Truck, heavy (highway, 70%)	300.000		Estimated

The sum of output flow(s) (0.429 kg) is used to calculate emissions and energies

Process Card: 34. Hi-cone

Inflows	Percent	Massflow [kg]	
LDPE		0.429	
Outflows			
Hi-cone, LDPE		0.429	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (0.429 kg) is used to calculate emissions and energies

Notes
Datagap. No data for production of Hi-cone have been available. The effect of this data gap on total LCA results is likely to be negligible.

Process Card: 35. Planks for pallets

Outflows	Percent	Massflow [kg]	
Planks		1.402	
Emissions, waste and resources	**[g]**		**Reference**
Land use [m2*years] (r)	18.770		

--- To be continued ---

HC	0.571
CO2	103.005
CO	1.324
NOx	1.050
SO2	0.140
NMVOC	0.250
CH4	0.131
Dioxin	1.08e-010
NH3	1.88e-004
N2O	2.28e-003
HCl	3.03e-004
H2S	5.98e-006
HF	3.33e-005
Particulates	0.273
Radioactive emissions [kBq]	7.04e+005
As	5.62e-007
Cd	1.32e-006
Cr	2.24e-006
Hg	2.67e-007
Ni	5.33e-005
Pb	4.51e-006
CN-	8.70e-009
COD (aq)	4.72e-003
BOD-5 (aq)	1.43e-004
Tot-N (aq)	6.90e-003
Phosphate (aq)	7.58e-005
H2S (aq)	2.49e-007
Oil (aq)	2.92e-002
Organics (aq)	2.44e-002
Radioactive emissions [kBq] (aq)	6.61e+003
Al (aq)	9.89e-004
As (aq)	3.22e-006
Cd (aq)	1.79e-006
Co (aq)	9.57e-005
Cr (aq)	2.39e-005
Cu (aq)	7.85e-006
Ni (aq)	9.68e-006
Pb (aq)	1.25e-005
Sb (aq)	2.72e-008
Sn (aq)	2.13e-003
V (aq)	6.37e-006
Zn (aq)	2.69e-005
F- (aq)	3.60e-005
Cl- (aq)	0.854
SO42- (aq)	3.37e-002
CN- (aq)	7.59e-006
Waste, industrial	3.666
Waste, hazardous	3.74e-002
Waste, highly radioactive	1.04e-002
Crude oil (r)	31.529
Natural gas (r)	1.306
Hard coal (r)	0.606
Brown coal (r)	0.505
Wood (r)	3.10e-002
Uranium (as pure U) (r)	3.67e-005
Hydro power-water (r)	7.42e+007
NMVOC, diesel engines	0.146
Zn	2.22e-005
Se	2.21e-007
Cu	3.85e-005
Ethane	2.11e-005
Propane	3.17e-005
Alkanes	2.64e-004
Ethene	5.28e-005
Acetylene	1.06e-005
Propene	2.11e-005
Alkenes	2.11e-005
PAH	1.21e-007
Benzene	2.11e-005
Toluene	1.06e-005
Aromates (C9-C10)	2.11e-005
Formaldehyde	6.34e-006
TOC (aq)	6.60e-005
Bark (in)	94.080

--- To be continued ---

Waste, slags & ashes	5.760		
Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	0.525	Ex	
Oil, light fuel	0.264	None	
Diesel, heavy & medium truck (urban)	0.783	None	
Bark	1.600	None	
Diesel, heavy & medium truck (highway)	0.118	None	
Diesel, ship (4-stroke)	5.94e-002	None	

The sum of output flow(s) (1.402 kg) is used to calculate emissions and energies

Notes

Production of 1 kg of planks. The data are imported from a database file (planks.lca).

The file includes data on production (planting, forestry and harvesting) of pine pulpwood (softwood) in Sweden, using mechanised and manual wood harvesting (1). The softwood is both naturally rejuvenated and planted. The sawmill includes barking, sawing and drying of wood (2). The transport between harvesting and saw mill is included as well (3).

The data above include emissions etc. from fuel production and combustion. These have been calculated by using emission factors from our energy database. The emission factors take into account emissions etc. for production of the electricity that is used for fuel production. However the data above do not include emissions etc. for production of the electricity that is used in the saw mill. When the total emissions profile of the packaging system is calculated, these emissions etc. are included through the use of emission factors for extraction etc. as is denoted above (E Factor: Ex).

References:

(1) Örjan Hedenberg, Birgit Backlund Jacobson, Tiina Pajula, Lisa Person, Helena Wessman; Use of agro fibre for paper production from an environmental point of view, NordPap DP2/54, Scan Forskrapport 682, Nordic Industrial Fund, Oslo, 1997.
(2) Tillman et al., Packaging and the Environment, Chalmers Industriteknik, Gothenburg, Sweden, 1992.
(3) Data from the STFI database (The Swedish Pulp and Paper Institute).

Transport Card: 36. Trp

Inflows	**Percent**	**Massflow [kg]**	
Planks		1.402	
Outflows			
Planks		1.402	
Modes of conveyance	**[km]**		**Reference**
Truck, heavy (highway, 70%)	100.000		Estimated

The sum of output flow(s) (1.402 kg) is used to calculate emissions and energies

Process Card: 37. Pallet

Inflows	**Percent**	**Massflow [kg]**	
Planks		1.402	
Outflows			
5% of pallets		1.402	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (1.402 kg) is used to calculate emissions and energies

Notes

Datagap: No data for the production of pallets have been available. The effect of this data gap on total LCA results is likely to be negligible.

The pallet is reused in 95% of the cases, why it only needs to be replaced in 5% of the cases. Each life cycle should therefore hold 5% of the environmental loadings caused by the pallet.

Transport Card: 38. Trp

Inflows	**Percent**	**Massflow [kg]**	
5% of pallets		1.402	
Outflows			
5% of pallets		1.402	
Modes of conveyance	**[km]**		**Reference**
Truck, medium (rural, 40%)	100.000		Estimated

The sum of output flow(s) (1.402 kg) is used to calculate emissions and energies

Transport Card: 39. Trp

Inflows	**Percent**	**Massflow [kg]**	
5% of pallet		1.402	
Outflows			
5% of pallet		1.402	
Modes of conveyance	**[km]**		**Reference**
Truck, medium (rural, 40%)	20.000		(1)

--- To be continued ---

The sum of output flow(s) (1.402 kg) is used to calculate emissions and energies

Notes

Transport of wood to inceneration plant.

Reference:
(1) Bryggeriforeningen via Jan Jacobsen, Logisys, 1997.

Process Card: 40. Wood incineration

Inflows	**Percent**	**Massflow [kg]**	
5% of pallet		1.402	
Outflows			
Energy, wood		20.149	

Emissions, waste and resources	**[g]**	**Reference**
Ca(OH)2 (in)	17.600	(1)(2) Non-elementary inflow
Water (r)	243.000	(1)(2)
CO2 (bio)	1.78e+003	(1)(5) Air
CO	6.000	(1)(5)
NOx	1.200	(1)(5)
Dioxin	1.00e-008	(1)(5)
H2O	522.000	(1)(5)
Water to WWTP	243.000	(1) Water
Waste, slags & ashes	30.000	(1) Waste

Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	0.180	Ex	(1)

The sum of input flow(s) (1.402 kg) is used to calculate emissions and energies
Mass change factor 14.370

Notes

Incineration of wood used in pallets.
Data used for wood were found in the EDIP unit process database (1), except data for the amount of heat and electricity produced in the process. These were calculated based on energy production in Danish waste incineration plants in 1992 (3). The incineration plants' own energy consumption was subtracted from the production, to yield the energy exported from the plant. The (lower) heat value used for wood was 18.3 MJ/kg (5). For further details, see Technical report 7.

Energy production:
The heat produced in waste incineration is 13.8 MJ/kg waste and the electricity produced is 0.57 MJ/kg waste (3).

The outflow of energy from this process is not a mass flow, despite what is indicated above. Instead it is an energy flow, measured in MJ.

"Mass change factor":
The mass change factor in the LCAiT software is generally defined as the total outflow [kg]/total inflow [kg]. Since the outflow from this process is energy, the "mass change factor" is in this case the energy outflow[MJ]/the waste inflow [kg] = 14.37 MJ produced energy/kg waste.

References and comments:
(1) Frees N and Pedersen M A (1996): EDIP unit database.
(2) Used for flue gas cleaning.
(3) SK energi (1994): Opgørelse af affaldsressourcer i Danmark. Elsam/Elkraft. Styregruppe 4 for biomasse.
(4) The air emissions are calculated based on an assumption that during incineration, 1 % of the wood becomes ashes, and also that the ashes consist of 50 wt% C, 44 wt% O and 6 wt% H (6).
(5) Arbeidsrapport nr. 29 (1995): Miljøøkonomi for papir- og papkredsløb. Delrapport 2: Bølgepap. Miljø- og Energiministeriet Miljøstyrelsen.

Process Card: 41. Energy use

Inflows	**Percent**	**Massflow [kg]**	
Alternative energy	50.000 %	34.521	
Energy, wood		20.149	
Energy, CB		14.372	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (69.041 kg) is used to calculate emissions and energies

Notes

Heat and electricity produced in waste incineration is assumed to replace the same amount of heat and electricity from alternative energy production. The outflows/inflows of energy to/from this process are not mass flows, despite what is indicated above. Instead they are energy flows, measured in MJ (see remarks in the incineration processes).

Process Card: 42. Alt. energy production

Outflows	**Percent**	**Massflow [kg]**	
Alternative energy		34.521	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

--- To be continued ---

Natural gas (>100 kW)	-0.447	FU/Ex	(1) (2)
Oil, light fuel	-0.671	FU/Ex	(1) (2)
Electricity, coal marginal	-5.00e-002	Ex	(1)

The sum of output flow(s) (34.521 kg) is used to calculate emissions and energies

Notes
Alternative production of heat and electricity per MJ total energy produced:

- Heat: 0.95 MJ (2). The efficiency for production of heat from oil and natural gas is assumed to be 85 %. The total amount of primary fuels = 0.95/0.85 = 1.118 MJ/MJ of total energy produced. The heat produced in waste incineration is assumed to replace district heat produced from other fuels, which (as an average for Denmark) is a mix of 60 % light fuel oil and 40 % natural gas (1). This corresponds to 0.671 MJ of light fuel oil and 0.447 MJ of natural gas.

- Electricity: 0.05 MJ (2). The electricity produced in waste incineration is assumed to replace electricity from the grid.

The outflow of energy from this process is not a mass flow, despite what is indicated above. Instead it is an energy flow, measured in MJ (see remarks in the incineration processes).

References:
(1) Eurostat. (1997a). Energy Balance Sheets 1994-1995. Luxembourg: Statistical Office of the European Communities.
(2) Frees N and Pedersen M A (1996): EDIP unit database.

Transport Card: 43. Trp

Inflows	**Percent**	**Massflow [kg]**	
90% of can (recyc.)		39.362	
Outflows			
90% of can (recyc.)		39.362	
Modes of conveyance	**[km]**		**Reference**
Truck, heavy (highway, 70%)	500.000		Estimated
Ship, coaster	50.000		Estimated

The sum of output flow(s) (39.362 kg) is used to calculate emissions and energies

Notes
Transport of used aluminium cans from brewery to remelting plant.
The transport modes and the distances has been estimated.

Process Card: 44. Remelting

Inflows	**Percent**	**Massflow [kg]**	
Scraps, strip roll.		0.500	
90% of can (recyc.)		39.362	
Scraps, can prod.		9.616	
Outflows			
Remelted aluminium		44.481	
Emissions, waste and resources	**[g]**		**Reference**
Particulates	1.61e-002		(1) Air
HCl	5.01e-003		(1)
HF	4.40e-004		(1)
SO2	5.45e-003		(1)
NOx	0.191		(1)
Al (aq)	9.42e-003		(1) Water
Oil (aq)	4.19e-003		(1)
Suspended solids (aq)	8.18e-002		(1)
Waste, non hazardous	18.902		(1) Waste
Waste, ashes	111.807		(1)
CO2	42.913		(2) Air
CO	2.64e-002		(2)
NH3	6.60e-006		(2)
NMVOC, natural gas combustion	2.31e-003		(2)
CH4	9.90e-004		(2)
N2O	1.98e-003		(2)
Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	4.264	Ex	(1)
LPG, thermal	0.660	Ex	(1)

The sum of output flow(s) (44.481 kg) is used to calculate emissions and energies
Mass change factor 0.899

Notes
Remelting of used aluminium cans and of process scraps from strip rolling and can production.

Material balance per can :

--- To be continued ---

-Material inputs:
Process scraps from strip rolling: 0.1653 g.
Process scraps from can production: 3.177 g.
90% of used aluminium cans for recycling: 13.0054 g.
- Total input: 16.3477 g.
- Total output: 14.6966 g rolling ingots.
- Mass change factor (out/in): 14.6966/16.3477 = 0.899.

Energy data:
The production of liquefied petroleum gas (LPG) and electricity is not included in the data from reference 1. Therefore the emission factors (extraction/Ex) from the database are used.

Emissions:
Specific emissions for particulates, HCl, HF, SO2 and NOx have been received by reference 1.
As a complement to the air emissions in reference 1, emissions from the combustion of thermal LPG have been calculated (and inserted manually) using emission factors from the database.

Data-gaps:
The landfill disposal of waste is not included.

References:
(1) Confidential.
(2) Calculated from the emission factors for LPG, thermal (as a complement to the air emissions in reference 1.

Data were entered by Anna Ryberg, CIT.

Transport Card: 45. Trp

Inflows	**Percent**	**Massflow [kg]**
Remelted aluminium		44.481

Outflows		
Remelted aluminium		44.481

Modes of conveyance	**[km]**	**Reference**
Truck, heavy (highway, 70%)	1.25e+003	Estimated
Ship, container	150.000	Estimated

The sum of output flow(s) (44.481 kg) is used to calculate emissions and energies

Notes
Transport of rolling ingots from remelting plant to strip rolling. The transport distances have been estimated.

Transport Card: 46. Trp. - Distribution

Inflows	**Percent**	**Massflow [kg]**
Beverage distrib.		1.09e+003

Outflows		
Beverage distrib.		1.09e+003

Modes of conveyance	**[km]**	**Reference**
Distr, heavy (highway, 50%)(Scan)	56.700	(1)
Distr, heavy (rural, 50%)(Scan)	45.360	(1)
Distr, heavy (urban, 50%)(Scan)	11.340	(1)
Distr, medium (highway, 50%)	14.400	(1)
Distr, medium (rural, 50%)	14.400	(1)
Distr, medium (urban, 50%)	19.200	(1)
Distr, medium (highway, 50%)	0.792	(1)
Distr, medium (rural, 50%)	2.376	(1)
Distr, medium (urban, 50%)	4.752	(1)

Calculated for a reference flow of 1.09e+003 [kg] which corresponds to distr. of 1000 l.
The sum of output flow(s) (1.09e+003 kg) is used to calculate emissions and energies

Notes
Reference:
(1) Bryggeriforeningen via Jan Jacobsen, Logisys, 1997.

Transport Card: 47. Trp

Inflows	**Percent**	**Massflow [kg]**
Return		67.389

Outflows		
Return		67.389

Modes of conveyance	**[km]**	**Reference**

The sum of output flow(s) (67.389 kg) is used to calculate emissions and energies

Notes

--- To be continued ---

This transport is included in the distribution.

Process Card: 48. Retailer

Inflows	**Percent**	**Massflow [kg]**	
Beverage distrib.		1.09e+003	
90% of can (recyc.)		39.367	
Outflows			
Return	5.967 %	67.389	
CB recycling (tray)	0.134 %	1.513	
Bever. to consumer		1.06e+003	
Emissions, waste and resources	**[g]**		**Reference**
Plastic ligature (out)	1.18e-002		(1) Non-elementary outflow
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (1.13e+003 kg) is used to calculate emissions and energies

Notes
Retailer

The choice of packaging is assumed to have negligible effect on the environmental impacts of the retailer.

70% of the plastic ligature (0.0044 g/can or 0.0118 g/kg outflow) is assumed to be recycled to be used in other products (1). We do not expand system boundaries to deal with this recycling, since the outflow is less than 1% of the primary packaging. Instead, the outflow of plastic ligature to recycling is a non-elementary outflow from the system

Material balance per can:
Inflows:
- Beverage distribution: Can + beverage, secondary packaging, pallet (distribution flow), plastic ligature and glue: 360.1533 g.
- 90% of the can for recycling: 13.0054 g.
Total inflows: 373.1587 g.

Outflows:
- To consumer: Can + beverage, cardboard box, foil for cardboard, corrugated board box, hi-cone, 80% of tray to waste incineration, 30% of plastic ligature to waste incineration and glue: 350.3896 g.
- Return: 90% of the can for recycling, pallet (distribution flow): 22.2647 g.
- CB recycling: 20% of tray for recycling: 0.5 g.
Total outflows: 373.1543 g.

Mass change factor = 1.0.

Reference:
(1) Bryggeriforeningen via Jan Jacobsen, Logisys, 1997.

Transport Card: 49. Trp

Inflows	**Percent**	**Massflow [kg]**	
CB recycling (tray)		1.513	
Outflows			
CB recycling (tray)		1.513	
Modes of conveyance	**[km]**		**Reference**
Truck, heavy (highway, 70%)	130.000		(1)

The sum of output flow(s) (1.513 kg) is used to calculate emissions and energies

Notes
Transport of 20% of the used corrugated trays to recycling.

Reference:
(1) Bryggeriforeningen via Jan Jacobsen, Logisys, 1997.

Transport Card: 50. Trp

Inflows	**Percent**	**Massflow [kg]**	
Bever. to consumer		1.06e+003	
Outflows			
Bever. to consumer		1.06e+003	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (1.06e+003 kg) is used to calculate emissions and energies

Notes
Transport of filled aluminium cans from retailer to consumer.

The choice of beverage packaging is assumed not to affect the transport mode, the transport distance or the number of transports from retailer

--- To be continued ---

home. Under this assumption, preliminary calculations show that the choice of packaging has negligible effect on the environmental impact of this transport.

Transport Card: 51. Trp

Inflows	**Percent**	**Massflow [kg]**	
90% of can (recyc.)		39.367	
Outflows			
90% of can (recyc.)		39.367	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (39.367 kg) is used to calculate emissions and energies

Notes

Transport of used aluminium cans from customer back to retailer.

In accordance with the terms of this project, the recycling rate is assumed to be 90%.

The choice of beverage packaging is assumed not to affect the transport mode, the transport distance or the number of transports from home to retailer. Under this assumption, preliminary calculations show that the choice of packaging has negligible effect on the environmental impact of this transport.

Process Card: 52. Use (refrigeration)

Inflows	**Percent**	**Massflow [kg]**	
Bever. to consumer		1.06e+003	
Outflows			
90% of can (recyc.)		39.367	
CB recyc. (box 24)	1.389 %	0.857	
CB recyc. (box 6)	2.043 %	1.261	
Waste	32.783 %	20.233	
Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	2.90e-002	Ex	(1) (2)

The sum of output flow(s) (61.719 kg) is used to calculate emissions and energies
Mass change factor 5.82e-002

Notes

The aluminium can is cooled from 20 to 5 degrees Celcius. The heat capacitivity of aluminium is 0.0009 MJ/(kg*degree Celcius) (1), which gives an energy demand of 0.0135 MJ/kg aluminium. An efficiency of 33% for the refrigerator has been used (2), which gives a total energy demand of 0.0409 MJ/kg aluminium. The amount of aluminium in the outflow is 14.4505 g/can. The total outflow is (see below) 20.3896 g/can, which gives 14.4505/20.3896 = 0.7087 kg aluminium/kg outflow. This means that the energy demand becomes 0.0409*0.7087 = 0.0290 MJ/kg outflo

Material balance per can:

Inflows:
- To consumer: Can + beverage, cardboard box, foil for cardboard, corrugated board box, hi-cone, 80% of tray to waste incineration, 30% of plastic ligature to waste incineration, glue: 350.3896 g/can.

Outflows:
- Waste: 10% of can to waste incineration, 80% of cardboard box to waste incineration, foil for cardboard (to waste incineration), 80% of corrugated board box to waste incineration, 80% of tray to waste incineration, 30% of plastic ligature to waste incineration, hi-cone (to waste incineration) and glue (to waste water treatment plant): 6.6843 g.
- 90% of can for recycling: 13.0054 g.
- CB recycling: 20% of corrugated board box for recycling: 0.2833 g.
- Cardboard recycling: 20% of cardboard box for recycling. 0.4166 g.

Total outflows: 20.3896 g.

Mass change factor (out/in): 20.3896/350.3896 = 0.0582.

References:
(1) Nordling Carl, Österman Jonny, Physics handbook.
(2) Pommer K., Wesn's M.S., Madsen C., Miljfm'ssig kortl'gning af emballager til fl og l'skedrikke, Delrapport 6: Engangsflasker af PET, Arbefjdsrapport fra Miljístyrelsen Nr. 75 1995.

Transport Card: 53. Trp

Inflows	**Percent**	**Massflow [kg]**	
CB recyc. (box 24)		0.857	
Outflows			
CB recyc. (box 24)		0.857	
Modes of conveyance	**[km]**		**Reference**
Truck, heavy (highway, 70%)	130.000		(1)

The sum of output flow(s) (0.857 kg) is used to calculate emissions and energies

--- To be continued ---

Notes
Transport of 20 % of the used corrugated board boxes to recycling.

Reference:
(1) Bryggeriforeningen via Jan Jacobsen, Logisys, 1997.

Transport Card: 54. Trp

Inflows	Percent	Massflow [kg]	
CB recyc. (box 6)		1.261	
Outflows			
CB recyc. (box 6)		1.261	
Modes of conveyance	**[km]**		**Reference**
Truck, heavy (highway, 70%)	130.000		(1)

The sum of output flow(s) (1.261 kg) is used to calculate emissions and energies

Notes
Transport of 20% of the cardboard boxes to recycling.

Reference:
(1) Bryggeriforeningen via Jan Jacobsen, Logisys, 1997.

Process Card: 55. Testliner

Inflows	Percent	Massflow [kg]	
CB recyc. (box 6)		1.261	
CB recyc. (box 24)		0.857	
CB recycling (tray)		1.513	
Outflows			
Testliner		3.330	
Emissions, waste and resources	**[g]**		**Reference**
CO2 (bio)	11.000		Air
CO2	464.000		
CO	4.00e-002		Not representative
SO2	0.120		
NOx	0.740		As NO2
COD (aq)	0.580		Water
BOD-5 (aq)	4.00e-002		
Suspended solids (aq)	4.00e-002		
Tot-N (aq)	2.99e-002		Not representative
NH3 (aq)	0.0		Not available
NO3- (aq)	1.82e-002		Not representative
AOX (aq)	0.0		Not available
Phosphate (aq)	3.10e-003		Not available
Cl- (aq)	0.476		Not representative
SO42- (aq)	0.657		Not representative
Cu (aq)	7.00e-005		Not representative
Zn (aq)	2.50e-004		Not representative
Waste, paper related	9.600		Waste
Waste, other rejects	28.700		
Waste, organic sludges	0.100		
Rejects incinerated + energy (out)	1.100		Non-elementary outflow
Recycled lubricants (out)	0.100		
Reused lubricants (out)	0.200		
NaOH (in)	0.500		Non-elementary inflow
HCl (in)	0.200		
Colorants (in)	1.390		(wet weight)
Starch (in)	26.300		
Sizing agents (in)	3.300		(wet weight)
Retention agents (in)	0.300		
Defoamer (in)	0.100		
Biocides (in)	1.00e-002		
Lubricants (in)	0.170		
Urea (in)	0.120		
Phosphoric acid (in)	0.140		
Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	0.210	Ex	
Oil, light fuel	6.00e-004	Ex	
Natural gas (>100 kW)	7.670	Ex	
Diesel, heavy & medium truck (urban)	2.00e-002	Ex	
LPG, forklift	3.00e-002	Ex	

--- To be continued ---

The sum of output flow(s) (3.330 kg) is used to calculate emissions and energies
Mass change factor 0.917

Notes
Production of testliner (1) for the packaging system.

Material balance per kg testliner (2):
- Input: 1.09 kg of recovered paper (as wet weight).
- Output: 1 kg of testliner.
- Mass change factor (out/in) = ... = 0.9174.

Reference:
(1) European Database for Corrugated Board Life Cycle Studies, FEFCO, Groupement Ondulé, KRAFT Institute, 1996/1.
(2) Reference 1, page 14.

Process Card: 56. New product

Inflows	Percent	Massflow [kg]
Avoided kraftliner	40.000 %	2.664
Avoided testliner	10.000 %	0.666
Testliner		3.330

Energy carrier	[MJ]	E Factor	Reference

The sum of output flow(s) (6.660 kg) is used to calculate emissions and energies

Notes
The testliner produced from recycled fibres from the packaging system is assumed to replace in part (20%) kraftliner and in part (80%) testliner based on recycled fibres from other systems in Europe.

Process Card: 57. Avoided kraftliner (Database)

Outflows	Percent	Massflow [kg]
Avoided kraftliner		2.664

Emissions, waste and resources	[g]	Reference
Land use [m2*years] (r)	18.069	
Particulates	-1.846	
CO2 (bio)	-1.33e+003	
CO2	-329.751	
NOx	-2.579	
SO2	-1.053	
H2S	-0.110	
COD (aq)	-16.704	
BOD-5 (aq)	-5.900	
Suspended solids (aq)	-2.100	
Waste, ashes	-5.800	
Waste, inorganic sludges	-15.700	
Waste, other rejects	-10.800	
Waste, organic sludges	-2.600	
NaOH (in)	-7.800	
HCl (in)	-6.00e-002	
Starch (in)	-1.600	
Sizing agents (in)	-5.900	
Retention agents (in)	-2.000	
Defoamer (in)	-1.200	
Biocides (in)	-2.00e-002	
Lubricants (in)	-0.260	
Na2CO3 (in)	-1.700	
CaCO3 (in)	-3.100	
CaO (in)	-8.200	
Na2SO4 (in)	-4.900	
H2SO4 (in)	-13.200	
Sulphur (in)	-0.200	
Alum (in)	-3.700	
Other additives (in)	-0.300	
CO	2.71e-002	
NMVOC	-0.203	
CH4	-0.335	
Dioxin	-3.25e-010	
NH3	3.43e-005	
N2O	-6.51e-003	
HCl	-1.05e-003	
HF	-8.83e-004	
Radioactive emissions [kBq]	-2.92e+004	
As	-2.06e-006	
Cd	-4.39e-006	

--- To be continued ---

Cr	-2.01e-006
Hg	-4.68e-007
Ni	-1.65e-004
Pb	-1.43e-005
CN-	-1.61e-005
Tot-N (aq)	-1.16e-002
Phosphate (aq)	-6.11e-005
H2S (aq)	-2.01e-007
Oil (aq)	-7.80e-002
Organics (aq)	-6.15e-002
Radioactive emissions [kBq] (aq)	-274.056
Al (aq)	-7.98e-004
As (aq)	-9.33e-006
Cd (aq)	-4.70e-006
Co (aq)	-2.17e-003
Cr (aq)	-1.93e-005
Cu (aq)	-6.34e-006
Ni (aq)	-2.79e-005
Pb (aq)	-3.46e-005
Sb (aq)	-2.19e-008
Sn (aq)	-1.72e-003
V (aq)	-5.14e-006
Zn (aq)	-2.16e-005
F- (aq)	-7.02e-004
Cl- (aq)	-2.297
SO42- (aq)	-8.96e-002
CN- (aq)	-6.13e-006
Waste, industrial	-46.544
Waste, hazardous	-5.280
Waste, highly radioactive	-2.85e-002
Crude oil (r)	-84.859
Natural gas (r)	-17.863
Hard coal (r)	-1.872
Brown coal (r)	-1.714
Wood (r)	-2.50e-002
Uranium (as pure U) (r)	-1.32e-004
Hydro power-water (r)	-8.33e+008
NMVOC, diesel engines	2.47e-002
Zn	-2.18e-005
Se	-2.18e-007
Cu	-3.79e-005
NMVOC, oil combustion	-0.471
Benzene	-1.61e-003
Cr3+	-2.71e-006
PO43- (aq)	-1.63e-004
Cr3+ (aq)	-4.88e-005
Waste, radioactive	-2.86e-004
Biomass (r)	-6.24e-002
Peat (in)	-5.236
Bark (in)	-48.216

Energy carrier	[MJ]	E Factor	Reference
Electricity, coal marginal	-2.600	Ex	
Oil, heavy fuel	-2.040	None	
Oil, light fuel	-1.00e-002	None	
Natural gas (>100 kW)	-0.690	None	
Diesel, heavy & medium truck (urban)	0.724	None	
Peat	-0.110	None	
Bark	-0.820	None	
Heat	0.340	None	
Diesel, heavy & medium truck (highway)	-0.325	None	
Diesel, ship (4-stroke)	-1.377	None	

The sum of output flow(s) (2.664 kg) is used to calculate emissions and energies
Mass change factor 1.312

Notes

The avoided production of 1 kg of kraftliner caused by the outflow of recycled fibres from the packaging system. The data are imported from database file (kraftlin.lca). The file includes data on avoided wood harvesting, wood transport and production of kraftliner. Data on wood transport and on kraftliner production are adapted from FEFCO (1). Data on wood harvesting are adapted from reference 2.

The data above include emissions etc. from fuel production. These have been calculated by using emission factors from our energy database. emission factors take into account emissions etc. for production of the electricity that is used for fuel production. However, the data above dc include emissions etc. for production of the electricity that is used in production of kraftliner. When the total emissions profile of the packagi system is calculated, these emissions etc. are included through the use of emission factors for extraction etc. as is denoted above (E Factor: E

--- To be continued ---

33 cl Aluminium can

File: 33CL-AL.LCA **Printed:** Fri 98-05-29 10:40

References:
(1) European Database for Corrugated Board Life Cycle Studies, FEFCO, Groupement Ondulé, KRAFT Institute, 1996/1.
(2) Örjan Hedenberg, Birgit Backlund Jacobson, Tiina Pajula, Lisa Person, Helena Wessman; Use of agro fibre for paper production from an environmental point of view, NordPap DP2/54, Scan Forskrapport 682, Nordic Industrial Fund, Oslo, 1997.

The data were entered by Lisa Person, CIT. The notes were revised by Tomas Ekvall, CIT, 98-01-06.

Process Card: 58. Avoided testliner

Inflows	**Percent**	**Massflow [kg]**	
Avoided testliner		0.726	
Outflows			
Avoided testliner		0.666	

Emissions, waste and resources	**[g]**	**Reference**
CO2 (bio)	-11.000	Air
CO2	-464.000	
CO	-4.00e-002	Not representative
SO2	-0.120	
NOx	-0.740	As NO2
COD (aq)	-0.580	Water
BOD-5 (aq)	-4.00e-002	
Suspended solids (aq)	-4.00e-002	
Tot-N (aq)	-2.99e-002	Not representative
NH3 (aq)	0.0	Not available
NO3- (aq)	-1.82e-002	Not representative
AOX (aq)	0.0	Not available
Phosphate (aq)	-3.10e-003	Not available
Cl-	-0.476	Not representative
SO42- (aq)	-0.657	Not representative
Cu (aq)	-7.00e-005	Not representative
Zn (aq)	-2.50e-004	Not representative
Waste, paper related	-9.600	Waste
Waste, other rejects	-28.700	
Waste, organic sludges	-0.100	
Rejects incinerated + energy (out)	-1.100	Non-elementary outflow
Recycled lubricants (out)	-0.100	
Reused lubricants (out)	-0.200	
NaOH (in)	-0.500	Non-elementary inflow
HCl (in)	-0.200	
Colorants (in)	-1.390	(wet weight)
Starch (in)	-26.300	
Sizing agents (in)	-3.300	(wet weight)
Retention agents (in)	-0.300	
Defoamer (in)	-0.100	
Biocides (in)	-1.00e-002	
Lubricants (in)	-0.170	
Urea (in)	-0.120	
Phosphoric acid (in)	-0.140	

Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	-0.210	Ex	
Oil, light fuel	-6.00e-004	Ex	
Natural gas (>100 kW)	-7.670	Ex	
Diesel, heavy & medium truck (urban)	-2.00e-002	Ex	
LPG, forklift	-3.00e-002	Ex	

The sum of output flow(s) (0.666 kg) is used to calculate emissions and energies
Mass change factor 0.917

Notes
This is the production of testliner (1) for other systems which is reduced through the use of recycled fibres in the packaging system. The reason for the negative figures is that they refer to a reduction in the production.

For further details, see process 55.

Process Card: 59. Other products

Outflows	**Percent**	**Massflow [kg]**
Fibres to landfill	50.000 %	0.726
Fibres to recycling		0.726

Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (1.453 kg) is used to calculate emissions and energies

Notes

--- To be continued ---

When production of testliner based on recycled fibres from other systems (in Europe) is reduced, these fibres end up at waste management. The marginal waste management is assumed to be landfilling (see Main report).

Process Card: 60. Landfill-corrugated board

Inflows	Percent	Massflow [kg]	
Fibres to landfill		0.726	

Emissions, waste and resources	[g]		Reference
CH_4	83.000		Air, See notes
CO_2 (bio)	428.000		Air, See notes
Elementary waste, corrugated board	447.000		Waste, See notes
Biogas (out)	42.000		Co-product, See notes

Energy carrier	[MJ]	E Factor	Reference
Electricity, coal marginal	7.00e-004	Ex	(3)
Diesel, heavy & medium truck (urban)	3.50e-002	FU/Ex	(3)

The sum of input flow(s) (0.726 kg) is used to calculate emissions and energies

Notes
Landfilling of corrugated board.

Emissions:
According to reference 1 the methane produced from degradation paper is dependent of the composition of the paper according to (unit; g/kg paper): $CH_4 = 186 \times Xc$, Xc; the cellulose (and hemicellulose) content.
If the cellulose content is unkown Xc can be calculated from: $Xc = 1 - (Xl + Xa + Xm)$
- Xl; the lignin content
- Xa; the content of ashes
- Xm: the moisture (water content)

The carbondioxide produced is:
$CO_2 = 514 \times Xc$

The methane produced is not equal to the methane emitted since 15 % of the methane is oxidized into carbondioxide. The correct formulas will therefore be:
$CH_4 = (1-0.15) \times 186 \times Xc = 158 \times Xc$
$CO_2 = (514 \times Xc) + (0.15 \times 186 \times Xc) = 542 \times Xc$

Calculation of emissions:
According to reference 2 the corrugated board content is:
Xl = 12 % (10-15 %)
Xa = 2 % (1.5-2 %)
Xm = 7 % (6-8 %)
According to the formula above Xc = ...= 79 %
$CH_4 = 158 \times 0.79 = 125$ g/kg corrugated board.
$CO_2 = 542 \times 0.79 = 428$ g/kg corrugated board.

Part of the methane (we assume 1/3) is collected as biogas and used for energy production, which means that the emissions of methane is 83 g/l corrugated board. The biogas is a non-elementary outflow from the system, i.e. it is not followed to the grave. This has little effect on the total LCA results since the amount of biogas is small.

Remaining waste:
The remaining waste is calculated from $1000 - CH_4 - CO_2 = ... = 447$ g/kg corrugated board.

References:
(1) Sundqvist J-O et al, Life Cycle Assessment and Solid Waste, AFR, Stockholm, 1994, page 78.
(2) ASSI Kraftliner, Research Corp., Christer Söremark, personal communication.
(3) Tillman et al., Packaging and the Environment, Chalmers Industriteknik, Gothenburg, Sweden, 1992.

Transport Card: 61. Trp

Inflows	Percent	Massflow [kg]	
Waste		20.233	
Outflows			
Waste		20.233	

Modes of conveyance	[km]		Reference
Truck, medium (rural, 40%)	20.000		(1)

The sum of output flow(s) (20.233 kg) is used to calculate emissions and energies

Notes
Transport to waste management.

Reference:
(1) Bryggeriforeningen via Jan Jacobsen, Logisys, 1997.

Process Card: 62. Waste management

--- To be continued ---

Inflows	Percent	Massflow [kg]	
Waste		20.233	
Outflows			
CB waste		14.531	
PE-waste	6.282 %	1.267	
Aluminium waste	21.687 %	4.375	
Emissions, waste and resources	**[g]**		**Reference**
Glue (out)	3.121		Non-elementary outflow
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (20.173 kg) is used to calculate emissions and energies
Mass change factor 0.997

Notes
Waste management.

This process is only used in order to distribute the different waste flows.

The marginal waste management in Denmark is assumed to be waste incineration with energy recovery (see Main report).

The waste flow of glue has not been followed to the grave. Instead, this flow has been accounted for as a non-elementary outflow from the system. The amount of glue is 0.0208 g/can or 3.121 g/kg outflow.

Material balance per can:

Inflow:
- Waste: 10% of can to waste incineration, 80% of cardboard box to waste incineration, foil for cardboard (to waste incineration), 80% of corrugated board box to waste incineration, 80% of tray to waste incineration, 30% of plastic ligature to waste incineration, hi-cone (to waste incineration) and glue (to waste water treatment plant): 6.6843 g.

Outflows:
- CB waste: 80% of cardboard box, 80% of tray, 80% of corrugated board box: 4.7998 g.
- Aluminium waste: 10% of the aluminium can: 1.4451 g.
- PE waste: 30% of plastic ligature, foil for cardboard, hi-cone: 0.4186 g.

Total outflows: 6.6635 g.

Mass change factor (out/in) = 0.997.

Process Card: 63. Aluminium incineration

Inflows	Percent	Massflow [kg]	
Aluminium waste		4.375	
Outflows			
Energy, aluminium		108.934	
Emissions, waste and resources	**[g]**		**Reference**
Ca(OH)2 (in)	17.600		(1)(2) Non-elementary inflow
Water (r)	243.000		(1)(2)
NOx	1.200		(1)
Dioxin	1.00e-008		(1)
Water to WWTP	243.000		(1) Water
Waste, slags & ashes	1.89e+003		(1) Waste
Al2O3	0.200		
Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	0.180	Ex	(1)

The sum of input flow(s) (4.375 kg) is used to calculate emissions and energies
Mass change factor 24.900

Notes
Incineration of aluminium used in cans.
Data used for aluminium were found in the EDIP unit process database (1), except data for the amount of heat and electricity produced in the process. These were calculated based on energy production in Danish waste incineration plants in 1992 (3). The incineration plants' own energy consumption was subtracted from the production, to yield the energy exported from the plant. The (lower) heat value of aluminium was 30.9 MJ/kg, calculated from the heat produced in the formation of Al_2O_3. (During incineration of aluminium, the aluminium oxidises to Al_2O_3, hereby releasing energy (4)). For further details, see Technical report 7.

Energy production:
The heat produced in waste incineration is 23.7 MJ/kg waste and the electricity produced is 1.20 MJ/kg waste (3).

The outflow energy from this process is not a massflow, despite what is indicated above. Instead it is an energy flow, measured in MJ.

"Mass change factor":
The mass change factor in the LCAiT software is generally defined as the total outflow [kg]/total inflow [kg]. Since the outflow from this

--- To be continued ---

process is energy, the "mass change factor" is in this case the energy outflow[MJ]/the waste inflow [kg] = 24.9 MJ produced energy/kg waste.

References and comments:
(1) Frees N and Pedersen M A (1996): EDIP unit database.
(2) Used for fluegas cleaning.
(3) SK energi (1994): Opgørelse af affaldsressourcer i Danmark. Elsam/Elkraft. Styregruppe 4 for biomasse.
(4) Tillman A-M, Bauman H, Eriksson E, Rydberg T (1991: Packaging and the Environment. Life-cycle analyses of selected packaging materials. Quantification of environmental loadings. Chalmers Industriteknik (CIT). Göteborg, Sweden.

Process Card: 64. PE incineration

Inflows	**Percent**	**Massflow [kg]**	
PE-waste		1.267	
Outflows			
Energy, PE		43.403	

Emissions, waste and resources	**[g]**		**Reference**
Ca(OH)2 (in)	17.600		(1)(2) Non-elementary inflow
Water (r)	243.000		(1)(2)
CO2	3.07e+003		(1) Air
CO	10.000		(1)
NOx	1.200		(1)
Dioxin	1.00e-008		(1)
H2O	1.26e+003		(1)
Water to WWTP	243.000		(1) Water
Waste, slags & ashes	20.000		(1) Waste
Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	0.180	Ex	(1)

The sum of input flow(s) (1.267 kg) is used to calculate emissions and energies
Mass change factor 34.250

Notes
Incineration of PE used in ligature, foil and hi-cones.
PE includes both HDPE and LDPE since the processes for these plastics during incineration are the same. Data used for PE were found in the EDIP unit process database (1), except data for the amount of heat and electricity produced in the process. These were calculated based on energy production in Danish waste incineration plants in 1992 (3). The incineration plants' own energy consumption was subtracted from the production, to yield the energy exported from the plant. The (lower) heat value used for PE was 43.3 MJ/kg (3). For further details, see Technica report 7.

Energy production:
The heat produced in waste incineration is 32.6 MJ/kg waste and the electricity produced is 1.65 MJ/kg waste (3).

The outflow of energy from this process is not a mass flow, despite what is indicated above. Instead it is an energy flow, measured in MJ.

"Mass change factor":
The mass change factor in the LCAiT software is generally defined as the total outflow [kg]/total inflow [kg]. Since the outflow from this process is energy, the "mass change factor" is in this case the energy outflow[MJ]/the waste inflow [kg] = 34.25 MJ produced energy/kg waste.

References and comments:
(1) Frees N and Pedersen M A (1996): EDIP unit database.
(2) Used for flue gas cleaning.
(3) SK energi (1994): Opgørelse af affaldsressourcer i Danmark. Elsam/Elkraft. Styregruppe 4 for biomasse.

Process Card: 65. Cardboard/corrugated board incin.

Inflows	**Percent**	**Massflow [kg]**	
CB waste		14.531	
Outflows			
Energy, CB		172.478	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of input flow(s) (14.531 kg) is used to calculate emissions and energies
Mass change factor 11.870

Notes
Incineration of cardboard and corrugated board (CB) used in secondary packaging.

For further details, se process 19.

Process Card: 66. Energy use

Inflows	**Percent**	**Massflow [kg]**
Energy, aluminium		108.934
Energy, PE		43.403
Energy, CB		172.478
Alternetive energy	50.000 %	324.815

--- To be continued ---

Energy carrier	[MJ]	E Factor	Reference

The sum of output flow(s) (649.629 kg) is used to calculate emissions and energies

Notes
Identical to process 41.

Process Card: 67. Alt. energy production

Outflows	Percent	Massflow [kg]
Alternetive energy		324.815

Energy carrier	[MJ]	E Factor	Reference

The sum of output flow(s) (324.815 kg) is used to calculate emissions and energies

Notes
Identical to process 42.

50 cl Aluminium can

File: 50CL-AL.LCA **Printed:** Fri 98-05-29 10:03

For general comments, see Annex A.

Process Card: 68. Methyl acrylate (Data Base)

Outflows	**Percent**	**Massflow [kg]**	
Overvarnish		0.918	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (0.918 kg) is used to calculate emissions and energies

Notes

Identical to the 33 cl aluminium can system, see Annex A.

Transport Card: 69. Trp

Inflows	**Percent**	**Massflow [kg]**	
Overvarnish		0.918	
Outflows			
Overvarnish		0.918	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (0.918 kg) is used to calculate emissions and energies

Notes

Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 70. Epoxy resins

Outflows	**Percent**	**Massflow [kg]**	
Inside coatings		2.202	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (2.202 kg) is used to calculate emissions and energies

Notes

Identical to the 33 cl aluminium can system, see Annex A.

Transport Card: 71. Trp

Inflows	**Percent**	**Massflow [kg]**	
Inside coatings		2.202	
Outflows			
Inside coatings		2.202	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (2.202 kg) is used to calculate emissions and energies

Notes

Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 1. Bauxite mining - Alumina production

Outflows	**Percent**	**Massflow [kg]**	
Alumina, Al2O3		4.795	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (4.795 kg) is used to calculate emissions and energies

Notes

Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 2. Trp

Inflows	**Percent**	**Massflow [kg]**	
Alumina, Al2O3		4.795	
Outflows			
Alumina, Al2O3		4.795	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (4.795 kg) is used to calculate emissions and energies

Notes

Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 3. Electrolysis (prebake)

Inflows	**Percent**	**Massflow [kg]**
Alumina, Al2O3		4.795

--- To be continued ---

Outflows

Aluminium (l)		4.795	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (4.795 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 4. Trp

Inflows	**Percent**	**Massflow [kg]**	
Aluminium (l)		4.795	
Outflows			
Aluminium (l)		4.795	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (4.795 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 5. Cast house

Inflows	**Percent**	**Massflow [kg]**	
Aluminium (l)		4.795	
Manganese	1.500 %	7.30e-002	
Outflows			
Al rolling ingots		4.868	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (4.868 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 6. Manganese production

Outflows	**Percent**	**Massflow [kg]**	
Manganese		7.30e-002	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (7.30e-002 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Transport Card: 7. Trp

Inflows	**Percent**	**Massflow [kg]**	
Al rolling ingots		4.868	
Outflows			
Al rolling ingots		4.868	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (4.868 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 8. Strip rolling

Inflows	**Percent**	**Massflow [kg]**	
Al rolling ingots		4.868	
Remelted aluminium		37.345	
Outflows			
Scraps, strip roll.	0.990 %	0.416	
Rolled Al. sheets		41.586	
Emissions, waste and resources	**[g]**		**Reference**
VOC	0.376		(1) Air
COD (aq)	2.77e-002		(1) Water
Waste, non hazardous	1.416		(1) Waste
Waste, hazardous	2.644		(1)
Waste, oil	4.248		(1)
Water (r)	138.614		(1) Resource

--- To be continued ---

Salt (r)	0.168		(1)
Limestone (r)	1.228		(1)
Oil (in)	5.050		(1) Non-elementary inflow
Chlorine (in)	0.208		(1)
Argon (in)	0.347		(1)
Packaging (in)	32.970		(1)
Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	3.108	Ex	(1)
Natural gas (>100 kW)	2.544	FU/Ex	(1)(2)

The sum of output flow(s) (42.002 kg) is used to calculate emissions and energies
Mass change factor 0.995

Notes
Strip rolling of aluminium ingots.

Material balance per can:
Material inputs:
- Aluminium rolling ingots from primary aluminium: 2.4267 g.
- Aluminium rolling ingots from secondary aluminium: 18.5904 g.

Total input: 21.0171 g.
Outputs:
- Rolled aluminium sheets: 20.705 g.
- Process scraps from strip rolling: 0.20705 g.

Total outputs: 20.91205 g.
Mass change factor (out/in): 0.995.

Energy data:
The production of natural gas and electricity is not included in the data from reference 1. Therefore the emission factors (extraction/Ex) from the database have been used.

Emissions:
The emissions associated with the combustion of natural gas are not included. Therefore the emission factors (final use/FU) from the database have been used.

Data-gaps:
The production of chemicals, additives etc. are not included in the data from reference 1. These materials have therefore been accounted for as inflows not traced back to the cradle (non-elementary inflows to the system). The landfill disposal of waste is not included in the LCA. Hence, the waste flows are non-elementary outflows.

References:
(1) Bernard de Gélas, European Aluminium Association.
(2) A furnace size larger than 100 kW has been assumed.

Data were entered by Anna Ryberg, CIT.

Transport Card: 9. Trp

Inflows	**Percent**	**Massflow [kg]**	
Scraps, strip roll.		0.416	
Outflows			
Scraps, strip roll.		0.416	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (0.416 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Transport Card: 10. Trp

Inflows	**Percent**	**Massflow [kg]**	
Rolled Al. sheets		41.586	
Outflows			
Rolled Al. sheets		41.586	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (41.586 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 11. Can production

Inflows	**Percent**	**Massflow [kg]**
Rolled Al. sheets		41.586
Layer pads, CB	2.197 %	1.004

--- To be continued ---

50 cl Aluminium can

File: 50CL-AL.LCA **Printed:** Fri 98-05-29 10:03

Inside coatings	4.818 %	2.202	
Overvarnish	2.008 %	0.918	
Outflows			
Scraps, can prod.	16.765 %	7.686	
Cans+ layer pads.		38.161	

Emissions, waste and resources	[g]	Reference
CO2	135.837	(1) Air
CO	0.438	(1)
NOx	0.175	(1)
Butanol	0.460	(1)
Butylglycole	0.600	(1)
Amylaclohol	0.114	(1)
Xylene	1.32e-002	(1)
Butydiglycole	1.75e-002	(1)
COD (aq)	3.024	(1) Water
BOD (aq)	0.526	(1)
Oil (aq)	0.132	(1)
Suspended solids (aq)	0.482	(1)
Totally extractible (aq)	1.139	(1)
Waste, oil	2.410	(1) Waste
Waste, solvent	0.920	(1)
Waste, ink	4.38e-002	(1)
Waste, sludge	10.473	(1)
Waste, combustible	8.807	(1)
Waste, wood	9.290	(1)
Waste	2.235	(1)
Oil (in)	4.645	(1) Non-elementary inflow
Washing chemicals (in)	8.326	(1)
Finish (in)	1.643	(1)
Polyester for strips (in)	2.936	(1)
SO2	1.20e-003	(2) Air
CH4	4.92e-003	(2)
Propane	4.92e-004	(2)
Butane	1.72e-003	(2)
Pentane	2.95e-003	(2)
PAH	2.46e-005	(2)
Benzene	9.84e-004	(2)
Toluene	4.92e-004	(2)
Benzo(a)pyrene	2.46e-008	(2)
Formaldehyde	2.46e-004	(2)
Acetaldehyde	2.46e-006	(2)
N2O	2.46e-004	(2)
Particulates	4.92e-004	(2)
Hg	1.35e-007	(2)
Printing ink (in)	2.761	(1)
Fluoride (aq)	0.482	(1) Water

Energy carrier	[MJ]	E Factor	Reference
Electricity, coal marginal	4.067	Ex	(1)
Natural gas (>100 kW)	2.461	Ex	(1)

The sum of output flow(s) (45.848 kg) is used to calculate emissions and energies
Mass change factor 1.003

Notes
Production of 50 cl aluminium can.

Material balance per can:
Inputs:
- Rolled aluminium sheets: 20.705 g (1).
- Layer pads, corrugated board: 0.5 g (1).
- Over varnish: 0.457 g (1).
- Inside coatings: 1.0965 g (1) *

Total input: 18.0905 g.
Outputs
- Scraps, can production: 3.177 g (1).
- Can and layer pads: 14.4505 + 0.5 = 14.9505 g (1).

Total outputs: 18.1275 g.

Mass change factor (out/in): 18.1275/18.0905 = 1.002.

Energy data:
The production of natural gas and electricity is not included in the data from reference 1. Therefore the emission factors (extraction/Ex) from database are used.

--- To be continued ---

Emissions.
The emissions of CO2, CO and NOx arise from the combustion of natural gas.
As a complement to the air emissions in reference 1, emissions from the combustion of natural gas have been calculated using emission factors from the database and inserted manually in the process card.

Data-gaps:
The production of chemicals, additives etc. are not included in the data from reference 1. These materials have therefore been accounted for as non-elementary inflows. The landfill disposal of waste from the process is not included in the LCA.

Reference and comments:
(1) Göte Nylin, PLM Beverage Can Division AB, Malmö.
(2) Calculated from the emission factors (final use) for natural gas (as a complement to the air emissions from reference 1.

* The amount of inside coatings is higher in the soft drink cans than in the beer cans. In this study, we have used the average amount of inside coatin

Data were entered by Anna Ryberg, CIT.

Process Card: 12. Corrugated board (Database)

Inflows	**Percent**	**Massflow [kg]**	
Recycled fibres		9.815	
Outflows			
Corrugated board		1.004	
Corrugated board		3.187	
Corrugated board		5.624	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (9.815 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 13. Use of recycled fibres (Database)

Outflows	**Percent**	**Massflow [kg]**	
Recycled fibres		9.815	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (9.815 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Transport Card: 14. Trp

Inflows	**Percent**	**Massflow [kg]**	
Corrugated board		1.004	
Outflows			
Corrugated board		1.004	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (1.004 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Transport Card: 15. Trp

Inflows	**Percent**	**Massflow [kg]**	
Scraps, can prod.		7.686	
Outflows			
Scraps, can prod.		7.686	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (7.686 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Transport Card: 16. Trp

Inflows	**Percent**	**Massflow [kg]**	
Cans+ layer pads		38.161	
Outflows			
Cans+ layer pads		38.161	
Modes of conveyance	**[km]**		**Reference**

--- To be continued ---

The sum of output flow(s) (38.161 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 17. Washing & filling

Inflows	Percent	Massflow [kg]	
Cans+ layer pads		38.161	
Outflows			
80% of layer pads	7.70e-002 %	0.803	
Can + beverage		1.04e+003	
Emissions, waste and resources	**[g]**		**Reference**
Water (r)	43.265		
Layer pads, CB (out)	0.193		Non-elementary outflow
Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	7.32e-003	Ex	
Natural gas (>100 kW)	5.11e-002	FU/Ex	

The sum of output flow(s) (1.04e+003 kg) is used to calculate emissions and energies
Mass change factor 27.317

Notes
Washing and filling of 50 cl aluminium cans for beer and soft drinks in the brewery (1).

20% of the corrugated board spacer is assumed to be recycled into other materials (5). We do not expand system boundaries to deal with this recycling, since the outflow is less than 1% of the primary packaging. Instead, the outflow of corrugated board to recycling is a non-elementary outflow from the system. This has little effect on the total LCA results. The system has other, larger outflows of board to recycling, and there the system is expanded.

The amount of heat (provided by the data supplier) has been recalculated into primary fuel assuming an efficiency of 80 % (2). The fuel used is natural gas according to the supplier, but no information about the furnace size was provided. A furnace size larger than 100 kW has been assum

Material balance per can:
Inflows:
- Can + layer pads (corrugated board): 18.9955 g (3).

Outflows:
- Can + beverage: 18.4955 + 500 = 518.4955 g (4).
- 80% of layer pads (CB) to incineration = 0.4 g (5).
Total outflows: 518.8955 g.

Mass change factor (out/in):518.8955/18.9955 = 27.3168.

Data gaps:
Pasteurisation of beer and soft drink is associated with the beverage. Thus energy use associated with the pasteurisation procedure is not included. Cleaning agents are used in quite small amounts and have not been accounted for. Aquatic emissions of e.g. COD, BOD, N and P are subject to efficient cleaning procedures in municipal waste water treatment plants and emissions to the environment are assumed to be negligibl Energy use at the waste water treatment plant is estimated to be only a few percent of the total energy use for tapping. The fate of organic cleaning agents in municipal waste water treatment plants as well as their eventual impact in the environment have not been quantified due to lack of data, and potential environmental impacts are unknown.

References and comments:
(1) The brewery (confidential).
(2) O'Callaghan, P. (1993): Energy management. A comprehensive guide to reducing costs by efficient energy use. McGraw-Hill Book Company. London. United Kingdom.
(3) Göte Nylin, PLM Beverage Can Division, Malmö, Sweden.
(4) The amount of beverage is 33 cl, which corresponds to 330 g.
(5) Bryggeriforeningen via Jan Jacobsen, Logisys, 1997.

Transport Card: 18. Trp

Inflows	Percent	Massflow [kg]	
80% of layer pads		0.803	
Outflows			
80% of layer pads		0.803	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (0.803 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 19. Corrugated board incin.

--- To be continued ---

Inflows	Percent	Massflow [kg]	
80% of layer pads		0.803	
Outflows			
Energy, CB		0.803	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (0.803 kg) is used to calculate emissions and energies

Notes

Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 20. Packaging

Inflows	Percent	Massflow [kg]	
Can + beverage		1.04e+003	
Return		57.354	
5% of pallets	0.107 %	1.193	
Seckondary packagin	1.295 %	14.434	
Outflows			
90% of can (recyc.)	3.000 %	33.439	
5% of pallet	0.107 %	1.193	
Beverage distrib.		1.08e+003	
Emissions, waste and resources	**[g]**		**Reference**
Plastic ligature (in)	1.46e-002		Non-elementary inflow
Glue (in)	3.75e-002		
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (1.11e+003 kg) is used to calculate emissions and energies

Notes

Packaging of the beverage cans in the brewery.

The environmental impact of the actual packaging process is not included in the LCA. It is likely to be negligible.

When packing the corrugated board boxes on the pallet, LDPE ligature or glue is used for holding the boxes together. On 75% of the pallets, 20 g of ligature is used (1). This means the amount of ligature is: 20/1848*0.75=0.0081 g/can or 0.0146 g/kg outflow.

Glue is used on 25% of the pallets. Our data indicate that the amount of glue is 2 g (1), but we assume that this amount is used for each box. This means the amount of glue is 0.25*2/24=0.0208 g/can or 0.0375 g/kg outflow.

The glue and ligature are non-elementary inflows, i.e. they are not followed from the cradle.

Material balance per can:
Inflows:
- Can + beverage: 518.4955 g.
- Secondary packaging: 7.1875 g.
- 5% of pallet (The pallet is reused in 95% of the cases, why it only needs to be replaced in 5% of the cases. Each life cycle should therefore hold 5% of the environmental loadings caused by the pallet): 0.5952 g.
- Return: 90% of the (used) cans for recycling, pallet (distribution flow): 28.5507 g.

Total inflows: 554.8289 g.

Outflows:
- Beverage distribution: Can + beverage, secondary packaging, pallet (distribution flow), plastic ligature and glue: 537.6167 g.
- 5% of the pallet to waste incineration: 0.5952 g.
- 90% of the can for recycling: 16.6459 g.

Total outflows: 554.8578 g.

Mass change factor (out/in):= 1.000.

Reference: Bryggeriforeningen via Jan Jacobsen, Logisys, 1997.

Process Card: 21. Secondary packaging

Inflows	Percent	Massflow [kg]	
Tray, CB		5.624	
CB box (24 cans)	22.079 %	3.187	
Foil, LDPE	4.286 %	0.619	
Hi-cone, LDPE	2.208 %	0.319	
CB box (6 cans)	32.464 %	4.686	
Outflows			
Secondary packaging		14.434	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (14.434 kg) is used to calculate emissions and energies

--- To be continued ---

50 cl Aluminium can

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Notes
21. Secondary packaging
Secondary packaging:
- Tray, corrugated board (24 cans): 120/24*0.5 = 2.5 g/can.
- Cardboard box (6 cans): 60/6*0.25 = 2.5 g/can.
- Foil for cardboard, LDPE (24 cans): 20/24*0.33 = 0.275 g/can.
- Corrugated board box (24 cans): 200/24*0.17 = 250/24*0.17 = 1.7708 g/can.
- Hi-cone, LDPE (6 cans): 3.4/6*0.25 = 0.1417 g/can.
Total, secondary packaging: 7.1875 g/can.

Reference: Bryggeriforeningen via Jan Jacobsen, Logisys, 1997.

Transport Card: 22. Trp

Inflows	Percent	Massflow [kg]
Secondary packaging		14.434

Outflows		
Secondary packaging		14.434

Modes of conveyance	[km]	Reference

The sum of output flow(s) (14.434 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Transport Card: 23. Trp

Inflows	Percent	Massflow [kg]
Corrugated board		3.187

Outflows		
Corrugated board		3.187

Modes of conveyance	[km]	Reference

The sum of output flow(s) (3.187 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 24. Box

Inflows	Percent	Massflow [kg]
Corrugated board		3.187

Outflows		
CB box (24 cans)		3.187

Energy carrier	[MJ]	E Factor	Reference

The sum of output flow(s) (3.187 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Transport Card: 25. Trp

Inflows	Percent	Massflow [kg]
Corrugated board		5.624

Outflows		
Corrugated board		5.624

Modes of conveyance	[km]	Reference

The sum of output flow(s) (5.624 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 26. Tray

Inflows	Percent	Massflow [kg]
Corrugated board		5.624

Outflows		
Tray, CB		5.624

Energy carrier	[MJ]	E Factor	Reference

The sum of output flow(s) (5.624 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

--- To be continued ---

Process Card: 27. Cardboard (Database)

Outflows	Percent	Massflow [kg]	
Cardboard		4.686	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (4.686 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Transport Card: 28. Trp

Inflows	Percent	Massflow [kg]	
Cardboard		4.686	
Outflows			
Cardboard		4.686	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (4.686 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 29. Cardboard box

Inflows	Percent	Massflow [kg]	
Cardboard		4.686	
Outflows			
CB box (6 cans)		4.686	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (4.686 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 30. LDPE

Outflows	Percent	Massflow [kg]	
LDPE		0.319	
LDPE		0.619	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (0.937 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Transport Card: 31. Trp

Inflows	Percent	Massflow [kg]	
LDPE		0.619	
Outflows			
LDPE		0.619	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (0.619 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 32. Foil

Inflows	Percent	Massflow [kg]	
LDPE		0.619	
Outflows			
Foil, LDPE		0.619	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (0.619 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Transport Card: 33. Trp

--- To be continued ---

Inflows	Percent	Massflow [kg]	
LDPE		0.319	
Outflows			
LDPE		0.319	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (0.319 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 34. Hi-cone

Inflows	Percent	Massflow [kg]	
LDPE		0.319	
Outflows			
Hi-cone, LDPE		0.319	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (0.319 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 35. Planks for pallets

Outflows	Percent	Massflow [kg]	
Planks		1.193	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (1.193 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Transport Card: 36. Trp

Inflows	Percent	Massflow [kg]	
Planks		1.193	
Outflows			
Planks		1.193	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (1.193 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 37. Pallet

Inflows	Percent	Massflow [kg]	
Planks		1.193	
Outflows			
5% of pallets		1.193	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (1.193 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Transport Card: 38. Trp

Inflows	Percent	Massflow [kg]	
5% of pallets		1.193	
Outflows			
5% of pallets		1.193	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (1.193 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Transport Card: 39. Trp

Inflows	Percent	Massflow [kg]

--- To be continued ---

5% of pallet		1.193	
Outflows			
5% of pallet		1.193	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (1.193 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 40. Wood incineration

Inflows	**Percent**	**Massflow [kg]**	
5% of pallet		1.193	
Outflows			
Energy, wood		1.193	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (1.193 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 41. Energy use

Inflows	**Percent**	**Massflow [kg]**	
Alternative energy	50.000 %	1.995	
Energy, wood		1.193	
Energy, CB		0.803	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (3.991 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 42. Alt. energy production

Outflows	**Percent**	**Massflow [kg]**	
Alternative energy		1.995	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (1.995 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Transport Card: 43. Trp

Inflows	**Percent**	**Massflow [kg]**	
90% of can (recyc.)		33.439	
Outflows			
90% of can (recyc.)		33.439	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (33.439 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 44. Remelting

Inflows	**Percent**	**Massflow [kg]**	
Scraps, strip roll.		0.416	
90% of can (recyc.)		33.439	
Scraps, can prod.		7.686	
Outflows			
Remelted aluminium		37.345	
Emissions, waste and resources	**[g]**		**Reference**
Particulates	1.61e-002		(1) Air
HCl	5.01e-003		(1)
HF	4.40e-004		(1)
SO2	5.45e-003		(1)
NOx	0.191		(1)
Al (aq)	9.42e-003		(1) Water
Oil (aq)	4.19e-003		(1)

--- To be continued ---

Suspended solids (aq)	8.18e-002		(1)
Waste, non hazardous	18.902		(1) Waste
Waste, ashes	111.807		(1)
CO2	42.913		(2) Air
CO	2.64e-002		(2)
NH3	6.60e-006		(2)
NMVOC, natural gas combustion	2.31e-003		(2)
CH4	9.90e-004		(2)
N2O	1.98e-003		(2)

Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	4.264	Ex	(1)
LPG, thermal	0.660	Ex	(1)

The sum of output flow(s) (37.345 kg) is used to calculate emissions and energies
Mass change factor 0.899

Notes

Remelting of used aluminium cans and of process scraps from strip rolling and can production.

Material balance per can :
-Material inputs:
Process scraps from strip rolling: 0.20705 g.
Process scraps from can production: 3.826 g.
90% of used aluminium cans for recycling: 16.6459 g.
- Total input: 20.67895 g.
- Total output: 18.5904 g rolling ingots.
- Mass change factor (out/in):18.5904/20.67895 = 0.899.

Energy data:
The production of liquefied petroleum gas (LPG) and electricity is not included in the data from reference 1. Therefore the emission factors (extraction/Ex) from the database are used.

Emissions:
Specific emissions for particulates, HCl, HF, SO2 and NOx have been received by reference 1.
As a complement to the air emissions in reference 1, emissions from the combustion of thermal LPG have been calculated (and inserted manually) using emission factors from the database.

Data-gaps:
The landfill disposal of waste is not included.

References:
(1) Confidential.
(2) Calculated from the emission factors for LPG, thermal (as a complement to the air emissions in reference 1.

Data were entered by Anna Ryberg, CIT.

Transport Card: 45. Trp

Inflows	**Percent**	**Massflow [kg]**	
Remelted aluminium		37.345	
Outflows			
Remelted aluminium		37.345	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (37.345 kg) is used to calculate emissions and energies

Notes

Identical to the 33 cl aluminium can system, see Annex A.

Transport Card: 46. Trp. - Distribution

Inflows	**Percent**	**Massflow [kg]**	
Beverage distrib.		1.08e+003	
Outflows			
Beverage distrib.		1.08e+003	
Modes of conveyance	**[km]**		**Reference**
Distr, heavy (highway, 50%)(Scan)	56.700		(1)
Distr, heavy (rural, 50%)(Scan)	45.360		(1)
Distr, heavy (urban, 50%)(Scan)	11.340		(1)
Distr, medium (highway, 50%)	14.400		(1)
Distr, medium (rural, 50%)	14.400		(1)
Distr, medium (urban, 50%)	19.200		(1)
Distr, medium (highway, 50%)	0.792		(1)
Distr, medium (rural, 50%)	2.376		(1)
Distr, medium (urban, 50%)	4.752		(1)

--- To be continued ---

Calculated for a reference flow of 1.08e+003 [kg] which corresponds to distr. of 1000 l.
The sum of output flow(s) (1.08e+003 kg) is used to calculate emissions and energies

Notes
Reference:
(1) Bryggeriforeningen via Jan Jacobsen, Logisys, 1997.

Transport Card: 47. Trp

Inflows	**Percent**	**Massflow [kg]**	
Return		57.354	
Outflows			
Return		57.354	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (57.354 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 48. Retailer

Inflows	**Percent**	**Massflow [kg]**	
Beverage distrib.		1.08e+003	
90% of can (recyc.)		33.445	
Outflows			
Return	5.151 %	57.354	
CB recycling (tray)	9.00e-002 %	1.002	
Bever. to consumer		1.06e+003	
Emissions, waste and resources	**[g]**		**Reference**
Plastic ligature (out)	1.03e-002		(1) Non-elementary outflow
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (1.11e+003 kg) is used to calculate emissions and energies

Notes
Retailer

The choice of packaging is assumed to have negligible effect on the environmental impacts of the retailer.

70% of the plastic ligature (0.0057 g/can or 0.0103 g/kg outflow) is assumed to be recycled to be used in other products (1). We do not expand system boundaries to deal with this recycling, since the outflow is less than 1% of the primary packaging. Instead, the outflow of plastic ligature to recycling is a non-elementary outflow from the system

Material balance per can:
Inflows:
- Beverage distribution: Can + beverage, secondary packaging, pallet (distribution flow), plastic ligature and glue: 537.6167 g.
- 90% of the can for recycling: 16.6459 g.

Total inflows: 554.2626 g.

Outflows:
- To consumer: Can + beverage, cardboard box, foil for cardboard, corrugated board box, hi-cone, 80% of tray to waste incineration, 30% of plastic ligature to waste incineration and glue: 525.2062 g.
- Return: 90% of the can for recycling, pallet (distribution flow): 28.5507 g.
- CB recycling: 20% of tray for recycling: 0.5 g.

Total outflows: 554.2569 g.

Mass change factor = 1.000.

Reference:
(1) Bryggeriforeningen via Jan Jacobsen, Logisys, 1997.

Transport Card: 49. Trp

Inflows	**Percent**	**Massflow [kg]**	
CB recycling (tray)		1.002	
Outflows			
CB recycling (tray)		1.002	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (1.002 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

--- To be continued ---

Transport Card: 50. Trp

Inflows	**Percent**	**Massflow [kg]**	
Bever. to consumer		1.06e+003	
Outflows			
Bever. to consumer		1.06e+003	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (1.06e+003 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Transport Card: 51. Trp

Inflows	**Percent**	**Massflow [kg]**	
90% of can (recyc.)		33.445	
Outflows			
90% of can (recyc.)		33.445	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (33.445 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 52. Use (refrigeration)

Inflows	**Percent**	**Massflow [kg]**	
Bever. to consumer		1.06e+003	
Outflows			
90% of can (recyc.)		33.445	
CB recyc. (box 24)	1.405 %	0.712	
CB recyc. (box 6)	1.984 %	1.005	
Waste	30.572 %	15.483	
Energy carrier	**[MJ]**	**E Factor**	**Reference**
Electricity, coal marginal	3.00e-002	Ex	(1) (2)

The sum of output flow(s) (50.644 kg) is used to calculate emissions and energies
Mass change factor 4.80e-002

Notes
The aluminium can is cooled from 20 to 5 degrees Celcius. The heat capacitivity of aluminium is 0.0009 MJ/(kg*degree Celcius) (1), which gives an energy demand of 0.0135 MJ/kg aluminium. An efficiency of 33% for the refrigerator has been used (2), which gives a total energy demand of 0.0409 MJ/kg aluminium. The amount of aluminium in the outflow is 18.4955 g/can. The total outflow is (see below) 25.2062 g/can which gives 18.4955/25.2062 = 0.7338 kg aluminium/kg outflow. This means that the energy demand becomes 0.0409*0.7338 = 0.030 MJ/kg c

Material balance per can:

Inflows:
- To consumer: Can + beverage, cardboard box, foil for cardboard, corrugated board box, hi-cone, 80% of tray to waste incineration, 30% of plastic ligature to waste incineration, glue: 525.2062 g/can.

Outflows:
- Waste: 10% of can to waste incineration, 80% of cardboard box to waste incineration, foil for cardboard (to waste incineration), 80% of corrugated board box to waste incineration, 80% of tray to waste incineration, 30% of plastic ligature to waste incineration, hi-cone (to waste incineration) and glue (to waste water treatment plant): 7.7061 g.
- 90% of can for recycling: 16.6459 g.
- CB recycling: 20% of corrugated board box for recycling: 0.3542 g.
- Cardboard recycling: 20% of cardboard box for recycling. 0.50 g.

Total outflows: 25.2062 g.

Mass change factor (out/in): 25.2062/525.2062 = 0.048.

References:
(1) Nordling Carl, Österman Jonny, Physics handbook.
(2) Pommer K., Wesn's M.S., Madsen C., Miljím'ssig kortl'gning af emballager til fl og l'skedrikke, Delrapport 6: Engangsflasker af PET, Arbefjdsrapport fra Miljístyrelsen Nr. 75 1995.

Transport Card: 53. Trp

Inflows	**Percent**	**Massflow [kg]**
CB recyc. (box 24)		0.712
Outflows		
CB recyc. (box 24)		0.712

--- To be continued ---

Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (0.712 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Transport Card: 54. Trp

Inflows	**Percent**	**Massflow [kg]**
CB recyc. (box 6)		1.005
Outflows		
CB recyc. (box 6)		1.005

Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (1.005 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 55. Testliner

Inflows	**Percent**	**Massflow [kg]**
CB recyc. (box 6)		1.005
CB recyc. (box 24)		0.712
CB recycling (tray)		1.002
Outflows		
Testliner		2.718

Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (2.718 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 56. New product

Inflows	**Percent**	**Massflow [kg]**
Avoided kraftliner	40.000 %	2.175
Avoided testliner	10.000 %	0.544
Testliner		2.718

Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (5.437 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 57. Avoided kraftliner (Database)

Outflows	**Percent**	**Massflow [kg]**
Avoided kraftliner		2.175

Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (2.175 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 58. Avoided testliner

Inflows	**Percent**	**Massflow [kg]**
Avoided testliner		0.544
Outflows		
Avoided testliner		0.544

Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (0.544 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 59. Other products

Outflows	**Percent**	**Massflow [kg]**
Fibres to landfill	50.000 %	0.544
Fibres to recycling		0.544

Energy carrier	**[MJ]**	**E Factor**	**Reference**

--- To be continued ---

The sum of output flow(s) (1.087 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 60. Landfill-corrugated board

Inflows	Percent	Massflow [kg]	
Fibres to landfill		0.544	
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (0.544 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Transport Card: 61. Trp

Inflows	Percent	Massflow [kg]	
Waste		15.483	
Outflows			
Waste		15.483	
Modes of conveyance	**[km]**		**Reference**

The sum of output flow(s) (15.483 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 62. Waste management

Inflows	Percent	Massflow [kg]	
Waste		15.483	
Outflows			
CB waste		10.880	
PE-waste	5.453 %	0.842	
Aluminium waste	24.067 %	3.715	
Emissions, waste and resources	**[g]**		**Reference**
Glue (out)	2.706		Non-elementary outflow
Energy carrier	**[MJ]**	**E Factor**	**Reference**

The sum of output flow(s) (15.437 kg) is used to calculate emissions and energies
Mass change factor 0.997

Notes
Waste management.

This process is only used in order to distribute the different waste flows.

The marginal waste management in Denmark is assumed to be waste incineration with energy recovery (see Main report).

The waste flow of glue has not been followed to the grave. Instead, this flow has been accounted for as a non-elementary outflow from the system. The amount of glue is 0.0208 g/can or 3.121 g/kg outflow.

Material balance per can:

Inflow:
- Waste: 10% of can to waste incineration, 80% of cardboard box to waste incineration, foil for cardboard (to waste incineration), 80% of corrugated board box to waste incineration, 80% of tray to waste incineration, 30% of plastic ligature to waste incineration, hi-cone (to waste incineration) and glue (to waste water treatment plant): 7.7061 g.

Outflows:
- CB waste: 80% of cardboard box, 80% of tray, 80% of corrugated board box: 5.4166 g.
- Aluminium waste: 10% of the aluminium can: 1.8496 g.
- PE waste: 30% of plastic ligature, foil for cardboard, hi-cone: 0.4191 g.

Total outflows: 7.6853 g.

Mass change factor (out/in) = 0.997.

Process Card: 63. Aluminium incineration

Inflows	Percent	Massflow [kg]
Aluminium waste		3.715
Outflows		
Energy, aluminium		3.715

--- To be continued ---

Energy carrier	[MJ]	E Factor	Reference

The sum of output flow(s) (3.715 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 64. PE incineration

Inflows	Percent	Massflow [kg]
PE-waste		0.842
Outflows		
Energy, PE		0.842

Energy carrier	[MJ]	E Factor	Reference

The sum of output flow(s) (0.842 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 65. Cardboard/corrugated board incin.

Inflows	Percent	Massflow [kg]
CB waste		10.880
Outflows		
Energy, CB		10.880

Energy carrier	[MJ]	E Factor	Reference

The sum of output flow(s) (10.880 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 66. Energy use

Inflows	Percent	Massflow [kg]
Energy, aluminium		3.715
Energy, PE		0.842
Energy, CB		10.880
Alternetive energy	50.000 %	15.437

Energy carrier	[MJ]	E Factor	Reference

The sum of output flow(s) (30.873 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

Process Card: 67. Alt. energy production

Outflows	Percent	Massflow [kg]
Alternetive energy		15.437

Energy carrier	[MJ]	E Factor	Reference

The sum of output flow(s) (15.437 kg) is used to calculate emissions and energies

Notes
Identical to the 33 cl aluminium can system, see Annex A.

C.1 Energy demand [per 1000 litres of beverage]: 33 cl aluminium cans

	68. Methyl acrylate (Data Base)	69. Trp	70. Epoxy resins	71. Trp
Electricity [MJ]	5,63E+00			
Electricity, coal marginal [MJ]			5,82E+01	
Hydro power [MJelectricity]	1,81E-01	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**5,81E+00**	**0,00E+00**	**5,82E+01**	**0,00E+00**
Coal [MJ]	4,26E-01			
Coal, feedstock [MJ]	1,50E-04			
Diesel, heavy & medium truck (highway) [MJ]		8,66E-01		6,94E-01
Diesel, heavy & medium truck (rural) [MJ]				
Diesel, heavy & medium truck (urban) [MJ]				
Diesel, ship (4-stroke) [MJ]		1,57E-02		7,83E-01
Fuel oil, ship (2-stroke) [MJ]				
Fuel, unspecified [MJ]	1,29E-08		1,12E-04	
Hard coal [MJ]	6,78E-02			
LPG, forklift [MJ]				
LPG, thermal [MJ]				
Natural gas (>100 kW) [MJ]	7,15E+00		2,03E+02	
Natural gas [MJ]	1,01E+01			
Natural gas, feedstock [MJ]	3,54E-01			
Oil [MJ]	2,40E+00			
Oil, feedstock [MJ]	1,58E+01			
Oil, heavy fuel [MJ]	3,68E+01		3,06E+01	
Oil, heavy, feedstock [MJ]			3,50E+01	
Oil, light fuel [MJ]				
Peat [MJ]				
Fossil fuel, total [MJ at final use]	**7,31E+01**	**8,82E-01**	**2,68E+02**	**1,48E+00**
Bark [MJ]				
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]				
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.1 Energy demand [per 1000 litres of beverage]: 33 cl aluminium cans

	1. Bauxite mining - Alumina production	2. Trp	3. Electrolysis (prebake)	4. Trp	5. Cast house
Electricity [MJ]					
Electricity, coal marginal [MJ]	1,31E+01			8,55E-02	3,25E+02
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**1,31E+01**	**0,00E+00**	**0,00E+00**	**8,55E-02**	**3,25E+02**
Coal [MJ]					
Coal, feedstock [MJ]					
Diesel, heavy & medium truck (highway) [MJ]		5,56E-01		6,94E-01	
Diesel, heavy & medium truck (rural) [MJ]					
Diesel, heavy & medium truck (urban) [MJ]					
Diesel, ship (4-stroke) [MJ]					
Fuel oil, ship (2-stroke) [MJ]		3,75E+01		1,18E+01	
Fuel, unspecified [MJ]	2,53E-05			1,65E-07	6,28E-04
Hard coal [MJ]					
LPG, forklift [MJ]					
LPG, thermal [MJ]					
Natural gas (>100 kW) [MJ]					
Natural gas [MJ]					
Natural gas, feedstock [MJ]					
Oil [MJ]					
Oil, feedstock [MJ]					
Oil, heavy fuel [MJ]					
Oil, heavy, feedstock [MJ]					
Oil, light fuel [MJ]					
Peat [MJ]					
Fossil fuel, total [MJ at final use]	**2,53E-05**	**3,81E+01**	**0,00E+00**	**1,25E+01**	**6,28E-04**
Bark [MJ]					
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]					
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.1 Energy demand [per 1000 litres of beverage]: 33 cl aluminium cans

	6. Manganese production	7. Trp	8. Strip rolling	9. Trp	10. Trp	11. Can production
Electricity [MJ]						
Electricity, coal marginal [MJ]	3,38E+00		1,57E+02			2,81E+02
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**3,38E+00**	**0,00E+00**	**1,57E+02**	**0,00E+00**	**0,00E+00**	**2,81E+02**
Coal [MJ]						
Coal, feedstock [MJ]						
Diesel, heavy & medium truck (highway) [MJ]		2,32E+00		4,19E-01	4,02E+01	
Diesel, heavy & medium truck (rural) [MJ]						
Diesel, heavy & medium truck (urban) [MJ]	9,06E-02					
Diesel, ship (4-stroke) [MJ]						
Fuel oil, ship (2-stroke) [MJ]		3,78E-02		2,25E-02	2,33E+00	
Fuel, unspecified [MJ]	6,53E-06		3,03E-04			5,42E-04
Hard coal [MJ]						
LPG, forklift [MJ]						
LPG, thermal [MJ]						
Natural gas (>100 kW) [MJ]			1,29E+02			1,70E+02
Natural gas [MJ]						
Natural gas, feedstock [MJ]						
Oil [MJ]						
Oil, feedstock [MJ]						
Oil, heavy fuel [MJ]						
Oil, heavy, feedstock [MJ]						
Oil, light fuel [MJ]						
Peat [MJ]						
Fossil fuel, total [MJ at final use]	**9,06E-02**	**2,36E+00**	**1,29E+02**	**4,42E-01**	**4,25E+01**	**1,70E+02**
Bark [MJ]						
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]	-3,38E+00					
Heat etc., total [MJ at final use]	**-3,38E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.1 Energy demand [per 1000 litres of beverage]: 33 cl aluminium cans

	12. Corrugated board (Database)	13. Use of recycled fibres (Database)	14. Trp	15. Trp
Electricity [MJ]				
Electricity, coal marginal [MJ]	2,00E+01	1,83E+01		
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**2,00E+01**	**1,83E+01**	**0,00E+00**	**0,00E+00**
Coal [MJ]				
Coal, feedstock [MJ]				
Diesel, heavy & medium truck (highway) [MJ]	2,30E+00	2,74E+00	5,58E-01	3,22E+00
Diesel, heavy & medium truck (rural) [MJ]		-6,48E-02		
Diesel, heavy & medium truck (urban) [MJ]	4,00E+00	5,63E+00		
Diesel, ship (4-stroke) [MJ]	5,07E+00	1,38E+01	1,29E-02	
Fuel oil, ship (2-stroke) [MJ]				
Fuel, unspecified [MJ]	3,89E-05	3,54E-05		
Hard coal [MJ]	1,58E+00			
LPG, forklift [MJ]	1,63E-01	-2,24E-01		
LPG, thermal [MJ]				
Natural gas (>100 kW) [MJ]	7,81E+01	-5,22E+01		
Natural gas [MJ]				
Natural gas, feedstock [MJ]				
Oil [MJ]				
Oil, feedstock [MJ]				
Oil, heavy fuel [MJ]	2,44E+01	1,52E+01		
Oil, heavy, feedstock [MJ]				
Oil, light fuel [MJ]	3,21E+00	7,03E-02		
Peat [MJ]	5,93E+00	8,22E-01		
Fossil fuel, total [MJ at final use]	**1,25E+02**	**-1,42E+01**	**5,71E-01**	**3,22E+00**
Bark [MJ]	3,69E+00	6,13E+00		
Renewable fuel, total [MJ at final use]	**3,69E+00**	**6,13E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]	-1,62E+00	-2,54E+00		
Heat etc., total [MJ at final use]	**-1,62E+00**	**-2,54E+00**	**0,00E+00**	**0,00E+00**

C.1 Energy demand [per 1000 litres of beverage]: 33 cl aluminium cans

	16. Trp	17. Washing & filling	18. Trp	19. Corrugated board incin.	20. Packaging
Electricity [MJ]					
Electricity, coal marginal [MJ]		7,59E+00		2,18E-01	
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**0,00E+00**	**7,59E+00**	**0,00E+00**	**2,18E-01**	**0,00E+00**
Coal [MJ]					
Coal, feedstock [MJ]					
Diesel, heavy & medium truck (highway) [MJ]					
Diesel, heavy & medium truck (rural) [MJ]	1,92E+01		5,13E-02		
Diesel, heavy & medium truck (urban) [MJ]					
Diesel, ship (4-stroke) [MJ]	3,85E-01				
Fuel oil, ship (2-stroke) [MJ]					
Fuel, unspecified [MJ]		1,46E-05		4,21E-07	
Hard coal [MJ]					
LPG, forklift [MJ]					
LPG, thermal [MJ]					
Natural gas (>100 kW) [MJ]		5,29E+01			
Natural gas [MJ]					
Natural gas, feedstock [MJ]					
Oil [MJ]					
Oil, feedstock [MJ]					
Oil, heavy fuel [MJ]					
Oil, heavy, feedstock [MJ]					
Oil, light fuel [MJ]					
Peat [MJ]					
Fossil fuel, total [MJ at final use]	**1,96E+01**	**5,29E+01**	**5,13E-02**	**4,21E-07**	**0,00E+00**
Bark [MJ]					
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]					
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.1 Energy demand [per 1000 litres of beverage]: 33 cl aluminium cans

	21. Secondary packaging	22. Trp	23. Trp	24. Box	25. Trp	26. Tray
Electricity [MJ]						
Electricity, coal marginal [MJ]						
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Coal [MJ]						
Coal, feedstock [MJ]						
Diesel, heavy & medium truck (highway) [MJ]			8,62E-01		1,52E+00	
Diesel, heavy & medium truck (rural) [MJ]		4,12E+00				
Diesel, heavy & medium truck (urban) [MJ]						
Diesel, ship (4-stroke) [MJ]						
Fuel oil, ship (2-stroke) [MJ]						
Fuel, unspecified [MJ]						
Hard coal [MJ]						
LPG, forklift [MJ]						
LPG, thermal [MJ]						
Natural gas (>100 kW) [MJ]						
Natural gas [MJ]						
Natural gas, feedstock [MJ]						
Oil [MJ]						
Oil, feedstock [MJ]						
Oil, heavy fuel [MJ]						
Oil, heavy, feedstock [MJ]						
Oil, light fuel [MJ]						
Peat [MJ]						
Fossil fuel, total [MJ at final use]	**0,00E+00**	**4,12E+00**	**8,62E-01**	**0,00E+00**	**1,52E+00**	**0,00E+00**
Bark [MJ]						
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]						
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.1 Energy demand [per 1000 litres of beverage]: 33 cl aluminium cans

	27. Cardboard (Database)	28. Trp	29. Cardboard box	30. LDPE	31. Trp	32. Foil
Electricity [MJ]				3,96E+00		
Electricity, coal marginal [MJ]	1,64E+01					
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	6,81E-01	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**1,64E+01**	**0,00E+00**	**0,00E+00**	**4,64E+00**	**0,00E+00**	**0,00E+00**
Coal [MJ]				4,14E+00		
Coal, feedstock [MJ]				1,26E-02		
Diesel, heavy & medium truck (highway) [MJ]	2,05E+00	1,27E+00			1,67E-01	
Diesel, heavy & medium truck (rural) [MJ]						
Diesel, heavy & medium truck (urban) [MJ]	4,94E+00					
Diesel, ship (4-stroke) [MJ]	8,68E+00					
Fuel oil, ship (2-stroke) [MJ]						
Fuel, unspecified [MJ]	3,16E-05					
Hard coal [MJ]						
LPG, forklift [MJ]						
LPG, thermal [MJ]						
Natural gas (>100 kW) [MJ]	4,35E+00					
Natural gas [MJ]				1,56E+01		
Natural gas, feedstock [MJ]				4,16E+01		
Oil [MJ]				4,78E+00		
Oil, feedstock [MJ]				4,27E+01		
Oil, heavy fuel [MJ]	1,29E+01					
Oil, heavy, feedstock [MJ]						
Oil, light fuel [MJ]	6,30E-02					
Peat [MJ]	6,93E-01					
Fossil fuel, total [MJ at final use]	**3,36E+01**	**1,27E+00**	**0,00E+00**	**1,09E+02**	**1,67E-01**	**0,00E+00**
Bark [MJ]	5,17E+00					
Renewable fuel, total [MJ at final use]	**5,17E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]	-2,14E+00					
Heat etc., total [MJ at final use]	**-2,14E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.1 Energy demand [per 1000 litres of beverage]: 33 cl aluminium cans

	33. Trp	34. Hi-cone	35. Planks for pallets	36. Trp	37. Pallet	38. Trp	39. Trp
Electricity [MJ]							
Electricity, coal marginal [MJ]			7,36E-01				
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**7,36E-01**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Coal [MJ]							
Coal, feedstock [MJ]							
Diesel, heavy & medium truck (highway) [MJ]	8,62E-02		1,65E-01	9,39E-02			
Diesel, heavy & medium truck (rural) [MJ]						2,97E-01	5,95E-02
Diesel, heavy & medium truck (urban) [MJ]			1,10E+00				
Diesel, ship (4-stroke) [MJ]			8,33E-02				
Fuel oil, ship (2-stroke) [MJ]							
Fuel, unspecified [MJ]			1,42E-06				
Hard coal [MJ]							
LPG, forklift [MJ]							
LPG, thermal [MJ]							
Natural gas (>100 kW) [MJ]							
Natural gas [MJ]							
Natural gas, feedstock [MJ]							
Oil [MJ]							
Oil, feedstock [MJ]							
Oil, heavy fuel [MJ]							
Oil, heavy, feedstock [MJ]							
Oil, light fuel [MJ]			3,70E-01				
Peat [MJ]							
Fossil fuel, total [MJ at final use]	**8,62E-02**	**0,00E+00**	**1,72E+00**	**9,39E-02**	**0,00E+00**	**2,97E-01**	**5,95E-02**
Bark [MJ]			2,24E+00				
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**2,24E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]							
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.1 Energy demand [per 1000 litres of beverage]: 33 cl aluminium cans

	40. Wood incineration	41. Energy use	42. Alt. energy production	43. Trp	44. Remelting	45. Trp
Electricity [MJ]						
Electricity, coal marginal [MJ]	2,52E-01		-1,73E+00		1,90E+02	
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**2,52E-01**	**0,00E+00**	**-1,73E+00**	**0,00E+00**	**1,90E+02**	**0,00E+00**
Coal [MJ]						
Coal, feedstock [MJ]						
Diesel, heavy & medium truck (highway) [MJ]				1,32E+01		3,73E+01
Diesel, heavy & medium truck (rural) [MJ]						
Diesel, heavy & medium truck (urban) [MJ]						
Diesel, ship (4-stroke) [MJ]				6,69E-01		
Fuel oil, ship (2-stroke) [MJ]						2,00E+00
Fuel, unspecified [MJ]	4,87E-07		-3,33E-06		3,66E-04	
Hard coal [MJ]						
LPG, forklift [MJ]						
LPG, thermal [MJ]					2,94E+01	
Natural gas (>100 kW) [MJ]			-1,54E+01			
Natural gas [MJ]						
Natural gas, feedstock [MJ]						
Oil [MJ]						
Oil, feedstock [MJ]						
Oil, heavy fuel [MJ]						
Oil, heavy, feedstock [MJ]						
Oil, light fuel [MJ]			-2,32E+01			
Peat [MJ]						
Fossil fuel, total [MJ at final use]	**4,87E-07**	**0,00E+00**	**-3,86E+01**	**1,39E+01**	**2,94E+01**	**3,93E+01**
Bark [MJ]						
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]						
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.1 Energy demand [per 1000 litres of beverage]: 33 cl aluminium cans

	46. Trp. - Distribution	47. Trp	48. Retailer	49. Trp	50. Trp	51. Trp	52. Use (refrigeration)
Electricity [MJ]							
Electricity, coal marginal [MJ]							1,79E+00
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**1,79E+00**
Coal [MJ]							
Coal, feedstock [MJ]							
Diesel, heavy & medium truck (highway) [MJ]	7,73E+01			1,32E-01			
Diesel, heavy & medium truck (rural) [MJ]	7,80E+01						
Diesel, heavy & medium truck (urban) [MJ]	6,39E+01						
Diesel, ship (4-stroke) [MJ]							
Fuel oil, ship (2-stroke) [MJ]							
Fuel, unspecified [MJ]							3,45E-06
Hard coal [MJ]							
LPG, forklift [MJ]							
LPG, thermal [MJ]							
Natural gas (>100 kW) [MJ]							
Natural gas [MJ]							
Natural gas, feedstock [MJ]							
Oil [MJ]							
Oil, feedstock [MJ]							
Oil, heavy fuel [MJ]							
Oil, heavy, feedstock [MJ]							
Oil, light fuel [MJ]							
Peat [MJ]							
Fossil fuel, total [MJ at final use]	**2,19E+02**	**0,00E+00**	**0,00E+00**	**1,32E-01**	**0,00E+00**	**0,00E+00**	**3,45E-06**
Bark [MJ]							
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]							
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.1 Energy demand [per 1000 litres of beverage]: 33 cl aluminium cans

	53. Trp	54. Trp	55. Testliner	56. New product	57. Avoided kraftliner (Database)
Electricity [MJ]					
Electricity, coal marginal [MJ]			6,99E-01		-6,93E+00
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**6,99E-01**	**0,00E+00**	**-6,93E+00**
Coal [MJ]					
Coal, feedstock [MJ]					
Diesel, heavy & medium truck (highway) [MJ]	7,47E-02	1,10E-01			-8,66E-01
Diesel, heavy & medium truck (rural) [MJ]					
Diesel, heavy & medium truck (urban) [MJ]			6,66E-02		1,93E+00
Diesel, ship (4-stroke) [MJ]					-3,67E+00
Fuel oil, ship (2-stroke) [MJ]					
Fuel, unspecified [MJ]			1,35E-06		-1,34E-05
Hard coal [MJ]					
LPG, forklift [MJ]			9,99E-02		
LPG, thermal [MJ]					
Natural gas (>100 kW) [MJ]			2,55E+01		-1,84E+00
Natural gas [MJ]					
Natural gas, feedstock [MJ]					
Oil [MJ]					
Oil, feedstock [MJ]					
Oil, heavy fuel [MJ]					-5,44E+00
Oil, heavy, feedstock [MJ]					
Oil, light fuel [MJ]			2,00E-03		-2,66E-02
Peat [MJ]					-2,93E-01
Fossil fuel, total [MJ at final use]	**7,47E-02**	**1,10E-01**	**2,57E+01**	**0,00E+00**	**-1,02E+01**
Bark [MJ]					-2,19E+00
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**-2,19E+00**
Heat [MJ]					9,06E-01
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**9,06E-01**

C.1 Energy demand [per 1000 litres of beverage]: 33 cl aluminium cans

	58. Avoided testliner	59. Other products	60. Landfill-corrugated board	61. Trp
Electricity [MJ]				
Electricity, coal marginal [MJ]	-1,40E-01		5,08E-04	
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**-1,40E-01**	**0,00E+00**	**5,08E-04**	**0,00E+00**
Coal [MJ]				
Coal, feedstock [MJ]				
Diesel, heavy & medium truck (highway) [MJ]				
Diesel, heavy & medium truck (rural) [MJ]				8,58E-01
Diesel, heavy & medium truck (urban) [MJ]	-1,33E-02		2,54E-02	
Diesel, ship (4-stroke) [MJ]				
Fuel oil, ship (2-stroke) [MJ]				
Fuel, unspecified [MJ]	-2,70E-07		9,81E-10	
Hard coal [MJ]				
LPG, forklift [MJ]	-2,00E-02			
LPG, thermal [MJ]				
Natural gas (>100 kW) [MJ]	-5,11E+00			
Natural gas [MJ]				
Natural gas, feedstock [MJ]				
Oil [MJ]				
Oil, feedstock [MJ]				
Oil, heavy fuel [MJ]				
Oil, heavy, feedstock [MJ]				
Oil, light fuel [MJ]	-4,00E-04			
Peat [MJ]				
Fossil fuel, total [MJ at final use]	**-5,14E+00**	**0,00E+00**	**2,54E-02**	**8,58E-01**
Bark [MJ]				
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]				
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.1 Energy demand [per 1000 litres of beverage]: 33 cl aluminium cans

	62. Waste management	63. Aluminium incineration	64. PE incineration
Electricity [MJ]			
Electricity, coal marginal [MJ]		7,87E-01	2,28E-01
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**0,00E+00**	**7,87E-01**	**2,28E-01**
Coal [MJ]			
Coal, feedstock [MJ]			
Diesel, heavy & medium truck (highway) [MJ]			
Diesel, heavy & medium truck (rural) [MJ]			
Diesel, heavy & medium truck (urban) [MJ]			
Diesel, ship (4-stroke) [MJ]			
Fuel oil, ship (2-stroke) [MJ]			
Fuel, unspecified [MJ]		1,52E-06	4,40E-07
Hard coal [MJ]			
LPG, forklift [MJ]			
LPG, thermal [MJ]			
Natural gas (>100 kW) [MJ]			
Natural gas [MJ]			
Natural gas, feedstock [MJ]			
Oil [MJ]			
Oil, feedstock [MJ]			
Oil, heavy fuel [MJ]			
Oil, heavy, feedstock [MJ]			
Oil, light fuel [MJ]			
Peat [MJ]			
Fossil fuel, total [MJ at final use]	**0,00E+00**	**1,52E-06**	**4,40E-07**
Bark [MJ]			
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]			
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.1 Energy demand [per 1000 litres of beverage]: 33 cl aluminium cans

	65. Cardboard/corrugated board incin.	66. Energy use	67. Alt. energy production	Total
Electricity [MJ]				9,58E+00
Electricity, coal marginal [MJ]	2,62E+00		-1,62E+01	1,07E+03
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	8,62E-01
Electricity, total [MJ at final use]	**2,62E+00**	**0,00E+00**	**-1,62E+01**	**1,08E+03**
Coal [MJ]				4,56E+00
Coal, feedstock [MJ]				1,28E-02
Diesel, heavy & medium truck (highway) [MJ]				1,88E+02
Diesel, heavy & medium truck (rural) [MJ]				1,02E+02
Diesel, heavy & medium truck (urban) [MJ]				8,17E+01
Diesel, ship (4-stroke) [MJ]				2,58E+01
Fuel oil, ship (2-stroke) [MJ]				5,37E+01
Fuel, unspecified [MJ]	5,05E-06		-3,13E-05	2,07E-03
Hard coal [MJ]				1,65E+00
LPG, forklift [MJ]				1,89E-02
LPG, thermal [MJ]				2,94E+01
Natural gas (>100 kW) [MJ]			-1,45E+02	4,49E+02
Natural gas [MJ]				2,57E+01
Natural gas, feedstock [MJ]				4,20E+01
Oil [MJ]				7,17E+00
Oil, feedstock [MJ]				5,85E+01
Oil, heavy fuel [MJ]				1,14E+02
Oil, heavy, feedstock [MJ]				3,50E+01
Oil, light fuel [MJ]			-2,18E+02	-2,37E+02
Peat [MJ]				7,16E+00
Fossil fuel, total [MJ at final use]	**5,05E-06**	**0,00E+00**	**-3,63E+02**	**9,89E+02**
Bark [MJ]				1,50E+01
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**1,50E+01**
Heat [MJ]				-8,77E+00
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**-8,77E+00**

C.1 Energy demand [per 1000 litres of beverage]: 33 cl aluminium cans

		Packaging system	Effects on other life cycles	Total
Electricity [MJ]		9,58E+00	0,00E+00	9,58E+00
Electricity, coal marginal [MJ]		1,08E+03	-5,99E+00	1,07E+03
Hydro power [MJelectricity]		8,62E-01	0,00E+00	8,62E-01
Electricity, total [MJ at final use]		**1,09E+03**	**-5,99E+00**	**1,08E+03**
Coal [MJ]		4,56E+00	0,00E+00	4,56E+00
Coal, feedstock [MJ]		1,28E-02	0,00E+00	1,28E-02
Diesel, heavy & medium truck (highway) [MJ]		1,86E+02	2,19E+00	1,88E+02
Diesel, heavy & medium truck (rural) [MJ]		1,03E+02	-6,48E-02	1,02E+02
Diesel, heavy & medium truck (urban) [MJ]		7,40E+01	7,64E+00	8,17E+01
Diesel, ship (4-stroke) [MJ]		1,57E+01	1,01E+01	2,58E+01
Fuel oil, ship (2-stroke) [MJ]		5,37E+01	0,00E+00	5,37E+01
Fuel, unspecified [MJ]		2,08E-03	-1,15E-05	2,07E-03
Hard coal [MJ]		1,64E+00	0,00E+00	1,64E+00
LPG, forklift [MJ]		1,63E-01	-1,44E-01	1,89E-02
LPG, thermal [MJ]		2,94E+01	0,00E+00	2,94E+01
Natural gas (>100 kW) [MJ]		6,44E+02	-1,94E+02	4,49E+02
Natural gas [MJ]		2,57E+01	0,00E+00	2,57E+01
Natural gas, feedstock [MJ]		4,20E+01	0,00E+00	4,20E+01
Oil [MJ]		7,18E+00	0,00E+00	7,18E+00
Oil, feedstock [MJ]		5,85E+01	0,00E+00	5,85E+01
Oil, heavy fuel [MJ]		1,05E+02	9,81E+00	1,14E+02
Oil, heavy, feedstock [MJ]		3,50E+01	0,00E+00	3,50E+01
Oil, light fuel [MJ]		3,64E+00	-2,41E+02	-2,37E+02
Peat [MJ]		6,63E+00	5,29E-01	7,16E+00
Fossil fuel, total [MJ at final use]		**1,39E+03**	**-4,05E+02**	**9,89E+02**
Bark [MJ]		1,11E+01	3,95E+00	1,50E+01
Renewable fuel, total [MJ at final use]		**1,11E+01**	**3,95E+00**	**1,50E+01**
Heat [MJ]		-7,14E+00	-1,63E+00	-8,77E+00
Heat etc., total [MJ at final use]		**-7,14E+00**	**-1,63E+00**	**-8,77E+00**

C.2 Energy demand [per 1000 litres of beverage]: 50 cl aluminium cans

	68. Methyl acrylate (Data Base)	69. Trp	70. Epoxy resins	71. Trp
Electricity [MJ]	5,59E+00			
Electricity, coal marginal [MJ]			5,57E+01	
Hydro power [MJelectricity]	1,80E-01	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**5,77E+00**	**0,00E+00**	**5,57E+01**	**0,00E+00**
Coal [MJ]	4,23E-01			
Coal, feedstock [MJ]	1,49E-04			
Diesel, heavy & medium truck (highway) [MJ]		8,61E-01		6,64E-01
Diesel, heavy & medium truck (rural) [MJ]				
Diesel, heavy & medium truck (urban) [MJ]				
Diesel, ship (4-stroke) [MJ]		1,56E-02		7,49E-01
Fuel oil, ship (2-stroke) [MJ]				
Fuel, unspecified [MJ]	1,29E-08		1,07E-04	
Hard coal [MJ]	6,74E-02			
LPG, forklift [MJ]				
LPG, thermal [MJ]				
Natural gas (>100 kW) [MJ]	7,11E+00		1,94E+02	
Natural gas [MJ]	1,00E+01			
Natural gas, feedstock [MJ]	3,52E-01			
Oil [MJ]	2,38E+00			
Oil, feedstock [MJ]	1,57E+01			
Oil, heavy fuel [MJ]	3,66E+01		2,93E+01	
Oil, heavy, feedstock [MJ]			3,35E+01	
Oil, light fuel [MJ]				
Peat [MJ]				
Fossil fuel, total [MJ at final use]	**7,26E+01**	**8,77E-01**	**2,57E+02**	**1,41E+00**
Bark [MJ]				
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]				
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.2 Energy demand [per 1000 litres of beverage]: 50 cl aluminium cans

	1. Bauxite mining - Alumina production	2. Trp	3. Electrolysis (prebake)	4. Trp	5. Cast house
Electricity [MJ]					
Electricity, coal marginal [MJ]	1,01E+01			6,62E-02	2,52E+02
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**1,01E+01**	**0,00E+00**	**0,00E+00**	**6,62E-02**	**2,52E+02**
Coal [MJ]					
Coal, feedstock [MJ]					
Diesel, heavy & medium truck (highway) [MJ]		4,30E-01		5,37E-01	
Diesel, heavy & medium truck (rural) [MJ]					
Diesel, heavy & medium truck (urban) [MJ]					
Diesel, ship (4-stroke) [MJ]					
Fuel oil, ship (2-stroke) [MJ]		2,90E+01		9,13E+00	
Fuel, unspecified [MJ]	1,96E-05			1,28E-07	4,85E-04
Hard coal [MJ]					
LPG, forklift [MJ]					
LPG, thermal [MJ]					
Natural gas (>100 kW) [MJ]					
Natural gas [MJ]					
Natural gas, feedstock [MJ]					
Oil [MJ]					
Oil, feedstock [MJ]					
Oil, heavy fuel [MJ]					
Oil, heavy, feedstock [MJ]					
Oil, light fuel [MJ]					
Peat [MJ]					
Fossil fuel, total [MJ at final use]	**1,96E-05**	**2,94E+01**	**0,00E+00**	**9,67E+00**	**4,85E-04**
Bark [MJ]					
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]					
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.2 Energy demand [per 1000 litres of beverage]: 50 cl aluminium cans

	6. Manganese production	7. Trp	8. Strip rolling	9. Trp	10. Trp	11. Can production
Electricity [MJ]						
Electricity, coal marginal [MJ]	2,62E+00		1,31E+02			1,86E+02
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**2,62E+00**	**0,00E+00**	**1,31E+02**	**0,00E+00**	**0,00E+00**	**1,86E+02**
Coal [MJ]						
Coal, feedstock [MJ]						
Diesel, heavy & medium truck (highway) [MJ]		1,79E+00		3,48E-01	3,34E+01	
Diesel, heavy & medium truck (rural) [MJ]						
Diesel, heavy & medium truck (urban) [MJ]	7,01E-02					
Diesel, ship (4-stroke) [MJ]						
Fuel oil, ship (2-stroke) [MJ]		2,92E-02		1,87E-02	1,93E+00	
Fuel, unspecified [MJ]	5,05E-06		2,52E-04			3,60E-04
Hard coal [MJ]						
LPG, forklift [MJ]						
LPG, thermal [MJ]						
Natural gas (>100 kW) [MJ]			1,07E+02			1,13E+02
Natural gas [MJ]						
Natural gas, feedstock [MJ]						
Oil [MJ]						
Oil, feedstock [MJ]						
Oil, heavy fuel [MJ]						
Oil, heavy, feedstock [MJ]						
Oil, light fuel [MJ]						
Peat [MJ]						
Fossil fuel, total [MJ at final use]	**7,01E-02**	**1,82E+00**	**1,07E+02**	**3,67E-01**	**3,54E+01**	**1,13E+02**
Bark [MJ]						
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]	-2,62E+00					
Heat etc., total [MJ at final use]	**-2,62E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.2 Energy demand [per 1000 litres of beverage]: 50 cl aluminium cans

	12. Corrugated board (Database)	13. Use of recycled fibres (Database)	14. Trp	15. Trp
Electricity [MJ]				
Electricity, coal marginal [MJ]	1,47E+01	1,35E+01		
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**1,47E+01**	**1,35E+01**	**0,00E+00**	**0,00E+00**
Coal [MJ]				
Coal, feedstock [MJ]				
Diesel, heavy & medium truck (highway) [MJ]	1,69E+00	2,01E+00	3,70E-01	2,58E+00
Diesel, heavy & medium truck (rural) [MJ]		-4,76E-02		
Diesel, heavy & medium truck (urban) [MJ]	2,94E+00	4,14E+00		
Diesel, ship (4-stroke) [MJ]	3,72E+00	1,01E+01	8,54E-03	
Fuel oil, ship (2-stroke) [MJ]				
Fuel, unspecified [MJ]	2,85E-05	2,60E-05		
Hard coal [MJ]	1,16E+00			
LPG, forklift [MJ]	1,20E-01	-1,65E-01		
LPG, thermal [MJ]				
Natural gas (>100 kW) [MJ]	5,73E+01	-3,83E+01		
Natural gas [MJ]				
Natural gas, feedstock [MJ]				
Oil [MJ]				
Oil, feedstock [MJ]				
Oil, heavy fuel [MJ]	1,79E+01	1,12E+01		
Oil, heavy, feedstock [MJ]				
Oil, light fuel [MJ]	2,36E+00	5,16E-02		
Peat [MJ]	4,36E+00	6,04E-01		
Fossil fuel, total [MJ at final use]	**9,16E+01**	**-1,04E+01**	**3,79E-01**	**2,58E+00**
Bark [MJ]	2,71E+00	4,50E+00		
Renewable fuel, total [MJ at final use]	**2,71E+00**	**4,50E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]	-1,19E+00	-1,86E+00		
Heat etc., total [MJ at final use]	**-1,19E+00**	**-1,86E+00**	**0,00E+00**	**0,00E+00**

C.2 Energy demand [per 1000 litres of beverage]: 50 cl aluminium cans

	16. Trp	17. Washing & filling	18. Trp	19. Corrugated board incin.	20. Packaging
Electricity [MJ]					
Electricity, coal marginal [MJ]		7,63E+00		1,44E-01	
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**0,00E+00**	**7,63E+00**	**0,00E+00**	**1,44E-01**	**0,00E+00**
Coal [MJ]					
Coal, feedstock [MJ]					
Diesel, heavy & medium truck (highway) [MJ]					
Diesel, heavy & medium truck (rural) [MJ]	1,62E+01		3,40E-02		
Diesel, heavy & medium truck (urban) [MJ]					
Diesel, ship (4-stroke) [MJ]	3,24E-01				
Fuel oil, ship (2-stroke) [MJ]					
Fuel, unspecified [MJ]		1,47E-05		2,79E-07	
Hard coal [MJ]					
LPG, forklift [MJ]					
LPG, thermal [MJ]					
Natural gas (>100 kW) [MJ]		5,33E+01			
Natural gas [MJ]					
Natural gas, feedstock [MJ]					
Oil [MJ]					
Oil, feedstock [MJ]					
Oil, heavy fuel [MJ]					
Oil, heavy, feedstock [MJ]					
Oil, light fuel [MJ]					
Peat [MJ]					
Fossil fuel, total [MJ at final use]	**1,65E+01**	**5,33E+01**	**3,40E-02**	**2,79E-07**	**0,00E+00**
Bark [MJ]					
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]					
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.2 Energy demand [per 1000 litres of beverage]: 50 cl aluminium cans

	21. Secondary packaging	22. Trp	23. Trp	24. Box	25. Trp	26. Tray
Electricity [MJ]						
Electricity, coal marginal [MJ]						
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Coal [MJ]						
Coal, feedstock [MJ]						
Diesel, heavy & medium truck (highway) [MJ]			6,41E-01		1,13E+00	
Diesel, heavy & medium truck (rural) [MJ]		3,06E+00				
Diesel, heavy & medium truck (urban) [MJ]						
Diesel, ship (4-stroke) [MJ]						
Fuel oil, ship (2-stroke) [MJ]						
Fuel, unspecified [MJ]						
Hard coal [MJ]						
LPG, forklift [MJ]						
LPG, thermal [MJ]						
Natural gas (>100 kW) [MJ]						
Natural gas [MJ]						
Natural gas, feedstock [MJ]						
Oil [MJ]						
Oil, feedstock [MJ]						
Oil, heavy fuel [MJ]						
Oil, heavy, feedstock [MJ]						
Oil, light fuel [MJ]						
Peat [MJ]						
Fossil fuel, total [MJ at final use]	**0,00E+00**	**3,06E+00**	**6,41E-01**	**0,00E+00**	**1,13E+00**	**0,00E+00**
Bark [MJ]						
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]						
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.2 Energy demand [per 1000 litres of beverage]: 50 cl aluminium cans

	27. Cardboard (Database)	28. Trp	29. Cardboard box	30. LDPE	31. Trp	32. Foil
Electricity [MJ]				2,94E+00		
Electricity, coal marginal [MJ]	1,22E+01					
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	5,06E-01	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**1,22E+01**	**0,00E+00**	**0,00E+00**	**3,45E+00**	**0,00E+00**	**0,00E+00**
Coal [MJ]				3,08E+00		
Coal, feedstock [MJ]				9,37E-03		
Diesel, heavy & medium truck (highway) [MJ]	1,52E+00	9,42E-01			1,24E-01	
Diesel, heavy & medium truck (rural) [MJ]						
Diesel, heavy & medium truck (urban) [MJ]	3,67E+00					
Diesel, ship (4-stroke) [MJ]	6,45E+00					
Fuel oil, ship (2-stroke) [MJ]						
Fuel, unspecified [MJ]	2,35E-05					
Hard coal [MJ]						
LPG, forklift [MJ]						
LPG, thermal [MJ]						
Natural gas (>100 kW) [MJ]	3,23E+00					
Natural gas [MJ]				1,16E+01		
Natural gas, feedstock [MJ]				3,10E+01		
Oil [MJ]				3,55E+00		
Oil, feedstock [MJ]				3,17E+01		
Oil, heavy fuel [MJ]	9,56E+00					
Oil, heavy, feedstock [MJ]						
Oil, light fuel [MJ]	4,69E-02					
Peat [MJ]	5,15E-01					
Fossil fuel, total [MJ at final use]	**2,50E+01**	**9,42E-01**	**0,00E+00**	**8,09E+01**	**1,24E-01**	**0,00E+00**
Bark [MJ]	3,84E+00					
Renewable fuel, total [MJ at final use]	**3,84E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]	-1,59E+00					
Heat etc., total [MJ at final use]	**-1,59E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.2 Energy demand [per 1000 litres of beverage]: 50 cl aluminium cans

	33. Trp	34. Hi-cone	35. Planks for pallets	36. Trp	37. Pallet	38. Trp	39. Trp
Electricity [MJ]							
Electricity, coal marginal [MJ]			6,26E-01				
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**6,26E-01**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Coal [MJ]							
Coal, feedstock [MJ]							
Diesel, heavy & medium truck (highway) [MJ]	6,41E-02		1,41E-01	7,99E-02			
Diesel, heavy & medium truck (rural) [MJ]						2,53E-01	5,06E-02
Diesel, heavy & medium truck (urban) [MJ]			9,34E-01				
Diesel, ship (4-stroke) [MJ]			7,08E-02				
Fuel oil, ship (2-stroke) [MJ]							
Fuel, unspecified [MJ]			1,21E-06				
Hard coal [MJ]							
LPG, forklift [MJ]							
LPG, thermal [MJ]							
Natural gas (>100 kW) [MJ]							
Natural gas [MJ]							
Natural gas, feedstock [MJ]							
Oil [MJ]							
Oil, feedstock [MJ]							
Oil, heavy fuel [MJ]							
Oil, heavy, feedstock [MJ]							
Oil, light fuel [MJ]			3,15E-01				
Peat [MJ]							
Fossil fuel, total [MJ at final use]	**6,41E-02**	**0,00E+00**	**1,46E+00**	**7,99E-02**	**0,00E+00**	**2,53E-01**	**5,06E-02**
Bark [MJ]			1,91E+00				
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**1,91E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]							
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.2 Energy demand [per 1000 litres of beverage]: 50 cl aluminium cans

	40. Wood incineration	41. Energy use	42. Alt. energy production	43. Trp	44. Remelting	45. Trp
Electricity [MJ]						
Electricity, coal marginal [MJ]	2,15E-01		-1,33E+00		1,59E+02	
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**2,15E-01**	**0,00E+00**	**-1,33E+00**	**0,00E+00**	**1,59E+02**	**0,00E+00**
Coal [MJ]						
Coal, feedstock [MJ]						
Diesel, heavy & medium truck (highway) [MJ]				1,12E+01		3,13E+01
Diesel, heavy & medium truck (rural) [MJ]						
Diesel, heavy & medium truck (urban) [MJ]						
Diesel, ship (4-stroke) [MJ]				5,68E-01		
Fuel oil, ship (2-stroke) [MJ]						1,68E+00
Fuel, unspecified [MJ]	4,14E-07		-2,57E-06		3,07E-04	
Hard coal [MJ]						
LPG, forklift [MJ]						
LPG, thermal [MJ]					2,46E+01	
Natural gas (>100 kW) [MJ]			-1,19E+01			
Natural gas [MJ]						
Natural gas, feedstock [MJ]						
Oil [MJ]						
Oil, feedstock [MJ]						
Oil, heavy fuel [MJ]						
Oil, heavy, feedstock [MJ]						
Oil, light fuel [MJ]			-1,79E+01			
Peat [MJ]						
Fossil fuel, total [MJ at final use]	**4,14E-07**	**0,00E+00**	**-2,98E+01**	**1,18E+01**	**2,46E+01**	**3,30E+01**
Bark [MJ]						
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]						
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.2 Energy demand [per 1000 litres of beverage]: 50 cl aluminium cans

	46. Trp. - Distribution	47. Trp	48. Retailer	49. Trp	50. Trp	51. Trp	52. Use (refrigeration)
Electricity [MJ]							
Electricity, coal marginal [MJ]							1,52E+00
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**1,52E+00**
Coal [MJ]							
Coal, feedstock [MJ]							
Diesel, heavy & medium truck (highway) [MJ]	7,66E+01			8,73E-02			
Diesel, heavy & medium truck (rural) [MJ]	7,73E+01						
Diesel, heavy & medium truck (urban) [MJ]	6,33E+01						
Diesel, ship (4-stroke) [MJ]							
Fuel oil, ship (2-stroke) [MJ]							
Fuel, unspecified [MJ]							2,93E-06
Hard coal [MJ]							
LPG, forklift [MJ]							
LPG, thermal [MJ]							
Natural gas (>100 kW) [MJ]							
Natural gas [MJ]							
Natural gas, feedstock [MJ]							
Oil [MJ]							
Oil, feedstock [MJ]							
Oil, heavy fuel [MJ]							
Oil, heavy, feedstock [MJ]							
Oil, light fuel [MJ]							
Peat [MJ]							
Fossil fuel, total [MJ at final use]	**2,17E+02**	**0,00E+00**	**0,00E+00**	**8,73E-02**	**0,00E+00**	**0,00E+00**	**2,93E-06**
Bark [MJ]							
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]							
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.2 Energy demand [per 1000 litres of beverage]: 50 cl aluminium cans

	53. Trp	54. Trp	55. Testliner	56. New product	57. Avoided kraftliner (Database)
Electricity [MJ]					
Electricity, coal marginal [MJ]			5,23E-01		-5,19E+00
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**5,23E-01**	**0,00E+00**	**-5,19E+00**
Coal [MJ]					
Coal, feedstock [MJ]					
Diesel, heavy & medium truck (highway) [MJ]	6,20E-02	8,75E-02			-6,48E-01
Diesel, heavy & medium truck (rural) [MJ]					
Diesel, heavy & medium truck (urban) [MJ]			4,99E-02		1,44E+00
Diesel, ship (4-stroke) [MJ]					-2,75E+00
Fuel oil, ship (2-stroke) [MJ]					
Fuel, unspecified [MJ]			1,01E-06		-1,00E-05
Hard coal [MJ]					
LPG, forklift [MJ]			7,48E-02		
LPG, thermal [MJ]					
Natural gas (>100 kW) [MJ]			1,91E+01		-1,38E+00
Natural gas [MJ]					
Natural gas, feedstock [MJ]					
Oil [MJ]					
Oil, feedstock [MJ]					
Oil, heavy fuel [MJ]					-4,07E+00
Oil, heavy, feedstock [MJ]					
Oil, light fuel [MJ]			1,50E-03		-1,99E-02
Peat [MJ]					-2,19E-01
Fossil fuel, total [MJ at final use]	**6,20E-02**	**8,75E-02**	**1,92E+01**	**0,00E+00**	**-7,63E+00**
Bark [MJ]					-1,64E+00
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**-1,64E+00**
Heat [MJ]					6,78E-01
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**	**6,78E-01**

C.2 Energy demand [per 1000 litres of beverage]: 50 cl aluminium cans

	58. Avoided testliner	59. Other products	60. Landfill-corrugated board	61. Trp
Electricity [MJ]				
Electricity, coal marginal [MJ]	-1,05E-01		3,81E-04	
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**-1,05E-01**	**0,00E+00**	**3,81E-04**	**0,00E+00**
Coal [MJ]				
Coal, feedstock [MJ]				
Diesel, heavy & medium truck (highway) [MJ]				
Diesel, heavy & medium truck (rural) [MJ]				6,56E-01
Diesel, heavy & medium truck (urban) [MJ]	-9,97E-03		1,90E-02	
Diesel, ship (4-stroke) [MJ]				
Fuel oil, ship (2-stroke) [MJ]				
Fuel, unspecified [MJ]	-2,02E-07		7,35E-10	
Hard coal [MJ]				
LPG, forklift [MJ]	-1,50E-02			
LPG, thermal [MJ]				
Natural gas (>100 kW) [MJ]	-3,82E+00			
Natural gas [MJ]				
Natural gas, feedstock [MJ]				
Oil [MJ]				
Oil, feedstock [MJ]				
Oil, heavy fuel [MJ]				
Oil, heavy, feedstock [MJ]				
Oil, light fuel [MJ]	-2,99E-04			
Peat [MJ]				
Fossil fuel, total [MJ at final use]	**-3,85E+00**	**0,00E+00**	**1,90E-02**	**6,56E-01**
Bark [MJ]				
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]				
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.2 Energy demand [per 1000 litres of beverage]: 50 cl aluminium cans

	62. Waste management	63. Aluminium incineration	64. PE incineration
Electricity [MJ]			
Electricity, coal marginal [MJ]		6,69E-01	1,52E-01
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00
Electricity, total [MJ at final use]	**0,00E+00**	**6,69E-01**	**1,52E-01**
Coal [MJ]			
Coal, feedstock [MJ]			
Diesel, heavy & medium truck (highway) [MJ]			
Diesel, heavy & medium truck (rural) [MJ]			
Diesel, heavy & medium truck (urban) [MJ]			
Diesel, ship (4-stroke) [MJ]			
Fuel oil, ship (2-stroke) [MJ]			
Fuel, unspecified [MJ]		1,29E-06	2,92E-07
Hard coal [MJ]			
LPG, forklift [MJ]			
LPG, thermal [MJ]			
Natural gas (>100 kW) [MJ]			
Natural gas [MJ]			
Natural gas, feedstock [MJ]			
Oil [MJ]			
Oil, feedstock [MJ]			
Oil, heavy fuel [MJ]			
Oil, heavy, feedstock [MJ]			
Oil, light fuel [MJ]			
Peat [MJ]			
Fossil fuel, total [MJ at final use]	**0,00E+00**	**1,29E-06**	**2,92E-07**
Bark [MJ]			
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**
Heat [MJ]			
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**

C.2 Energy demand [per 1000 litres of beverage]: 50 cl aluminium cans

	65. Cardboard/corrugated board incin.	66. Energy use	67. Alt. energy production	Total
Electricity [MJ]				8,54E+00
Electricity, coal marginal [MJ]	1,96E+00		-1,25E+01	8,31E+02
Hydro power [MJelectricity]	0,00E+00	0,00E+00	0,00E+00	6,86E-01
Electricity, total [MJ at final use]	**1,96E+00**	**0,00E+00**	**-1,25E+01**	**8,40E+02**
Coal [MJ]				3,50E+00
Coal, feedstock [MJ]				9,52E-03
Diesel, heavy & medium truck (highway) [MJ]				1,68E+02
Diesel, heavy & medium truck (rural) [MJ]				9,75E+01
Diesel, heavy & medium truck (urban) [MJ]				7,66E+01
Diesel, ship (4-stroke) [MJ]				1,93E+01
Fuel oil, ship (2-stroke) [MJ]				4,18E+01
Fuel, unspecified [MJ]	3,78E-06		-2,42E-05	1,60E-03
Hard coal [MJ]				1,23E+00
LPG, forklift [MJ]				1,50E-02
LPG, thermal [MJ]				2,46E+01
Natural gas (>100 kW) [MJ]			-1,12E+02	3,86E+02
Natural gas [MJ]				2,16E+01
Natural gas, feedstock [MJ]				3,13E+01
Oil [MJ]				5,94E+00
Oil, feedstock [MJ]				4,74E+01
Oil, heavy fuel [MJ]				1,00E+02
Oil, heavy, feedstock [MJ]				3,35E+01
Oil, light fuel [MJ]			-1,68E+02	-1,83E+02
Peat [MJ]				5,26E+00
Fossil fuel, total [MJ at final use]	**3,78E-06**	**0,00E+00**	**-2,80E+02**	**8,81E+02**
Bark [MJ]				1,13E+01
Renewable fuel, total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**1,13E+01**
Heat [MJ]				-6,58E+00
Heat etc., total [MJ at final use]	**0,00E+00**	**0,00E+00**	**0,00E+00**	**-6,58E+00**

C.2 Energy demand [per 1000 litres of beverage]: 50 cl aluminium cans

		Packaging system	Effects on other life cycles	Total
Electricity [MJ]		8,54E+00	0,00E+00	8,54E+00
Electricity, coal marginal [MJ]		8,36E+02	-5,15E+00	8,31E+02
Hydro power [MJelectricity]		6,86E-01	0,00E+00	6,86E-01
Electricity, total [MJ at final use]		**8,45E+02**	**-5,15E+00**	**8,40E+02**
Coal [MJ]		3,50E+00	0,00E+00	3,50E+00
Coal, feedstock [MJ]		9,52E-03	0,00E+00	9,52E-03
Diesel, heavy & medium truck (highway) [MJ]		1,66E+02	1,60E+00	1,68E+02
Diesel, heavy & medium truck (rural) [MJ]		9,75E+01	-4,76E-02	9,75E+01
Diesel, heavy & medium truck (urban) [MJ]		7,09E+01	5,64E+00	7,66E+01
Diesel, ship (4-stroke) [MJ]		1,19E+01	7,35E+00	1,93E+01
Fuel oil, ship (2-stroke) [MJ]		4,18E+01	0,00E+00	4,18E+01
Fuel, unspecified [MJ]		1,61E-03	-9,96E-06	1,60E-03
Hard coal [MJ]		1,23E+00	0,00E+00	1,23E+00
LPG, forklift [MJ]		1,20E-01	-1,05E-01	1,48E-02
LPG, thermal [MJ]		2,46E+01	0,00E+00	2,46E+01
Natural gas (>100 kW) [MJ]		5,34E+02	-1,48E+02	3,86E+02
Natural gas [MJ]		2,16E+01	0,00E+00	2,16E+01
Natural gas, feedstock [MJ]		3,13E+01	0,00E+00	3,13E+01
Oil [MJ]		5,94E+00	0,00E+00	5,94E+00
Oil, feedstock [MJ]		4,74E+01	0,00E+00	4,74E+01
Oil, heavy fuel [MJ]		9,33E+01	7,13E+00	1,00E+02
Oil, heavy, feedstock [MJ]		3,35E+01	0,00E+00	3,35E+01
Oil, light fuel [MJ]		2,72E+00	-1,86E+02	-1,83E+02
Peat [MJ]		4,87E+00	3,85E-01	5,26E+00
Fossil fuel, total [MJ at final use]		**1,19E+03**	**-3,12E+02**	**8,81E+02**
Bark [MJ]		8,46E+00	2,87E+00	1,13E+01
Renewable fuel, total [MJ at final use]		**8,46E+00**	**2,87E+00**	**1,13E+01**
Heat [MJ]		-5,40E+00	-1,19E+00	-6,58E+00
Heat etc., total [MJ at final use]		**-5,40E+00**	**-1,19E+00**	**-6,58E+00**

D.1 Inventory results for important air emissions [per 1000 litres of beverage]: 33 cl aluminium cans

Inventory results per 1000 litres	68. Methyl acrylate (Data Base)	69. Trp	70. Epoxy resins	71. Trp	1. Bauxite mining - Alumina production	2. Trp
CO2	5,55E+03	7,39E+01	2,58E+04	1,24E+02	1,39E+04	3,51E+03
CO2 relative	1,65%	0,02%	7,68%	0,04%	4,14%	1,04%
SO2	2,12E+01	8,29E-02	3,83E+01	1,56E-01	1,14E+02	5,85E+01
SO2 relative	2,66%	0,01%	4,80%	0,02%	14,26%	7,33%
NOx	2,05E+01	7,13E-01	5,56E+01	1,65E+00	3,46E+01	8,22E+01
NOx relative	1,64%	0,06%	4,44%	0,13%	2,77%	6,58%
NMVOC:s						
NMVOC	1,22E-02	1,80E-01	3,44E-01	3,01E-01		1,13E-01
NMVOC, diesel engines	1,50E-04	7,10E-02	4,11E-01	1,00E-01	9,26E-02	2,24E+00
NMVOC, el-coal			2,70E-01		6,09E-02	
NMVOC, natural gas combustion						
NMVOC, oil combustion	8,50E+00		1,52E+01			8,66E+00
NMVOC, petrol engines	2,18E-14		5,24E-11		1,18E-11	
NMVOC, power plants	6,16E-05		1,30E-01		2,94E-02	
Total NMVOC	8,51E+00	2,51E-01	1,63E+01	4,01E-01	1,83E-01	1,10E+01
Total NMVOC relative	5,91%	0,17%	11,32%	0,28%	0,13%	7,65%
VOC:s						
HC	7,62E+00		8,03E-01		1,81E-01	
VOC					3,71E+00	
VOC, coal combustion	3,43E-06		7,04E-03		1,59E-03	
VOC, diesel engines	8,07E-05		1,94E-01		4,38E-02	
VOC, natural gas combustion	2,27E-13		5,49E-10		1,24E-10	
Total VOC	7,62E+00	0,00E+00	1,00E+00	0,00E+00	3,94E+00	0,00E+00
Total VOC relative	9,99%	0,00%	1,32%	0,00%	5,17%	0,00%
"Other specified hydrocarbons"						
Acetaldehyde			1,42E-04			
Acetylene						
Aldehydes	1,39E-03		1,76E-04		3,96E-05	
Alkanes	2,21E-02		1,84E-02			
Alkenes	1,11E-03		9,18E-04			
Amylaclohol						
Aromates (C9-C10)	5,52E-03		7,16E-03		5,80E-04	
Butane			9,92E-02			
Butanol						
Butydiglycole						
Butylglycole						
CH4	5,00E+00	9,29E-02	7,82E+01	1,53E-01	1,57E+01	4,41E+00
Ethane						
Ethene						
Formaldehyde	1,65E-02		2,79E-02			
PAH	1,84E-05		1,43E-03		7,94E-08	
Pentane			1,70E-01			
Propane	1,11E-03		2,93E-02			
Propene						
Xylene						
Total "other"	5,05E+00	9,29E-02	7,86E+01	1,53E-01	1,57E+01	4,41E+00
Total "other" relative	0,39%	0,01%	6,11%	0,01%	1,22%	0,34%

D.1 Inventory results for important air emissions [per 1000 litres of beverage]: 33 cl aluminium cans

Inventory results per 1000 litres	3. Electrolysis (prebake)	4. Trp	5. Cast house	6. Manganese production	7. Trp	8. Strip rolling	9. Trp	10. Trp
CO2		1,17E+03	9,00E+04	7,89E+02	1,98E+02	4,43E+04	3,72E+01	3,59E+03
CO2 relative	0,00%	0,35%	26,79%	0,23%	0,06%	13,18%	0,01%	1,07%
SO2		1,85E+01	2,22E+02	1,31E+00	2,76E-01	6,05E+01	7,43E-02	7,39E+00
SO2 relative	0,00%	2,32%	27,82%	0,16%	0,03%	7,59%	0,01%	0,93%
NOx		2,63E+01	2,04E+02	2,15E+00	1,93E+00	1,04E+02	3,83E-01	3,71E+01
NOx relative	0,00%	2,11%	16,32%	0,17%	0,15%	8,35%	0,03%	2,97%
NMVOC:s								
NMVOC		1,42E-01		1,85E-02	4,73E-01	2,18E-01	8,54E-02	8,20E+00
NMVOC, diesel engines		7,47E-01	2,30E+00	3,93E-02	1,90E-01	1,11E+00	3,52E-02	3,39E+00
NMVOC, el-coal		3,97E-04	1,51E+00	1,57E-02		7,29E-01		
NMVOC, natural gas combustion								
NMVOC, oil combustion		2,73E+00			8,72E-03		5,20E-03	5,37E-01
NMVOC, petrol engines		7,71E-14	2,93E-10	3,05E-12		1,41E-10		
NMVOC, power plants		1,92E-04	7,28E-01	7,57E-03		3,52E-01		
Total NMVOC	0,00E+00	3,62E+00	4,53E+00	8,11E-02	6,72E-01	2,41E+00	1,26E-01	1,21E+01
Total NMVOC relative	0,00%	2,51%	3,15%	0,06%	0,47%	1,67%	0,09%	8,42%
VOC:s								
HC		1,18E-03	4,49E+00	4,67E-02		2,17E+00		
VOC			1,26E-01			1,90E+01		
VOC, coal combustion		1,03E-05	3,93E-02	4,09E-04		1,90E-02		
VOC, diesel engines		2,86E-04	1,09E+00	1,13E-02		5,24E-01		
VOC, natural gas combustion		8,07E-13	3,07E-09	3,19E-11		1,48E-09		
Total VOC	0,00E+00	1,48E-03	5,74E+00	5,84E-02	0,00E+00	2,17E+01	0,00E+00	0,00E+00
Total VOC relative	0,00%	0,00%	7,53%	0,08%	0,00%	28,47%	0,00%	0,00%
"Other specified hydrocarbons"								
Acetaldehyde						1,29E-04		
Acetylene								
Aldehydes		2,58E-07	9,82E-04	1,02E-05		4,74E-04		
Alkanes								
Alkenes								
Amylaclohol								
Aromates (C9-C10)		3,78E-06	1,44E-02	1,49E-04		6,94E-03		
Butane						9,00E-02		
Butanol								
Butydiglycole								
Butylglycole								
CH4		1,55E+00	3,90E+02	4,07E+00	2,49E-01	1,89E+02	4,68E-02	4,51E+00
Ethane								
Ethene								
Formaldehyde						1,29E-02		
PAH		5,17E-10	3,15E-01	2,05E-08		1,29E-03		
Pentane						1,54E-01		
Propane						2,57E-02		
Propene								
Xylene								
Total "other"	0,00E+00	1,55E+00	3,91E+02	4,07E+00	2,49E-01	1,89E+02	4,68E-02	4,51E+00
Total "other" relative	0,00%	0,12%	30,37%	0,32%	0,02%	14,72%	0,00%	0,35%

D.1 Inventory results for important air emissions [per 1000 litres of beverage]: 33 cl aluminium cans

Inventory results per 1000 litres	11. Can production	12. Corrugated board (Database)	13. Use of recycled fibres (Database)	14. Trp	15. Trp	16. Trp
CO2	7,48E+04	1,33E+04	4,30E+03	4,78E+01	2,70E+02	1,64E+03
CO2 relative	22,26%	3,96%	1,28%	0,01%	0,08%	0,49%
SO2	1,08E+02	2,81E+01	1,55E+01	5,37E-02	3,02E-01	1,84E+00
SO2 relative	13,57%	3,52%	1,94%	0,01%	0,04%	0,23%
NOx	1,87E+02	4,14E+01	3,81E+01	4,63E-01	2,57E+00	1,58E+01
NOx relative	14,97%	3,31%	3,05%	0,04%	0,21%	1,27%
NMVOC:s						
NMVOC	2,89E-01	3,10E+00	4,43E+00	1,16E-01	6,57E-01	3,99E+00
NMVOC, diesel engines	1,98E+00	1,24E+00	2,07E+00	4,59E-02	2,61E-01	1,58E+00
NMVOC, el-coal	1,30E+00	9,27E-02	8,51E-02			
NMVOC, natural gas combustion						
NMVOC, oil combustion		5,68E+00	3,47E+00			
NMVOC, petrol engines	2,53E-10	1,85E-11	1,65E-11			
NMVOC, power plants	6,29E-01	4,62E-02	4,11E-02			
Total NMVOC	4,20E+00	1,02E+01	1,01E+01	1,62E-01	9,18E-01	5,57E+00
Total NMVOC relative	2,92%	7,05%	7,01%	0,11%	0,64%	3,87%
VOC:s						
HC	3,88E+00	2,84E-01	2,53E-01			
VOC						
VOC, coal combustion	3,40E-02	2,50E-03	2,22E-03			
VOC, diesel engines	9,38E-01	6,86E-02	6,13E-02			
VOC, natural gas combustion	2,65E-09	1,94E-10	1,73E-10			
Total VOC	4,85E+00	3,55E-01	3,17E-01	0,00E+00	0,00E+00	0,00E+00
Total VOC relative	6,36%	0,47%	0,42%	0,00%	0,00%	0,00%
"Other specified hydrocarbons"						
Acetaldehyde	1,70E-04	6,01E-06				
Acetylene		1,07E-05				
Aldehydes	8,48E-04	6,23E-05	5,54E-05			
Alkanes		1,09E-02				
Alkenes		5,51E-04				
Amylaclohol	5,15E+00					
Aromates (C9-C10)	1,24E-02	3,58E-03	8,11E-04			
Butane	1,19E-01	4,21E-03				
Butanol	2,09E+01					
Butydiglycole	9,05E-01					
Butylglycole	2,75E+01					
CH4	3,38E+02	2,93E+01	-1,43E+02	6,01E-02	3,40E-01	2,06E+00
Ethane		2,14E-05				
Ethene		5,35E-05				
Formaldehyde	1,70E-02	8,54E-03				
PAH	1,70E-03	6,92E-05	1,11E-07			
Pentane	2,04E-01	7,22E-03				
Propane	3,40E-02	1,76E-03				
Propene		2,14E-05				
Xylene	6,04E-01					
Total "other"	3,93E+02	2,94E+01	-1,43E+02	6,01E-02	3,40E-01	2,06E+00
Total "other" relative	30,58%	2,29%	-11,13%	0,00%	0,03%	0,16%

D.1 Inventory results for important air emissions [per 1000 litres of beverage]: 33 cl aluminium cans

Inventory results per 1000 litres	17. Washing & filling	18. Trp	19. Corrugated board incin.	20. Packaging	21. Secondary packaging	22. Trp	23. Trp	24. Box	25. Trp
CO2	5,05E+03	4,30E+00	5,03E+01			3,45E+02	7,22E+01		1,27E+02
CO2 relative	1,50%	0,00%	0,01%	0,00%	0,00%	0,10%	0,02%	0,00%	0,04%
SO2	2,96E+00	4,81E-03	8,39E-02			3,85E-01	8,06E-02		1,42E-01
SO2 relative	0,37%	0,00%	0,01%	0,00%	0,00%	0,05%	0,01%	0,00%	0,02%
NOx	7,94E+00	4,09E-02	1,59E+00			3,28E+00	6,87E-01		1,21E+00
NOx relative	0,63%	0,00%	0,13%	0,00%	0,00%	0,26%	0,05%	0,00%	0,10%
NMVOC:s									
NMVOC	9,00E-02	1,05E-02				8,40E-01	1,76E-01		3,10E-01
NMVOC, diesel engines	5,36E-02	4,16E-03	1,54E-03			3,33E-01	6,98E-02		1,23E-01
NMVOC, el-coal	3,52E-02		1,01E-03						
NMVOC, natural gas combustion									
NMVOC, oil combustion									
NMVOC, petrol engines	6,84E-12		1,96E-13						
NMVOC, power plants	1,70E-02		4,88E-04						
Total NMVOC	1,96E-01	1,47E-02	3,04E-03	0,00E+00	0,00E+00	1,17E+00	2,46E-01	0,00E+00	4,33E-01
Total NMVOC relative	0,14%	0,01%	0,00%	0,00%	0,00%	0,81%	0,17%	0,00%	0,30%
VOC:s									
HC	1,05E-01		3,01E-03						
VOC									
VOC, coal combustion	9,18E-04		2,64E-05						
VOC, diesel engines	2,53E-02		7,28E-04						
VOC, natural gas combustion	7,16E-11		2,06E-12						
Total VOC	1,31E-01	0,00E+00	3,76E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Total VOC relative	0,17%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
"Other specified hydrocarbons"									
Acetaldehyde	5,29E-05								
Acetylene									
Aldehydes	2,29E-05		6,58E-07						
Alkanes									
Alkenes									
Amylaclohol									
Aromates (C9-C10)	3,35E-04		9,63E-06						
Butane	3,70E-02								
Butanol									
Butydiglycole									
Butylglycole									
CH4	9,32E+00	5,41E-03	2,62E-01			4,34E-01	9,08E-02		1,60E-01
Ethane									
Ethene									
Formaldehyde	5,29E-03								
PAH	5,29E-04		1,32E-09						
Pentane	6,35E-02								
Propane	1,06E-02								
Propene									
Xylene									
Total "other"	9,44E+00	5,41E-03	2,62E-01	0,00E+00	0,00E+00	4,34E-01	9,08E-02	0,00E+00	1,60E-01
Total "other" relative	0,73%	0,00%	0,02%	0,00%	0,00%	0,03%	0,01%	0,00%	0,01%

D.1 Inventory results for important air emissions [per 1000 litres of beverage]: 33 cl aluminium cans

Inventory results per 1000 litres	26. Tray	27. Cardboard (Database)	28. Trp	29. Cardboard box	30. LDPE	31. Trp	32. Foil	33. Trp	34. Hi-cone
CO2		6,66E+03	1,06E+02		1,58E+03	1,40E+01		7,22E+00	
CO2 relative	0,00%	1,98%	0,03%	0,00%	0,47%	0,00%	0,00%	0,00%	0,00%
SO2		1,38E+01	1,19E-01		1,13E+01	1,57E-02		8,07E-03	
SO2 relative	0,00%	1,73%	0,01%	0,00%	1,42%	0,00%	0,00%	0,00%	0,00%
NOx		3,39E+01	1,01E+00		1,51E+01	1,33E-01		6,87E-02	
NOx relative	0,00%	2,71%	0,08%	0,00%	1,21%	0,01%	0,00%	0,01%	0,00%
NMVOC:s									
NMVOC		3,22E+00	2,58E-01			3,41E-02		1,76E-02	
NMVOC, diesel engines		1,58E+00	1,03E-01			1,35E-02		6,98E-03	
NMVOC, el-coal		7,60E-02							
NMVOC, natural gas combustion									
NMVOC, oil combustion		2,97E+00							
NMVOC, petrol engines		1,48E-11							
NMVOC, power plants		3,67E-02							
Total NMVOC	0,00E+00	7,87E+00	3,61E-01	0,00E+00	0,00E+00	4,76E-02	0,00E+00	2,46E-02	0,00E+00
Total NMVOC relative	0,00%	5,47%	0,25%	0,00%	0,00%	0,03%	0,00%	0,02%	0,00%
VOC:s									
HC		2,26E-01			2,65E+01				
VOC									
VOC, coal combustion		1,98E-03							
VOC, diesel engines		5,47E-02							
VOC, natural gas combustion		1,55E-10							
Total VOC	0,00E+00	2,83E-01	0,00E+00	0,00E+00	2,65E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Total VOC relative	0,00%	0,37%	0,00%	0,00%	34,73%	0,00%	0,00%	0,00%	0,00%
"Other specified hydrocarbons"									
Acetaldehyde									
Acetylene									
Aldehydes		4,95E-05							
Alkanes									
Alkenes									
Amylaclohol									
Aromates (C9-C10)		7,24E-04							
Butane									
Butanol									
Butydiglycole									
Butylglycole									
CH4		2,28E+01	1,34E-01			1,76E-02		9,08E-03	
Ethane									
Ethene									
Formaldehyde									
PAH		9,91E-08							
Pentane									
Propane									
Propene									
Xylene									
Total "other"	0,00E+00	2,28E+01	1,34E-01	0,00E+00	0,00E+00	1,76E-02	0,00E+00	9,08E-03	0,00E+00
Total "other" relative	0,00%	1,77%	0,01%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%

D.1 Inventory results for important air emissions [per 1000 litres of beverage]: 33 cl aluminium cans

Inventory results per 1000 litres	35. Planks for pallets	36. Trp	37. Pallet	38. Trp	39. Trp	40. Wood incineration	41. Energy use	42. Alt. energy production	43. Trp
CO2	3,14E+02	7,87E+00		2,49E+01	4,99E+00	5,83E+01		-3,32E+03	1,16E+03
CO2 relative	0,09%	0,00%	0,00%	0,01%	0,00%	0,02%	0,00%	-0,99%	0,35%
SO2	4,80E-01	8,79E-03		2,78E-02	5,56E-03	9,72E-02		-2,85E+00	1,31E+00
SO2 relative	0,06%	0,00%	0,00%	0,00%	0,00%	0,01%	0,00%	-0,36%	0,16%
NOx	1,92E+00	7,49E-02		2,37E-01	4,74E-02	1,84E+00		-4,16E+00	1,15E+01
NOx relative	0,15%	0,01%	0,00%	0,02%	0,00%	0,15%	0,00%	-0,33%	0,92%
NMVOC:s									
NMVOC	3,51E-01	1,92E-02		6,06E-02	1,21E-02			-4,77E+00	2,83E+00
NMVOC, diesel engines	2,10E-01	7,61E-03		2,41E-02	4,82E-03	1,78E-03		-1,22E-02	1,11E+00
NMVOC, el-coal	3,42E-03					1,17E-03		-8,01E-03	
NMVOC, natural gas combustion									
NMVOC, oil combustion									
NMVOC, petrol engines	6,63E-13					2,27E-13		-1,56E-12	
NMVOC, power plants	1,65E-03					5,65E-04		-3,87E-03	
Total NMVOC	5,66E-01	2,68E-02	0,00E+00	8,47E-02	1,69E-02	3,52E-03	0,00E+00	-4,79E+00	3,93E+00
Total NMVOC relative	0,39%	0,02%	0,00%	0,06%	0,01%	0,00%	0,00%	-3,32%	2,73%
VOC:s									
HC	8,11E-01					3,48E-03		-2,38E-02	
VOC									
VOC, coal combustion	8,91E-05					3,05E-05		-2,09E-04	
VOC, diesel engines	2,46E-03					8,43E-04		-5,76E-03	
VOC, natural gas combustion	6,94E-12					2,38E-12		-1,63E-11	
Total VOC	8,14E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	4,35E-03	0,00E+00	-2,98E-02	0,00E+00
Total VOC relative	1,07%	0,00%	0,00%	0,00%	0,00%	0,01%	0,00%	-0,04%	0,00%
"Other specified hydrocarbons"									
Acetaldehyde								-1,54E-05	
Acetylene	1,49E-05							-9,27E-04	
Aldehydes	2,22E-06					7,62E-07		-5,21E-06	
Alkanes	3,70E-04							-2,32E-02	
Alkenes	2,96E-05							-1,85E-03	
Amylaclohol									
Aromates (C9-C10)	6,21E-05					1,12E-05		-1,93E-03	
Butane								-1,08E-02	
Butanol									
Butydiglycole									
Butylglycole									
CH4	1,07E+00	9,90E-03		3,13E-02	6,27E-03	3,03E-01		-4,51E+00	1,46E+00
Ethane	2,96E-05							-1,85E-03	
Ethene	7,40E-05							-4,63E-03	
Formaldehyde	8,89E-06							-2,10E-03	
PAH	1,74E-07					1,53E-09		-1,65E-04	
Pentane								-1,85E-02	
Propane	4,44E-05							-5,87E-03	
Propene	2,96E-05							-1,85E-03	
Xylene									
Total "other"	1,07E+00	9,90E-03	0,00E+00	3,13E-02	6,27E-03	3,03E-01	0,00E+00	-4,59E+00	1,46E+00
Total "other" relative	0,08%	0,00%	0,00%	0,00%	0,00%	0,02%	0,00%	-0,36%	0,11%

D.1 Inventory results for important air emissions [per 1000 litres of beverage]: 33 cl aluminium cans

Inventory results per 1000 litres	44. Remelting	45. Trp	46. Trp. - Distribution	47. Trp	48. Retailer	49. Trp	50. Trp	51. Trp	52. Use (refrigeration)	53. Trp	54. Trp
CO2	4,62E+04	3,31E+03	1,84E+04			1,10E+01			4,13E+02	6,26E+00	9,20E+00
CO2 relative	13,75%	0,99%	5,48%	0,00%	0,00%	0,00%	0,00%	0,00%	0,12%	0,00%	0,00%
SO2	7,61E+01	6,60E+00	2,05E+01			1,23E-02			6,89E-01	6,99E-03	1,03E-02
SO2 relative	9,54%	0,83%	2,57%	0,00%	0,00%	0,00%	0,00%	0,00%	0,09%	0,00%	0,00%
NOx	1,27E+02	3,41E+01	1,75E+02			1,05E-01			1,10E+00	5,95E-02	8,76E-02
NOx relative	10,18%	2,73%	13,98%	0,00%	0,00%	0,01%	0,00%	0,00%	0,09%	0,00%	0,01%
NMVOC:s											
NMVOC		7,60E+00	4,47E+01			2,69E-02				1,52E-02	2,24E-02
NMVOC, diesel engines	1,34E+00	3,14E+00	2,34E+01			1,07E-02			1,26E-02	6,05E-03	8,90E-03
NMVOC, el-coal	8,80E-01								8,30E-03		
NMVOC, natural gas combustion	1,03E-01										
NMVOC, oil combustion	6,78E+00	4,62E-01									
NMVOC, petrol engines	1,71E-10								1,61E-12		
NMVOC, power plants	4,25E-01								4,01E-03		
Total NMVOC	9,53E+00	1,12E+01	6,82E+01	0,00E+00	0,00E+00	3,76E-02	0,00E+00	0,00E+00	2,49E-02	2,13E-02	3,13E-02
Total NMVOC relative	6,62%	7,77%	47,32%	0,00%	0,00%	0,03%	0,00%	0,00%	0,02%	0,01%	0,02%
VOC:s											
HC	2,62E+00								2,47E-02		
VOC											
VOC, coal combustion	2,29E-02								2,17E-04		
VOC, diesel engines	6,33E-01								5,98E-03		
VOC, natural gas combustion	1,79E-09								1,69E-11		
Total VOC	3,27E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	3,09E-02	0,00E+00	0,00E+00
Total VOC relative	4,29%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,04%	0,00%	0,00%
"Other specified hydrocarbons"											
Acetaldehyde											
Acetylene											
Aldehydes	5,73E-04								5,41E-06		
Alkanes											
Alkenes											
Amylaclohol											
Aromates (C9-C10)	8,38E-03								7,91E-05		
Butane											
Butanol											
Butydiglycole											
Butylglycole											
CH4	2,31E+02	4,16E+00	2,33E+01			1,39E-02			2,15E+00	7,87E-03	1,16E-02
Ethane											
Ethene											
Formaldehyde											
PAH	1,15E-06								1,08E-08		
Pentane											
Propane											
Propene											
Xylene											
Total "other"	2,31E+02	4,16E+00	2,33E+01	0,00E+00	0,00E+00	1,39E-02	0,00E+00	0,00E+00	2,15E+00	7,87E-03	1,16E-02
Total "other" relative	17,97%	0,32%	1,81%	0,00%	0,00%	0,00%	0,00%	0,00%	0,17%	0,00%	0,00%

D.1 Inventory results for important air emissions [per 1000 litres of beverage]: 33 cl aluminium cans

Inventory results per 1000 litres	55. Testliner	56. New product	57. Avoided kraftliner (Database)	58. Avoided testliner	59. Other products
CO2	1,79E+03		-2,48E+03	-3,58E+02	
CO2 relative	0,53%	0,00%	-0,74%	-0,11%	0,00%
SO2	6,90E-01		-5,47E+00	-1,38E-01	
SO2 relative	0,09%	0,00%	-0,69%	-0,02%	0,00%
NOx	3,29E+00		-1,11E+01	-6,57E-01	
NOx relative	0,26%	0,00%	-0,89%	-0,05%	0,00%
NMVOC:s					
NMVOC	5,74E-02		-5,41E-01	-1,15E-02	
NMVOC, diesel engines	4,94E-03		1,69E-02	-9,87E-04	
NMVOC, el-coal	3,24E-03		-3,21E-02	-6,49E-04	
NMVOC, natural gas combustion					
NMVOC, oil combustion	2,31E-02		-1,26E+00	-4,62E-03	
NMVOC, petrol engines	6,30E-13		-6,24E-12	-1,26E-13	
NMVOC, power plants	1,57E-03		-1,55E-02	-3,13E-04	
Total NMVOC	9,03E-02	0,00E+00	-1,83E+00	-1,81E-02	0,00E+00
Total NMVOC relative	0,06%	0,00%	-1,27%	-0,01%	0,00%
VOC:s					
HC	9,65E-03		-9,56E-02	-1,93E-03	
VOC					
VOC, coal combustion	8,46E-05		-8,38E-04	-1,69E-05	
VOC, diesel engines	2,34E-03		-2,31E-02	-4,67E-04	
VOC, natural gas combustion	6,59E-12		-6,53E-11	-1,32E-12	
Total VOC	1,21E-02	0,00E+00	-1,20E-01	-2,41E-03	0,00E+00
Total VOC relative	0,02%	0,00%	-0,16%	0,00%	0,00%
"Other specified hydrocarbons"					
Acetaldehyde					
Acetylene					
Aldehydes	2,11E-06		-2,09E-05	-4,22E-07	
Alkanes					
Alkenes					
Amylaclohol					
Aromates (C9-C10)	3,09E-05		-3,06E-04	-6,18E-06	
Butane					
Butanol					
Butydiglycole					
Butylglycole					
CH4	9,11E-01		-9,20E+00	-1,82E-01	
Ethane					
Ethene					
Formaldehyde					
PAH	4,23E-09		-4,19E-08	-8,46E-10	
Pentane					
Propane					
Propene					
Xylene					
Total "other"	9,11E-01	0,00E+00	-9,20E+00	-1,82E-01	0,00E+00
Total "other" relative	0,07%	0,00%	-0,72%	-0,01%	0,00%

D.1 Inventory results for important air emissions [per 1000 litres of beverage]: 33 cl aluminium cans

Inventory results per 1000 litres	60. Landfill-corrugated board	61. Trp	62. Waste management	63. Aluminium incineration	64. PE incineration
CO2	2,25E+00	7,19E+01		1,82E+02	3,94E+03
CO2 relative	0,00%	0,02%	0,00%	0,05%	1,17%
SO2	2,57E-03	8,03E-02		3,03E-01	8,78E-02
SO2 relative	0,00%	0,01%	0,00%	0,04%	0,01%
NOx	2,06E-02	6,84E-01		5,73E+00	1,66E+00
NOx relative	0,00%	0,05%	0,00%	0,46%	0,13%
NMVOC:s					
NMVOC	5,19E-03	1,75E-01			
NMVOC, diesel engines	4,33E-03	6,95E-02		5,56E-03	1,61E-03
NMVOC, el-coal	2,36E-06			3,65E-03	1,06E-03
NMVOC, natural gas combustion					
NMVOC, oil combustion					
NMVOC, petrol engines	4,58E-16			7,10E-13	2,06E-13
NMVOC, power plants	1,14E-06			1,76E-03	5,11E-04
Total NMVOC	9,52E-03	2,45E-01	0,00E+00	1,10E-02	3,18E-03
Total NMVOC relative	0,01%	0,17%	0,00%	0,01%	0,00%
VOC:s					
HC	7,02E-06			1,09E-02	3,15E-03
VOC					
VOC, coal combustion	6,15E-08			9,53E-05	2,76E-05
VOC, diesel engines	1,70E-06			2,63E-03	7,62E-04
VOC, natural gas combustion	4,79E-15			7,43E-12	2,15E-12
Total VOC	8,78E-06	0,00E+00	0,00E+00	1,36E-02	3,94E-03
Total VOC relative	0,00%	0,00%	0,00%	0,02%	0,01%
"Other specified hydrocarbons"					
Acetaldehyde					
Acetylene					
Aldehydes	1,54E-09			2,38E-06	6,89E-07
Alkanes					
Alkenes					
Amylaclohol					
Aromates (C9-C10)	2,25E-08			3,48E-05	1,01E-05
Butane					
Butanol					
Butydiglycole					
Butylglycole					
CH4	6,03E+01	9,04E-02		9,45E-01	2,74E-01
Ethane					
Ethene					
Formaldehyde					
PAH	3,08E-12			4,76E-09	1,38E-09
Pentane					
Propane					
Propene					
Xylene					
Total "other"	6,03E+01	9,04E-02	0,00E+00	9,45E-01	2,74E-01
Total "other" relative	4,69%	0,01%	0,00%	0,07%	0,02%

D.1 Inventory results for important air emissions [per 1000 litres of beverage]: 33 cl aluminium cans

Inventory results per 1000 litres	65. Cardboard/corrugated board incin.	66. Energy use	67. Alt. energy production	Total
CO2	6,04E+02		-3,13E+04	**3,36E+05**
CO2 relative	0,18%	0,00%	-9,32%	**100,00%**
SO2	1,01E+00		-2,68E+01	**7,98E+02**
SO2 relative	0,13%	0,00%	-3,36%	**100,00%**
NOx	1,90E+01		-3,91E+01	**1,25E+03**
NOx relative	1,52%	0,00%	-3,13%	**100,00%**
NMVOC:s				
NMVOC			-4,48E+01	**3,34E+01**
NMVOC, diesel engines	1,85E-02		-1,15E-01	**4,95E+01**
NMVOC, el-coal	1,21E-02		-7,54E-02	**4,98E+00**
NMVOC, natural gas combustion				**1,03E-01**
NMVOC, oil combustion				**5,37E+01**
NMVOC, petrol engines	2,36E-12		-1,46E-11	**9,67E-10**
NMVOC, power plants	5,86E-03		-3,64E-02	**2,40E+00**
Total NMVOC	3,65E-02	0,00E+00	-4,51E+01	**1,44E+02**
Total NMVOC relative	0,03%	0,00%	-31,28%	**100,00%**
VOC:s				
HC	3,61E-02		-2,24E-01	**4,97E+01**
VOC				**2,28E+01**
VOC, coal combustion	3,16E-04		-1,97E-03	**1,30E-01**
VOC, diesel engines	8,74E-03		-5,42E-02	**3,58E+00**
VOC, natural gas combustion	2,47E-11		-1,53E-10	**1,01E-08**
Total VOC	4,52E-02	0,00E+00	-2,80E-01	**7,62E+01**
Total VOC relative	0,06%	0,00%	-0,37%	**100,00%**
"Other specified hydrocarbons"				
Acetaldehyde			-1,45E-04	**3,39E-04**
Acetylene			-8,72E-03	**-9,62E-03**
Aldehydes	7,90E-06		-4,90E-05	**4,63E-03**
Alkanes			-2,18E-01	**-1,89E-01**
Alkenes			-1,74E-02	**-1,67E-02**
Amylaclohol				**5,15E+00**
Aromates (C9-C10)	1,16E-04		-1,82E-02	**4,09E-02**
Butane			-1,02E-01	**2,37E-01**
Butanol				**2,09E+01**
Butydiglycole				**9,05E-01**
Butylglycole				**2,75E+01**
CH4	3,14E+00		-4,25E+01	**1,23E+03**
Ethane			-1,74E-02	**-1,92E-02**
Ethene			-4,36E-02	**-4,81E-02**
Formaldehyde			-1,98E-02	**6,63E-02**
PAH	1,58E-08		-1,55E-03	**3,18E-01**
Pentane			-1,74E-01	**4,06E-01**
Propane			-5,52E-02	**4,14E-02**
Propene			-1,74E-02	**-1,92E-02**
Xylene				**6,04E-01**
Total "other"	3,14E+00	0,00E+00	-4,32E+01	**1,29E+03**
Total "other" relative	0,24%	0,00%	-3,36%	**100,00%**

D.2 Inventory results for important air emissions [per 1000 litres of beverage]: 50 cl aluminium cans

Inventory results per 1000 litres	68. Methyl acrylate (Data Base)	69. Trp	70. Epoxy resins	71. Trp	1. Bauxite mining - Alumina production	2. Trp
CO2	5,52E+03	7,35E+01	2,47E+04	1,19E+02	1,08E+04	2,71E+03
CO2 relative	2,06%	0,03%	9,22%	0,04%	4,03%	1,01%
SO2	2,11E+01	8,24E-02	3,66E+01	1,50E-01	8,80E+01	4,52E+01
SO2 relative	3,35%	0,01%	5,82%	0,02%	13,98%	7,18%
NOx	2,04E+01	7,08E-01	5,31E+01	1,58E+00	2,68E+01	6,36E+01
NOx relative	2,00%	0,07%	5,21%	0,15%	2,63%	6,24%
NMVOC:s						
NMVOC	1,21E-02	1,79E-01	3,29E-01	2,88E-01		8,77E-02
NMVOC, diesel engines	1,50E-04	7,06E-02	3,93E-01	9,57E-02	7,16E-02	1,73E+00
NMVOC, el-coal			2,58E-01		4,71E-02	
NMVOC, natural gas combustion						
NMVOC, oil combustion	8,45E+00		1,45E+01			6,70E+00
NMVOC, petrol engines	2,17E-14		5,01E-11		9,14E-12	
NMVOC, power plants	6,12E-05		1,25E-01		2,27E-02	
Total NMVOC	8,47E+00	2,50E-01	1,56E+01	3,84E-01	1,41E-01	8,52E+00
Total NMVOC relative	6,37%	0,19%	11,74%	0,29%	0,11%	6,42%
VOC:s						
HC	7,57E+00		7,68E-01		1,40E-01	
VOC					2,87E+00	
VOC, coal combustion	3,41E-06		6,73E-03		1,23E-03	
VOC, diesel engines	8,02E-05		1,86E-01		3,39E-02	
VOC, natural gas combustion	2,26E-13		5,25E-10		9,57E-11	
Total VOC	7,57E+00	0,00E+00	9,61E-01	0,00E+00	3,05E+00	0,00E+00
Total VOC relative	12,40%	0,00%	1,57%	0,00%	4,99%	0,00%
"Other specified hydrocarbons"						
Acetaldehyde			1,36E-04			
Acetylene						
Aldehydes	1,39E-03		1,68E-04		3,06E-05	
Alkanes	2,19E-02		1,76E-02			
Alkenes	1,10E-03		8,78E-04			
Amylaclohol						
Aromates (C9-C10)	5,49E-03		6,85E-03		4,49E-04	
Butane			9,49E-02			
Butanol						
Butydiglycole						
Butylglycole						
CH4	4,97E+00	9,23E-02	7,48E+01	1,46E-01	1,22E+01	3,41E+00
Ethane						
Ethene						
Formaldehyde	1,64E-02		2,67E-02			
PAH	1,83E-05		1,37E-03		6,14E-08	
Pentane			1,63E-01			
Propane	1,10E-03		2,80E-02			
Propene						
Xylene						
Total "other"	5,02E+00	9,23E-02	7,52E+01	1,46E-01	1,22E+01	3,41E+00
Total "other" relative	0,49%	0,01%	7,37%	0,01%	1,19%	0,33%

D.2 Inventory results for important air emissions [per 1000 litres of beverage]: 50 cl aluminium cans

Inventory results per 1000 litres	3. Electrolysis (prebake)	4. Trp	5. Cast house	6. Manganese production	7. Trp	8. Strip rolling	9. Trp	10. Trp
CO2		9,03E+02	6,96E+04	6,10E+02	1,53E+02	3,68E+04	3,09E+01	2,98E+03
CO2 relative	0,00%	0,34%	25,97%	0,23%	0,06%	13,73%	0,01%	1,11%
SO2		1,43E+01	1,72E+02	1,01E+00	2,13E-01	5,03E+01	6,17E-02	6,14E+00
SO2 relative	0,00%	2,27%	27,27%	0,16%	0,03%	8,00%	0,01%	0,98%
NOx		2,04E+01	1,58E+02	1,66E+00	1,49E+00	8,68E+01	3,19E-01	3,09E+01
NOx relative	0,00%	2,00%	15,47%	0,16%	0,15%	8,51%	0,03%	3,03%
NMVOC:s								
NMVOC		1,10E-01		1,43E-02	3,66E-01	1,82E-01	7,10E-02	6,82E+00
NMVOC, diesel engines		5,78E-01	1,78E+00	3,04E-02	1,47E-01	9,22E-01	2,93E-02	2,82E+00
NMVOC, el-coal		3,07E-04	1,17E+00	1,21E-02		6,06E-01		
NMVOC, natural gas combustion								
NMVOC, oil combustion		2,11E+00			6,75E-03		4,32E-03	4,47E-01
NMVOC, petrol engines		5,96E-14	2,27E-10	2,36E-12		1,18E-10		
NMVOC, power plants		1,48E-04	5,63E-01	5,86E-03		2,92E-01		
Total NMVOC	0,00E+00	2,80E+00	3,51E+00	6,27E-02	5,20E-01	2,00E+00	1,05E-01	1,01E+01
Total NMVOC relative	0,00%	2,11%	2,64%	0,05%	0,39%	1,51%	0,08%	7,60%
VOC:s								
HC		9,13E-04	3,47E+00	3,61E-02		1,80E+00		
VOC			9,74E-02			1,58E+01		
VOC, coal combustion		8,01E-06	3,04E-02	3,16E-04		1,58E-02		
VOC, diesel engines		2,21E-04	8,40E-01	8,74E-03		4,36E-01		
VOC, natural gas combustion		6,24E-13	2,37E-09	2,47E-11		1,23E-09		
Total VOC	0,00E+00	1,14E-03	4,44E+00	4,52E-02	0,00E+00	1,80E+01	0,00E+00	0,00E+00
Total VOC relative	0,00%	0,00%	7,27%	0,07%	0,00%	29,56%	0,00%	0,00%
"Other specified hydrocarbons"								
Acetaldehyde						1,07E-04		
Acetylene								
Aldehydes		2,00E-07	7,60E-04	7,90E-06		3,94E-04		
Alkanes								
Alkenes								
Amylaclohol								
Aromates (C9-C10)		2,92E-06	1,11E-02	1,16E-04		5,77E-03		
Butane						7,48E-02		
Butanol								
Butydiglycole								
Butylglycole								
CH4		1,20E+00	3,02E+02	3,15E+00	1,92E-01	1,57E+02	3,89E-02	3,75E+00
Ethane								
Ethene								
Formaldehyde						1,07E-02		
PAH		4,00E-10	2,43E-01	1,58E-08		1,07E-03		
Pentane						1,28E-01		
Propane						2,14E-02		
Propene								
Xylene								
Total "other"	0,00E+00	1,20E+00	3,02E+02	3,15E+00	1,92E-01	1,57E+02	3,89E-02	3,75E+00
Total "other" relative	0,00%	0,12%	29,63%	0,31%	0,02%	15,43%	0,00%	0,37%

D.2 Inventory results for important air emissions [per 1000 litres of beverage]: 50 cl aluminium cans

Inventory results per 1000 litres	11. Can production	12. Corrugated board (Database)	13. Use of recycled fibres (Database)	14. Trp	15. Trp	16. Trp
CO2	4,97E+04	9,77E+03	3,16E+03	3,17E+01	2,16E+02	1,38E+03
CO2 relative	18,54%	3,65%	1,18%	0,01%	0,08%	0,51%
SO2	7,19E+01	2,06E+01	1,14E+01	3,56E-02	2,41E-01	1,55E+00
SO2 relative	11,42%	3,28%	1,80%	0,01%	0,04%	0,25%
NOx	1,24E+02	3,04E+01	2,80E+01	3,07E-01	2,05E+00	1,34E+01
NOx relative	12,18%	2,98%	2,74%	0,03%	0,20%	1,31%
NMVOC:s						
NMVOC	1,92E-01	2,28E+00	3,25E+00	7,72E-02	5,25E-01	3,37E+00
NMVOC, diesel engines	1,32E+00	9,10E-01	1,52E+00	3,05E-02	2,09E-01	1,33E+00
NMVOC, el-coal	8,65E-01	6,81E-02	6,25E-02			
NMVOC, natural gas combustion						
NMVOC, oil combustion		4,17E+00	2,55E+00			
NMVOC, petrol engines	1,68E-10	1,36E-11	1,21E-11			
NMVOC, power plants	4,18E-01	3,39E-02	3,02E-02			
Total NMVOC	2,79E+00	7,46E+00	7,41E+00	1,08E-01	7,34E-01	4,70E+00
Total NMVOC relative	2,10%	5,62%	5,58%	0,08%	0,55%	3,54%
VOC:s						
HC	2,57E+00	2,09E-01	1,86E-01			
VOC						
VOC, coal combustion	2,26E-02	1,83E-03	1,63E-03			
VOC, diesel engines	6,23E-01	5,04E-02	4,50E-02			
VOC, natural gas combustion	1,76E-09	1,42E-10	1,27E-10			
Total VOC	3,22E+00	2,61E-01	2,33E-01	0,00E+00	0,00E+00	0,00E+00
Total VOC relative	5,27%	0,43%	0,38%	0,00%	0,00%	0,00%
"Other specified hydrocarbons"						
Acetaldehyde	1,13E-04	4,42E-06				
Acetylene		7,85E-06				
Aldehydes	5,63E-04	4,58E-05	4,07E-05			
Alkanes		7,97E-03				
Alkenes		4,04E-04				
Amylaclohol	5,23E+00					
Aromates (C9-C10)	8,24E-03	2,63E-03	5,96E-04			
Butane	7,89E-02	3,09E-03				
Butanol	2,11E+01					
Butydiglycole	8,02E-01					
Butylglycole	2,75E+01					
CH4	2,24E+02	2,16E+01	-1,05E+02	3,99E-02	2,71E-01	1,74E+00
Ethane		1,57E-05				
Ethene		3,93E-05				
Formaldehyde	1,13E-02	6,27E-03				
PAH	1,13E-03	5,08E-05	8,15E-08			
Pentane	1,35E-01	5,30E-03				
Propane	2,26E-02	1,30E-03				
Propene		1,57E-05				
Xylene	6,05E-01					
Total "other"	2,80E+02	2,16E+01	-1,05E+02	3,99E-02	2,71E-01	1,74E+00
Total "other" relative	27,44%	2,12%	-10,31%	0,00%	0,03%	0,17%

D.2 Inventory results for important air emissions [per 1000 litres of beverage]: 50 cl aluminium cans

Inventory results per 1000 litres	17. Washing & filling	18. Trp	19. Corrugated board incin.	20. Packaging	21. Secondary packaging	22. Trp	23. Trp	24. Box	25. Trp
CO2	5,08E+03	2,85E+00	3,34E+01			2,57E+02	5,37E+01		9,47E+01
CO2 relative	1,90%	0,00%	0,01%	0,00%	0,00%	0,10%	0,02%	0,00%	0,04%
SO2	2,98E+00	3,19E-03	5,56E-02			2,86E-01	6,00E-02		1,06E-01
SO2 relative	0,47%	0,00%	0,01%	0,00%	0,00%	0,05%	0,01%	0,00%	0,02%
NOx	7,98E+00	2,71E-02	1,05E+00			2,44E+00	5,11E-01		9,02E-01
NOx relative	0,78%	0,00%	0,10%	0,00%	0,00%	0,24%	0,05%	0,00%	0,09%
NMVOC:s									
NMVOC	9,06E-02	6,94E-03				6,24E-01	1,31E-01		2,31E-01
NMVOC, diesel engines	5,39E-02	2,76E-03	1,02E-03			2,48E-01	5,19E-02		9,16E-02
NMVOC, el-coal	3,54E-02		6,70E-04						
NMVOC, natural gas combustion									
NMVOC, oil combustion									
NMVOC, petrol engines	6,88E-12		1,30E-13						
NMVOC, power plants	1,71E-02		3,24E-04						
Total NMVOC	1,97E-01	9,70E-03	2,01E-03	0,00E+00	0,00E+00	8,72E-01	1,83E-01	0,00E+00	3,23E-01
Total NMVOC relative	0,15%	0,01%	0,00%	0,00%	0,00%	0,66%	0,14%	0,00%	0,24%
VOC:s									
HC	1,05E-01		1,99E-03						
VOC									
VOC, coal combustion	9,23E-04		1,75E-05						
VOC, diesel engines	2,55E-02		4,83E-04						
VOC, natural gas combustion	7,20E-11		1,36E-12						
Total VOC	1,31E-01	0,00E+00	2,49E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Total VOC relative	0,22%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
"Other specified hydrocarbons"									
Acetaldehyde	5,33E-05								
Acetylene									
Aldehydes	2,30E-05		4,36E-07						
Alkanes									
Alkenes									
Amylaclohol									
Aromates (C9-C10)	3,37E-04		6,39E-06						
Butane	3,73E-02								
Butanol									
Butydiglycole									
Butylglycole									
CH4	9,38E+00	3,59E-03	1,73E-01			3,23E-01	6,75E-02		1,19E-01
Ethane									
Ethene									
Formaldehyde	5,33E-03								
PAH	5,33E-04		8,74E-10						
Pentane	6,39E-02								
Propane	1,07E-02								
Propene									
Xylene									
Total "other"	9,49E+00	3,59E-03	1,73E-01	0,00E+00	0,00E+00	3,23E-01	6,75E-02	0,00E+00	1,19E-01
Total "other" relative	0,93%	0,00%	0,02%	0,00%	0,00%	0,03%	0,01%	0,00%	0,01%

D.2 Inventory results for important air emissions [per 1000 litres of beverage]: 50 cl aluminium cans

Inventory results per 1000 litres	26. Tray	27. Cardboard (Database)	28. Trp	29. Cardboard box	30. LDPE	31. Trp	32. Foil	33. Trp	34. Hi-cone
CO2		4,95E+03	7,89E+01		1,17E+03	1,04E+01		5,37E+00	
CO2 relative	0,00%	1,85%	0,03%	0,00%	0,44%	0,00%	0,00%	0,00%	0,00%
SO2		1,03E+01	8,82E-02		8,44E+00	1,16E-02		6,00E-03	
SO2 relative	0,00%	1,63%	0,01%	0,00%	1,34%	0,00%	0,00%	0,00%	0,00%
NOx		2,52E+01	7,51E-01		1,12E+01	9,92E-02		5,11E-02	
NOx relative	0,00%	2,47%	0,07%	0,00%	1,10%	0,01%	0,00%	0,01%	0,00%
NMVOC:s									
NMVOC		2,39E+00	1,92E-01			2,54E-02		1,31E-02	
NMVOC, diesel engines		1,17E+00	7,63E-02			1,01E-02		5,19E-03	
NMVOC, el-coal		5,65E-02							
NMVOC, natural gas combustion									
NMVOC, oil combustion		2,21E+00							
NMVOC, petrol engines		1,10E-11							
NMVOC, power plants		2,73E-02							
Total NMVOC	0,00E+00	5,85E+00	2,68E-01	0,00E+00	0,00E+00	3,55E-02	0,00E+00	1,83E-02	0,00E+00
Total NMVOC relative	0,00%	4,41%	0,20%	0,00%	0,00%	0,03%	0,00%	0,01%	0,00%
VOC:s									
HC		1,68E-01			1,97E+01				
VOC									
VOC, coal combustion		1,47E-03							
VOC, diesel engines		4,07E-02							
VOC, natural gas combustion		1,15E-10							
Total VOC	0,00E+00	2,10E-01	0,00E+00	0,00E+00	1,97E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Total VOC relative	0,00%	0,34%	0,00%	0,00%	32,24%	0,00%	0,00%	0,00%	0,00%
"Other specified hydrocarbons"									
Acetaldehyde									
Acetylene									
Aldehydes		3,68E-05							
Alkanes									
Alkenes									
Amylaclohol									
Aromates (C9-C10)		5,39E-04							
Butane									
Butanol									
Butydiglycole									
Butylglycole									
CH4		1,70E+01	9,93E-02			1,31E-02		6,75E-03	
Ethane									
Ethene									
Formaldehyde									
PAH		7,37E-08							
Pentane									
Propane									
Propene									
Xylene									
Total "other"	0,00E+00	1,70E+01	9,93E-02	0,00E+00	0,00E+00	1,31E-02	0,00E+00	6,75E-03	0,00E+00
Total "other" relative	0,00%	1,66%	0,01%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%

D.2 Inventory results for important air emissions [per 1000 litres of beverage]: 50 cl aluminium cans

Inventory results per 1000 litres	35. Planks for pallets	36. Trp	37. Pallet	38. Trp	39. Trp	40. Wood incineration	41. Energy use	42. Alt. energy production	43. Trp
CO2	2,67E+02	6,70E+00		2,12E+01	4,24E+00	4,96E+01		-2,57E+03	9,87E+02
CO2 relative	0,10%	0,00%	0,00%	0,01%	0,00%	0,02%	0,00%	-0,96%	0,37%
SO2	4,08E-01	7,48E-03		2,37E-02	4,73E-03	8,27E-02		-2,20E+00	1,12E+00
SO2 relative	0,06%	0,00%	0,00%	0,00%	0,00%	0,01%	0,00%	-0,35%	0,18%
NOx	1,64E+00	6,37E-02		2,02E-01	4,03E-02	1,56E+00		-3,21E+00	9,73E+00
NOx relative	0,16%	0,01%	0,00%	0,02%	0,00%	0,15%	0,00%	-0,32%	0,95%
NMVOC:s									
NMVOC	2,98E-01	1,63E-02		5,16E-02	1,03E-02			-3,68E+00	2,40E+00
NMVOC, diesel engines	1,79E-01	6,47E-03		2,05E-02	4,10E-03	1,52E-03		-9,41E-03	9,39E-01
NMVOC, el-coal	2,91E-03					9,96E-04		-6,19E-03	
NMVOC, natural gas combustion									
NMVOC, oil combustion									
NMVOC, petrol engines	5,64E-13					1,93E-13		-1,20E-12	
NMVOC, power plants	1,40E-03					4,81E-04		-2,99E-03	
Total NMVOC	4,81E-01	2,28E-02	0,00E+00	7,21E-02	1,44E-02	3,00E-03	0,00E+00	-3,70E+00	3,34E+00
Total NMVOC relative	0,36%	0,02%	0,00%	0,05%	0,01%	0,00%	0,00%	-2,79%	2,51%
VOC:s									
HC	6,90E-01					2,96E-03		-1,84E-02	
VOC									
VOC, coal combustion	7,58E-05					2,60E-05		-1,61E-04	
VOC, diesel engines	2,09E-03					7,17E-04		-4,45E-03	
VOC, natural gas combustion	5,90E-12					2,02E-12		-1,26E-11	
Total VOC	6,92E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	3,70E-03	0,00E+00	-2,30E-02	0,00E+00
Total VOC relative	1,13%	0,00%	0,00%	0,00%	0,00%	0,01%	0,00%	-0,04%	0,00%
"Other specified hydrocarbons"									
Acetaldehyde								-1,19E-05	
Acetylene	1,26E-05							-7,16E-04	
Aldehydes	1,89E-06					6,48E-07		-4,03E-06	
Alkanes	3,15E-04							-1,79E-02	
Alkenes	2,52E-05							-1,43E-03	
Amylaclohol									
Aromates (C9-C10)	5,28E-05					9,49E-06		-1,49E-03	
Butane								-8,34E-03	
Butanol									
Butydiglycole									
Butylglycole									
CH4	9,08E-01	8,42E-03		2,66E-02	5,33E-03	2,58E-01		-3,49E+00	1,24E+00
Ethane	2,52E-05							-1,43E-03	
Ethene	6,30E-05							-3,58E-03	
Formaldehyde	7,56E-06							-1,62E-03	
PAH	1,48E-07					1,30E-09		-1,27E-04	
Pentane								-1,43E-02	
Propane	3,78E-05							-4,53E-03	
Propene	2,52E-05							-1,43E-03	
Xylene									
Total "other"	9,09E-01	8,42E-03	0,00E+00	2,66E-02	5,33E-03	2,58E-01	0,00E+00	-3,54E+00	1,24E+00
Total "other" relative	0,09%	0,00%	0,00%	0,00%	0,00%	0,03%	0,00%	-0,35%	0,12%

D.2 Inventory results for important air emissions [per 1000 litres of beverage]: 50 cl aluminium cans

Inventory results per 1000 litres	44. Remelting	45. Trp	46. Trp. - Distribution	47. Trp	48. Retailer	49. Trp	50. Trp	51. Trp	52. Use (refrigeration)	53. Trp	54. Trp
CO2	3,88E+04	2,78E+03	1,82E+04			7,32E+00			3,51E+02	5,19E+00	7,34E+00
CO2 relative	14,48%	1,04%	6,79%	0,00%	0,00%	0,00%	0,00%	0,00%	0,13%	0,00%	0,00%
SO2	6,39E+01	5,55E+00	2,03E+01			8,17E-03			5,85E-01	5,80E-03	8,19E-03
SO2 relative	10,15%	0,88%	3,23%	0,00%	0,00%	0,00%	0,00%	0,00%	0,09%	0,00%	0,00%
NOx	1,07E+02	2,86E+01	1,73E+02			6,96E-02			9,33E-01	4,94E-02	6,98E-02
NOx relative	10,48%	2,80%	16,98%	0,00%	0,00%	0,01%	0,00%	0,00%	0,09%	0,00%	0,01%
NMVOC:s											
NMVOC		6,38E+00	4,43E+01			1,78E-02				1,26E-02	1,79E-02
NMVOC, diesel engines	1,12E+00	2,63E+00	2,32E+01			7,07E-03			1,07E-02	5,02E-03	7,09E-03
NMVOC, el-coal	7,39E-01								7,05E-03		
NMVOC, natural gas combustion	8,63E-02										
NMVOC, oil combustion	5,69E+00	3,88E-01									
NMVOC, petrol engines	1,43E-10								1,37E-12		
NMVOC, power plants	3,57E-01								3,40E-03		
Total NMVOC	8,00E+00	9,40E+00	6,75E+01	0,00E+00	0,00E+00	2,49E-02	0,00E+00	0,00E+00	2,12E-02	1,76E-02	2,50E-02
Total NMVOC relative	6,02%	7,08%	50,84%	0,00%	0,00%	0,02%	0,00%	0,00%	0,02%	0,01%	0,02%
VOC:s											
HC	2,20E+00								2,10E-02		
VOC											
VOC, coal combustion	1,93E-02								1,84E-04		
VOC, diesel engines	5,32E-01								5,07E-03		
VOC, natural gas combustion	1,50E-09								1,43E-11		
Total VOC	2,75E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,63E-02	0,00E+00	0,00E+00
Total VOC relative	4,50%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,04%	0,00%	0,00%
"Other specified hydrocarbons"											
Acetaldehyde											
Acetylene											
Aldehydes	4,81E-04								4,59E-06		
Alkanes											
Alkenes											
Amylaclohol											
Aromates (C9-C10)	7,04E-03								6,72E-05		
Butane											
Butanol											
Butydiglycole											
Butylglycole											
CH4	1,94E+02	3,49E+00	2,31E+01			9,20E-03			1,82E+00	6,53E-03	9,22E-03
Ethane											
Ethene											
Formaldehyde											
PAH	9,63E-07								9,19E-09		
Pentane											
Propane											
Propene											
Xylene											
Total "other"	1,94E+02	3,49E+00	2,31E+01	0,00E+00	0,00E+00	9,20E-03	0,00E+00	0,00E+00	1,82E+00	6,53E-03	9,22E-03
Total "other" relative	19,03%	0,34%	2,26%	0,00%	0,00%	0,00%	0,00%	0,00%	0,18%	0,00%	0,00%

D.2 Inventory results for important air emissions [per 1000 litres of beverage]: 50 cl aluminium cans

Inventory results per 1000 litres	55. Testliner	56. New product	57. Avoided kraftliner (Database)	58. Avoided testliner	59. Other products
CO2	1,34E+03		-1,86E+03	-2,68E+02	
CO2 relative	0,50%	0,00%	-0,69%	-0,10%	0,00%
SO2	5,16E-01		-4,10E+00	-1,03E-01	
SO2 relative	0,08%	0,00%	-0,65%	-0,02%	0,00%
NOx	2,46E+00		-8,33E+00	-4,92E-01	
NOx relative	0,24%	0,00%	-0,82%	-0,05%	0,00%
NMVOC:s					
NMVOC	4,30E-02		-4,05E-01	-8,60E-03	
NMVOC, diesel engines	3,70E-03		1,27E-02	-7,39E-04	
NMVOC, el-coal	2,43E-03		-2,41E-02	-4,86E-04	
NMVOC, natural gas combustion					
NMVOC, oil combustion	1,73E-02		-9,39E-01	-3,46E-03	
NMVOC, petrol engines	4,72E-13		-4,67E-12	-9,43E-14	
NMVOC, power plants	1,17E-03		-1,16E-02	-2,35E-04	
Total NMVOC	6,76E-02	0,00E+00	-1,37E+00	-1,35E-02	0,00E+00
Total NMVOC relative	0,05%	0,00%	-1,03%	-0,01%	0,00%
VOC:s					
HC	7,22E-03		-7,16E-02	-1,44E-03	
VOC					
VOC, coal combustion	6,33E-05		-6,27E-04	-1,27E-05	
VOC, diesel engines	1,75E-03		-1,73E-02	-3,50E-04	
VOC, natural gas combustion	4,94E-12		-4,89E-11	-9,87E-13	
Total VOC	9,03E-03	0,00E+00	-8,95E-02	-1,80E-03	0,00E+00
Total VOC relative	0,01%	0,00%	-0,15%	0,00%	0,00%
"Other specified hydrocarbons"					
Acetaldehyde					
Acetylene					
Aldehydes	1,58E-06		-1,57E-05	-3,16E-07	
Alkanes					
Alkenes					
Amylaclohol					
Aromates (C9-C10)	2,31E-05		-2,29E-04	-4,63E-06	
Butane					
Butanol					
Butydiglycole					
Butylglycole					
CH4	6,82E-01		-6,89E+00	-1,36E-01	
Ethane					
Ethene					
Formaldehyde					
PAH	3,17E-09		-3,14E-08	-6,33E-10	
Pentane					
Propane					
Propene					
Xylene					
Total "other"	6,82E-01	0,00E+00	-6,89E+00	-1,36E-01	0,00E+00
Total "other" relative	0,07%	0,00%	-0,68%	-0,01%	0,00%

D.2 Inventory results for important air emissions [per 1000 litres of beverage]: 50 cl aluminium cans

Inventory results per 1000 litres	60. Landfill-corrugated board	61. Trp	62. Waste management	63. Aluminium incineration	64. PE incineration
CO2	1,68E+00	5,50E+01		1,54E+02	2,62E+03
CO2 relative	0,00%	0,02%	0,00%	0,06%	0,98%
SO2	1,93E-03	6,14E-02		2,57E-01	5,83E-02
SO2 relative	0,00%	0,01%	0,00%	0,04%	0,01%
NOx	1,54E-02	5,24E-01		4,87E+00	1,10E+00
NOx relative	0,00%	0,05%	0,00%	0,48%	0,11%
NMVOC:s					
NMVOC	3,88E-03	1,34E-01			
NMVOC, diesel engines	3,24E-03	5,32E-02		4,72E-03	1,07E-03
NMVOC, el-coal	1,77E-06			3,10E-03	7,03E-04
NMVOC, natural gas combustion					
NMVOC, oil combustion					
NMVOC, petrol engines	3,43E-16			6,03E-13	1,37E-13
NMVOC, power plants	8,53E-07			1,50E-03	3,39E-04
Total NMVOC	7,12E-03	1,87E-01	0,00E+00	9,32E-03	2,11E-03
Total NMVOC relative	0,01%	0,14%	0,00%	0,01%	0,00%
VOC:s					
HC	5,25E-06			9,23E-03	2,09E-03
VOC					
VOC, coal combustion	4,61E-08			8,09E-05	1,83E-05
VOC, diesel engines	1,27E-06			2,23E-03	5,06E-04
VOC, natural gas combustion	3,59E-15			6,31E-12	1,43E-12
Total VOC	6,57E-06	0,00E+00	0,00E+00	1,15E-02	2,61E-03
Total VOC relative	0,00%	0,00%	0,00%	0,02%	0,00%
"Other specified hydrocarbons"					
Acetaldehyde					
Acetylene					
Aldehydes	1,15E-09			2,02E-06	4,58E-07
Alkanes					
Alkenes					
Amylalcohol					
Aromates (C9-C10)	1,68E-08			2,96E-05	6,70E-06
Butane					
Butanol					
Butydiglycole					
Butylglycole					
CH4	4,51E+01	6,92E-02		8,02E-01	1,82E-01
Ethane					
Ethene					
Formaldehyde					
PAH	2,30E-12			4,05E-09	9,17E-10
Pentane					
Propane					
Propene					
Xylene					
Total "other"	4,51E+01	6,92E-02	0,00E+00	8,02E-01	1,82E-01
Total "other" relative	4,43%	0,01%	0,00%	0,08%	0,02%

D.2 Inventory results for important air emissions [per 1000 litres of beverage]: 50 cl aluminium cans

Inventory results per 1000 litres	65. Cardboard/corrugated board incin.	66. Energy use	67. Alt. energy production	Total
CO2	4,52E+02		-2,41E+04	2,68E+05
CO2 relative	0,17%	0,00%	-8,99%	100,00%
SO2	7,54E-01		-2,07E+01	6,30E+02
SO2 relative	0,12%	0,00%	-3,29%	100,00%
NOx	1,43E+01		-3,02E+01	1,02E+03
NOx relative	1,40%	0,00%	-2,96%	100,00%
NMVOC:s				
NMVOC			-3,46E+01	3,69E+01
NMVOC, diesel engines	1,38E-02		-8,84E-02	4,38E+01
NMVOC, el-coal	9,09E-03		-5,81E-02	3,86E+00
NMVOC, natural gas combustion				8,63E-02
NMVOC, oil combustion				4,63E+01
NMVOC, petrol engines	1,76E-12		-1,13E-11	7,49E-10
NMVOC, power plants	4,39E-03		-2,81E-02	1,86E+00
Total NMVOC	2,73E-02	0,00E+00	-3,47E+01	1,33E+02
Total NMVOC relative	0,02%	0,00%	-26,16%	100,00%
VOC:s				
HC	2,70E-02		-1,73E-01	3,94E+01
VOC				1,88E+01
VOC, coal combustion	2,37E-04		-1,52E-03	1,01E-01
VOC, diesel engines	6,54E-03		-4,18E-02	2,78E+00
VOC, natural gas combustion	1,85E-11		-1,18E-10	7,84E-09
Total VOC	3,38E-02	0,00E+00	-2,16E-01	6,11E+01
Total VOC relative	0,06%	0,00%	-0,35%	100,00%
"Other specified hydrocarbons"				
Acetaldehyde			-1,12E-04	2,89E-04
Acetylene			-6,72E-03	-7,42E-03
Aldehydes	5,91E-06		-3,78E-05	3,90E-03
Alkanes			-1,68E-01	-1,38E-01
Alkenes			-1,34E-02	-1,25E-02
Amylaclohol				5,23E+00
Aromates (C9-C10)	8,66E-05		-1,40E-02	3,37E-02
Butane			-7,84E-02	2,02E-01
Butanol				2,11E+01
Butydiglycole				8,02E-01
Butylglycole				2,75E+01
CH4	2,35E+00		-3,27E+01	9,64E+02
Ethane			-1,34E-02	-1,48E-02
Ethene			-3,36E-02	-3,71E-02
Formaldehyde			-1,52E-02	5,99E-02
PAH	1,18E-08		-1,20E-03	2,46E-01
Pentane			-1,34E-01	3,47E-01
Propane			-4,26E-02	3,79E-02
Propene			-1,34E-02	-1,48E-02
Xylene				6,05E-01
Total "other"	2,35E+00	0,00E+00	-3,33E+01	1,02E+03
Total "other" relative	0,23%	0,00%	-3,26%	100,00%

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Life Cycle Assessment of Packaging Systems for Beer and Soft Drinks : Aluminium Cans

Undertitel:
Technical Report 3

Forfatter(e):
Ryberg, Anna; Ekvall, Thomas; Person, Lisa; Weidema, Bo Pedersen

Udførende institution(er):
Chalmers Industriteknik; Instituttet for Produktudvikling

Resumé:
Rapporten er en del af en livscyklusvurdering, hvor potentielle miljøeffekter fra forskellige eksisterende og alternative emballagesystemer til øl og læskedrikke, påfyldt og solgt i Danmark, sammenlignes. Miljøvurderingen sammenligner retur- og engangsflasker af hhv. glas og PET samt aluminiums- og ståldåser. Denne delrapport handler om aluminiumsdåser.

Emneord:
livscyklusvurdering; emballage; drikkevarer; øl; aluminium

Andre oplysninger:
Hører sammen med en hovedrapport: Main Report (Miljøprojekt, 399),
5 andre tekniske delrapporter om de enkelte emballagetyper:
Refillable Glass Bottles (Miljøprojekt, 400), Disposable Glass Bottles (Miljøprojekt, 401),
Steel Cans (Miljøprojekt, 403), Refillable PET Bottles (Miljøprojekt, 404),
Disposable PET Bottles (Miljøprojekt, 405) og en delrapport om de anvendte energi- og transportscenarier: Energy and Transport Scenarios (Miljøprojekt, 406).
Opdatering af: Miljømæssig kortlægning af emballager til øl og læskedrikke
(Arbejdsrapport fra Miljøstyrelsen, 62/1995 og 70/1995-76/1995) og
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Author(s):
Ryberg, Anna; Ekvall, Thomas; Person, Lisa; Weidema, Bo Pedersen

Performing organization(s):
Stiftelsen Chalmers Industriteknik, Chalmers Teknikpark, S-412 88 Göteborg;
Institute for Product Development, Technical University of Denmark, DK-2800 Lyngby

Abstract:
This report is part of a life cycle assessment (LCA) comparing the potential environmental impacts associated with different existing or alternative packaging systems for beer and carbonated soft drinks that are filled and sold in Denmark. The study compares refillable and disposable glass and PET bottles and steel and aluminium cans and is an update of a previous study carried out in 1992-1996. This report is the technical report on aluminium cans.

Terms:
life cycle assessment; packaging systems; beer; soft drinks; alulminium cans

Supplementary notes:
The project comprises the main report (Environmental Project, 399), and 7 supplementary reports:
Refillable Glass Bottles (Environmental Project, 400), Disposable Glass Bottles (Environmental Project, 401),
Aluminium Cans (Environmental Project, 402), Steel Cans (Environmental Project, 403),
Refillable PET Bottles (Miljøprojekt, 404), Disposable PET Bottles (Miljøprojekt, 405),
Energy and Transport Scenarios (Miljøprojekt, 406).
The previous reports were published in Danish: Miljømæssig kortlægning af emballager til øl og læskedrikke (Arbejdsrapport fra Miljøstyrelsen, 62/1995 and 70 - 76/1995), and Miljøvurdering af emballager til øl og læskedrikke (Arbejdsrapport fra Miljøstyrelsen, 21/1996)

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Phone + 45 32 66 01 00