



LCI dataset for converting of beverage carton packaging material

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1 Introduction

Goal: Prepare a European gate-to-gate LCI dataset for converting of beverage carton packaging material.

Initiator: The Alliance for Beverage Cartons and the Environment (ACE)

Platform: Life Cycle Inventory Task Force within ACE supported by IFEU-Heidelberg. IFEU is an independent consultant with long standing experience in the LCI/LCA business and large expertise in packaging related topics.

Approach: A first version of this LCI dataset was published in 2009. Data was collected directly from converters and referred to the year 2005. For this updated version of the LCI dataset data could be collected from all three beverage carton converters in Europe thus increasing the number of converting sites from which data was gathered. The reference year for the data collected for this version of the dataset is 2009. As for the first version, data collected included that generated by both a top-down approach (i.e. input/output data at the site level) and that generated by a bottom-up approach (i.e. input/output data at the level of process line elements).

Application: The LCI data set is broadly applicable for converting of carton based liquid packaging material, and not specific to any particular beverage package format or family.

2 Description of the LCI dataset

2.1 Functional unit

1000 m² of laminated, and printed beverage carton packaging material ready for transport to fillers

2.2 System boundaries

Figure 1 shows the system boundaries covered by the LCI dataset. The processes included are those within the rectangle named “system boundary: gate-to-gate”. The inventory therefore does not include upstream or downstream processes¹.

Converting - Material flows and main process steps

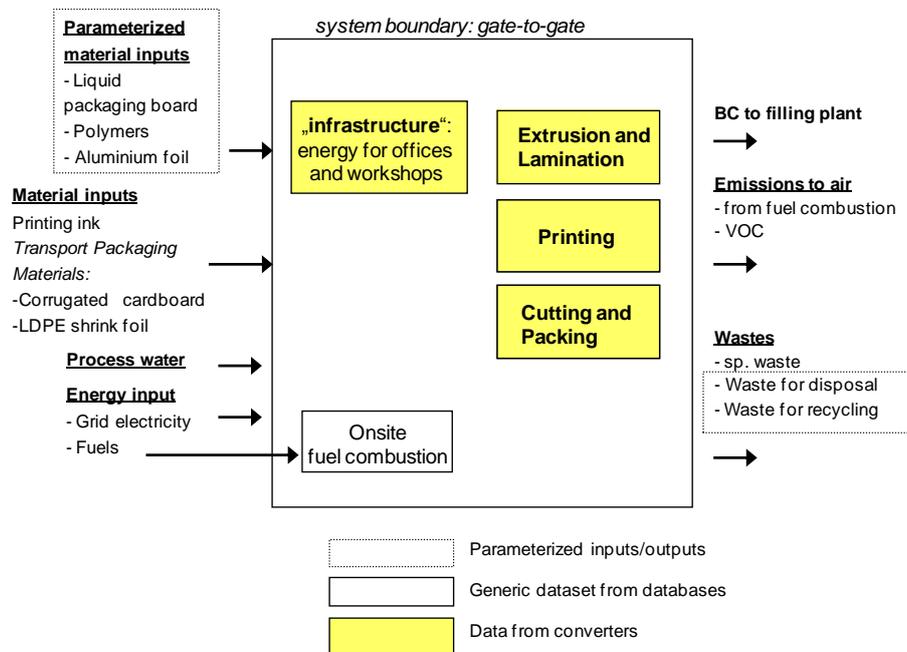


Figure 1: System boundaries of LCI dataset

¹ e.g. it contains the amount of electricity consumed by converting but not the inputs and output related to electricity generation

From figure 1 it can be seen that besides the core converting steps

- extrusion of polymers
- lamination of liquid packaging board
- printing, cutting and packing of beverage carton packaging material

the energy for on site transport and for offices and workshops (referred to as infrastructure) is within the boundaries definition.

At the output side the boundary is set at the point where the beverage carton rolls or blanks are ready for transport to the filler.

2.3 Data sources and compilation of data

Converters data: Inventory data were provided by converters for all process steps. Data were delivered separately for each converting site. These data obtained from converters were based on:

- a) annual consumption and emission monitoring documents
- b) background documents used for environmental reports
- c) background documents used in the context of LCA work (e.g. German UBA study, FKN studies, ACE studies)

All inventory data supplied to IFEU were subsequently normalized to 1000 m² of beverage carton packaging material.

Supplementary data: Converters provided data on on-site fuel consumption but not on the related emissions. Therefore, generic datasets from the internal IFEU database² have been applied for the calculation of fuel-related air emissions originating from on site heat and energy generation and on site transport. (see section 5.2).

2.4 “Representativeness”

Geographic Coverage: LCI data set currently includes data from 19 out of a total of 21 European plants. This roughly accounts for 47 billions out of approximately 50 billions of beverage cartons produced in Europe in the year 2009.

Time coverage: 2009

Technology coverage: Current installed at specified time

² See appendix for documentation of datasets applied

3 LCI dataset „Beverage carton converting“

Table 1 shows the draft LCI dataset for converting. It is based on data provided by converters. The data have been collected and reviewed by IFEU and have been supplemented, where necessary, with internal data available in the IFEU database.

Table 1: LCI data for converting of beverage carton packaging material

Inputs:		
	Quantity:	Unit:
Grid electricity	310.47	MJ
Natural Gas*	102.59	MJ
Fuel oil light*	1.24	MJ
LPG*	15.48	MJ
Water	0.11	m ³
Printing ink	1.7	kg
Polymers	Specified by user	
Aluminium foil	Specified by user	
Liquid Packaging Board	Specified by user	
<i>Secondary Packaging Materials:</i>		
corrugated cardboard	10	kg
LDPE shrink foil	0.6	kg
Outputs:		
	Quantity:	Unit:
<i>Product:</i>		
Converted board (BC)	1000	m ²
<i>Waste:</i>		
special waste	0.32	kg
<i>Emissions to air from process:</i>		
VOC	9.78E-02	kg
<i>Emissions to air from on-site fuel use:</i>		
CO ₂ , fossil	6.60	kg
N ₂ O	1.20E-04	kg
CO	2.51E-03	kg
CH ₄	6.04E-04	kg
NMVOG	6.01E-04	kg
NOx	6.65E-03	kg
SO ₂	1.47E-04	kg
dust	1.78E-05	kg
<i>Product waste:</i>		
Product waste	6.5	%**
* lower heating value used for calculation		
**: % of input materials, thereof >95% are sent to recycling (~1.6% landfill/ ~3.4% incineration)		

The inventory does not list preset inputs of liquid packaging board, polyethylene, aluminium, EVOH, PA or any other raw materials that can be used in beverage carton packaging material. These data should be specified by the user according to the particular package of interest.

Data is normalised to the area of laminated and printed beverage carton packaging material as most measures of operational performance are more closely correlated with area than with mass. This format facilitates use for a user specified packaging material composition.

4 Global Warming Potential

Global warming potential (GWP) is a measure of how much the sum of all greenhouse gas emissions contributes to global warming. Using the CO₂-equivalent values for the 100 year perspective published by the Intergovernmental Panel on Climate Change (IPCC) in 2007 the GWP of the converting of 1000 m² of beverage carton board is 49.59 kg CO₂eq. Calculated are the processes within the gate-to-gate system boundaries described in section 2.2 as well as the prechains for the energy needed. For electricity the EU27 average electricity mix is used. Not included is the production of raw materials like aluminium foil and liquid packaging board.

5 Comments for users

- The fossil fuels input, expressed as [MJ/1000 m²], is calculated based on lower heating values. This should be kept in mind when linking to or modelling upstream processes.
- The LCI dataset presented here does not consider any off site transport operations, neither of raw materials to the converter nor of the product to the fillers. On occasion laminating and printing are not performed at the same site so there may also be transport of intermediate products to consider. Indicative values for transport are given in table 5-1 (section 5.1), these may be of some guidance where specific values are not available.
- where this representative data set is judged to not provide the required level of detail please contact ACE
- It is recommended to contact the beverage carton producer regarding detailed material composition of the beverage carton under examination.
- Note: VOC emissions from process depend on the printing technology applied and could differ considerably from the average value given here for a specific site or beverage carton product.
- Note: Air emissions from on-site fuel use for a specific site depend on the actually applied technology. This technology could be different from the average technology underlying this dataset in case of a particular site or in a regional context with a particular legal framework.
- Data for the reference year 2009 was collected from 19 converting sites. For one of these sites though no data regarding the amount of waste and used water were available. In this single case these data were supplemented by data from the year 2005.

6 APPENDICES

6.1 Indicative data for implementation of converting data into LCAs

Table 5-1: Indicative values for raw material and product transports to and from the converting site

Transports	Type of transport	Transport distance [km]
Liquid Packaging Board to Converter	lorry	200
	train	400
	ship	1300
Polymers to Converter	lorry	200
Aluminium Foil to Converter	lorry	250
LDPE Shrink Foil* to Converter	lorry	400
Cardboard* to Converter	lorry	200
Rolls or Blanks to Filler	lorry	400
*: Transport packaging for delivery to fillers		

Source: IFEU database

6.2 Data used for calculation of emissions from on-site fuel use

Table 5-3: Onsite use of light fuel oil

Input Item	Quantity	Unit	Output Item	Quantity	Unit
Grid Electricity*	0.24	kWh	Product:		
Light Fuel Oil**	1.00	kg	Thermal Energy	9.76	kWh
			Air emissions:		
			N2O	4.15E-05	kg
			CO2	3.07	kg
			CO	8.90E-04	kg
			CH4	2.91E-04	kg
			NM VOC	2.08E-04	kg
			NOx	1.25E-03	kg
			SO2	3.20E-03	kg
			dust	4.15E-05	kg

* Grid electricity: European average 2007

** : Heating value of light fuel oil: 41.3 MJ/kg (source: GEMIS 4.0)

Table 5-4: Onsite use of natural gas

Input Item	Quantity	Unit	Output Item	Quantity	Unit
Grid Electricity*.	0.22	kWh	Product:		
Natural Gas**	1.00	kg	Thermal Energy	11.20	kWh
			Air emissions:		
			N2O	4.51E-05	kg
			CO2	2.47	kg
			CO	9.40E-04	kg
			CH4	2.26E-04	kg
			NM VOC	2.26E-04	kg
			NOx	2.51E-03	kg
			SO2	1.92E-05	kg
			dust	6.27E-06	kg

* Grid electricity: European average 2007

** : Heating value of natural gas: 44.8 MJ/kg (source: GEMIS 4.0)