CHALMERS

First examples of practical application of ISO/TS 14048 Data documentation format

Compiled by:
RAUL CARLSON
ANN-CHRISTIN PÅLSSON

CPM - Centre for Environmental Assessment of Product and Material Systems
CHALMERS UNIVERSITY OF TECHNOLOGY
Göteborg, Sweden 2001

CPM 2001:8

Table of contents

Introduction

This report includes eleven life cycle inventory (LCI) data sets documented according to the technical specification ISO/TS 14048 Data documentation format[1]. The data sets are practically useful to aid the understanding of the ISO/TS 14048 document. They should, however, not be considered as exemplary or comprehensive.

The data sets are the result from practical tests performed within industry with applying the format specified in ISO/TS 14048. The tests were performed during the development of the document, in parallel with the work made in the ISO task group. They were made to ensure that the format should be easily understood and used by users who are moderately acquainted with LCA methodology and terminology, and that it should assist practical and operative industrial LCA-work.

The tests were performed in ABB, Akzo Nobel Surface Chemistry, Ericsson, SCA, Stora Enso, Volvo, and Chalmers University of Technology. They show that:

- The flexible and stable framework of the data documentation format structures work with data collection, data interpretation and data reporting. It facilitates documentation, exchange and review of LCI data.
- Practitioners needed some extra education, except for what the document (ISO/TS 14048) supplies, in order to correctly apply the format. The extra education was given in the form of a documented example LCI data set and as conventional lecture and supervision (about 5 hours).

Due to that the work has been performed as tests, it needs to be stressed that the documentation of the data sets are not complete. For example, only a selected number of inputs and outputs have been included in the documentation. The data sets should therefore only be used as examples.

The different processes have been documented by practitioners within different industrial sectors, with varying experience in life cycle assessment and LCI-data documentation. They have all applied the format in line with their needs. It was concluded that the format supported the practitioners and guided them in regards of which documentation could be considered relevant as well as with regard to where to document that information within the format.

The examples reflect the state-of-the-art regarding the availability of LCI data documentation in sources that are generally used for LCA. The sources that were used in the tests are LCA study reports, environmental reports, inventories made within the companies, etc. The examples demonstrate that the flexibility of the format prescribed by ISO/TS 14048 allows a wide range of applications, including support for environmental management systems, partial life cycles and full life cycles.

[1] ISO/TS 14048 Environmental management - Life cycle assessment – Data documentation format

Please note:

- In the examples we have *removed fields* of the data format that were left blank in each documentation test case. However, the testers still found those fields relevant for LCI data used in other cases, or as information to start including when documenting their LCI data.
- Only a *limited number of inputs and outputs* are included in the examples and some numerical information has been removed.
- *References in the documentation to the specific organisations and personnel* that participated in the tests have been replaced with either "company" or "XXXXXX".

Hopefully, this should not influence the readability and the pedagogical value of the examples.

The documentation of the processes was prepared by personnel in the following organisations:

Manufacturing industry

- ABB
- Volvo

Pulp and paper industry

- Stora Enso
- SCA

Process industry

- Akzo Nobel Surface Chemistry

Electronics industry

- Ericsson

University

- Chalmers University of Technology

Data documentation of process

Process

Process description

Name

Painting process at the company's production plant

Class

Name
3420 Manufacture of bodies (coachwork) for motor vehicles
Reference to nomenclature
International Standard Industrial Classification of all economic activities, ISIC rev 3. Statistical Papers, Series M, No 4, Rev 3, United Nations, New York 1990 ST/ESA/STAT/SER.M/4/REV.3

Quantitative reference

Type	Functional unit
Name	One painted product unit during 1994
Unit	Piece
Amount	1

Technical scope

Gate to gate

Aggregation type

Non aggregated

Technology

Short technology descriptor
The major processes performed in the production plant are: filler and surface coatings, including touch-up of coatings.

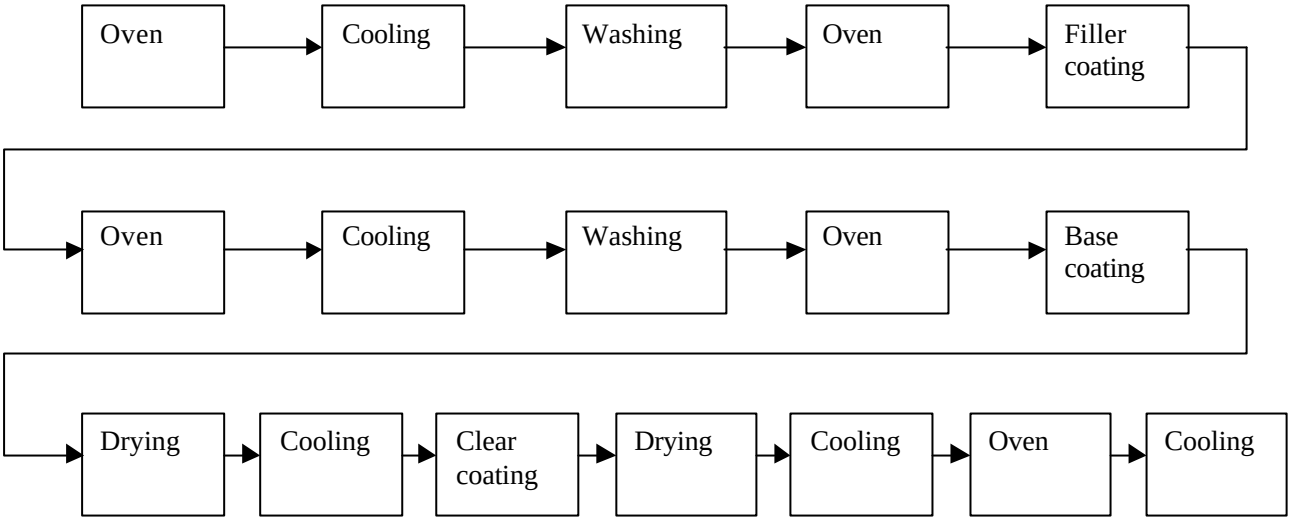
Technical content and functionality
Three layers of coating is applied on each product unit; filler-, clear- and base coating. First the filler coating is applied as a protection layer. Thereafter the base coat is applied which contains the colour pigment. Finally a layer of clear coat is applied as a top protection layer.

In between each coating the coach passes through an oven and is then cooled down and then washed.

The energy used in the production plant is produced in a natural gas driven hot water boiler, cooling machines and air pressure compressors.

The final cleaning of air, containing solvents, is done in the sand beds outside the production plant. This gives CO_2 emissions.
See also technology picture for further explanation.

Technology picture



Operating conditions Normal

Valid time span

Start date 1994-01-01
End date 1994-12-31
Time span description
Average for 1994.

Valid geography

Area name SE
Area description
The production plant is located in southern Sweden
Sites Confidential

Data acquisition

Sample volume
Absolute 104109 painted product units in 1994.

Inputs and outputs

Direction	Group	Receiving environment	Receiving environment specification	Geographical location	Related external system	Name	Amount	Documentation
Input	Ancillary	Technosphere	Technosphere	Sweden	**Origin or destination** Solvent producer **Transport type** Truck	**Name text** Solvent **Reference to nomenclature** Company specific	**Name** Average **Unit** *Symbol or Name* kg **Parameter** *Name* Average *Value* x	**Data collection** Economical information **Collection date** 1994 **Data treatment** Total amount of bought solvent during the year 1994. Recalculated per functional unit. (Total amount of solvent / Total amount painted product units at the production plant) **Reference to data sources** Personal contact
Input	Raw material	Technosphere	Technosphere	Sweden	**Origin or destination** Surface coating producer **Transport type** Truck	**Name text** Filler coating **Reference to nomenclature** Company specific	**Name** Average **Unit** *Symbol or Name* kg **Parameter** *Name* Average *Value* x	**Data collection** Economical information **Collection date** 1994 **Data treatment** Total amount of bought filler coating during the year 1994. Recalculated per functional unit. (Total amount of filler coating / Total amount painted product units at the production plant) **Reference to data sources** Personal contact
Input	Raw material	Technosphere	Technosphere	Sweden	**Origin or destination** Surface coating producer **Transport type** Truck	**Name text** Base coating **Reference to nomenclature** Company specific	**Name** Average **Unit** *Symbol or Name* kg **Parameter** *Name* Average *Value x*	**Data collection** Economical information **Collection date** 1994 **Data treatment** Total amount of bought base coating during the year 1994. Recalculated per functional unit. (Total amount of base coating / Total amount painted product units at the production plant) **Reference to data sources** Personal contact

Input	Raw material	Technosphere	Technosphere	Sweden	**Origin or destination** Surface coating producer **Transport type** Truck	**Name text** Clear coating **Reference to nomenclature** Company specific	**Name** Average **Unit** *Symbol or Name* kg **Parameter** *Name* Average *Value* x	**Data collection** Economical information **Collection date** 1994 **Data treatment** Total amount of bought clear coating during the year 1994. Recalculated per functional unit. (Total amount of clear coating / Total amount painted product units at the production plant) **Reference to data sources** Personal contact
Input	Energy ware	Technosphere	Technosphere	Sweden	**Origin or destination** Electricity producer **Transport type** Electricity grid	**Name text** Electricity **Reference to nomenclature** Company specific	**Name** Average **Unit** *Symbol or Name* MJ **Parameter** *Name* Average *Value* x	**Data collection** Continous measurement **Collection date** 1994 **Data treatment** Total amount measured over one year during the year 1994. Recalculated per functional unit. (Total amount electricity / Total amount painted product units at the production plant) **Reference to data sources** Personal contact
Input	Energy ware	Technosphere	Technosphere	Sweden	**Origin or destination** Natural gas producer **Transport type** Natural gas grid	**Name text** Natural gas **Reference to nomenclature** Company specific	**Name** Average **Unit** *Symbol or Name* MJ **Parameter** *Name* Average *Value* x	**Data collection** Continous measurement **Collection date** 1994 **Data treatment** Total amount of natural gas measured over one year. Recalculated per functional unit. (Total amount of natural gas / Total amount painted product units at the production plant) **Reference to data sources** Personal contact
Output	Residue	Technosphere	Technosphere	Sweden	**Origin or destination** Recycling company **Transport type** Truck	**Name text** Paint residue **Reference to nomenclature** Company specific	**Name** Average **Unit** *Symbol or Name* kg **Parameter** *Name* Average *Value* x	**Data collection** Continous measurement **Collection date** 1994 **Data treatment** Total amount of paint residues measured over one year. Recalculated per functional unit. (Total amount of paint residues / Total amount painted product units at the production plant) **Reference to data sources** Personal contact

Output	Residue	Technosphere	Technosphere	Sweden	**Origin or destination** Recycling company **Transport type** Truck	**Name text** Solvent residue **Reference to nomenclature** Company specific	**Name** Average **Unit** *Symbol or Name* kg **Parameter** *Name* Average *Value x*	**Data collection** Continous measurement **Collection date** 1994 **Data treatment** Total amount of solvent residues measured over one year. Recalculated per functional unit. (Total amount of solvent residues / Total amount painted product units at the production plant) **Reference to data sources** Personal contact
Output	Emission	Air	Urban air	Sweden		**Name text** CO_2 **Reference to nomenclature** Company specific	**Name** Average **Unit** *Symbol or Name* kg **Parameter** *Name* Average *Value x*	**Data collection** Unspecified **Collection date** 1994 **Data treatment** Total amount of CO_2 emission over one year, stated in the environmental report. Recalculated per functional unit. (Total amount of CO_2 / Total amount painted product units at the production plant) **Reference to data sources** Environmental report
Output	Emission	Air	Urban air	Sweden		**Name text** NO_x **Reference to nomenclature** Company specific	**Name** Average **Unit** *Symbol or Name kg* **Parameter** *Name* Average *Value x*	**Data collection** Unspecified **Collection date** 1994 **Data treatment** Total amount of NO_x emission over one year, stated in the environmental report. Recalculated per functional unit. (Total amount of NO_x / Total amount painted product units at the production plant) **Reference to data sources** Environmental report
Output	Emission	Air	Urban air	Sweden		**Name text** Solvent **Reference to nomenclature** Company specific	**Name** Average **Unit** *Symbol or Name kg* **Parameter** *Name* Average *Value x*	**Data collection** Unspecified **Collection date** 1994 **Data treatment** Total amount of solvent emission over one year, stated in the environmental report. Recalculated per functional unit. (Total amount of solvent / Total amount painted product units at the production plant) **Reference to data sources** Environmental report

Modelling and validation

Intended application

There has been some interest in performing a life cycle assessment of the painting process, especially since purification technique requires a great amount of energy.

The purpose was to perform an inventory of the painting process to use as a basis for furter studies. Specifically the aim was to calculate the environmental load for the process and to identify processes with high environmental impacts.

The inventory was performed as a part of a Master of Science thesis.

Information sources

- Environmental report (”Xxx-omradets Miljorapport 1994, Company XX, 1995”)
- Personal comunication with Company XX employees
- Internal Company XX reports

Modelling principles

Data selection principle

The main task was to get an overview of the environmental load of the entire process and not look into each single unit operation.

Modelling choices

Criteria for excluding elementary flows

The parameters reported in the environmental report, that the plant is obligated to report by law.

Criteria for excluding intermediate product flows

-Packaging material has been excluded.
-Only materials used in the painting process has been included.

Criteria for externalising processes

The following processes have been excluded from the described process:
-The spare-part painting plant.
-Internal transports, e.g. diesel trucks.

Data quality statement

Data for the emissions is collected from the environmental report and they therefore follow the data quality requirements set by authorities. Certain data are approximated from the environmental report of 1995 to describe values for 1994. This is assumed to not have a great impact on the data quality, due to the large flows. Data for use of raw materials is based on economical information.

Administrative information

Identification number
CPM_ISO/TS14048_WorkExamples_89

Registration authority
CPM (Center for Environmental Assessment of Product and Material Systems), Chalmers University of Technology, Göteborg, Sweden

Version number
1

Data commissioner
XXX, Company XX

Data generator
XXXXXXX

Data documentor
XXXXXXX

Date completed
1996-10-21

Publication
XXXXXXX

Copyright
XXXXXXX

Access restrictions
Company internal

Data documentation of process

Process

Process description

Name

Extraction to polyethylene all grades APME

Class

Name
2520 Manufacture of plastic product
Reference to nomenclature
International Standard Industrial Classification of all economic activities, ISIC rev 3. Statistical Papers, Series M, No 4, Rev 3, United Nations, New York 1990 ST/ESA/STAT/SER.M/4/REV.3

Quantitative reference

Type	Functional unit
Name	polyethylene (all grades)
Unit	kg
Amount	1

Technical scope

Cradle to gate

Aggregation type

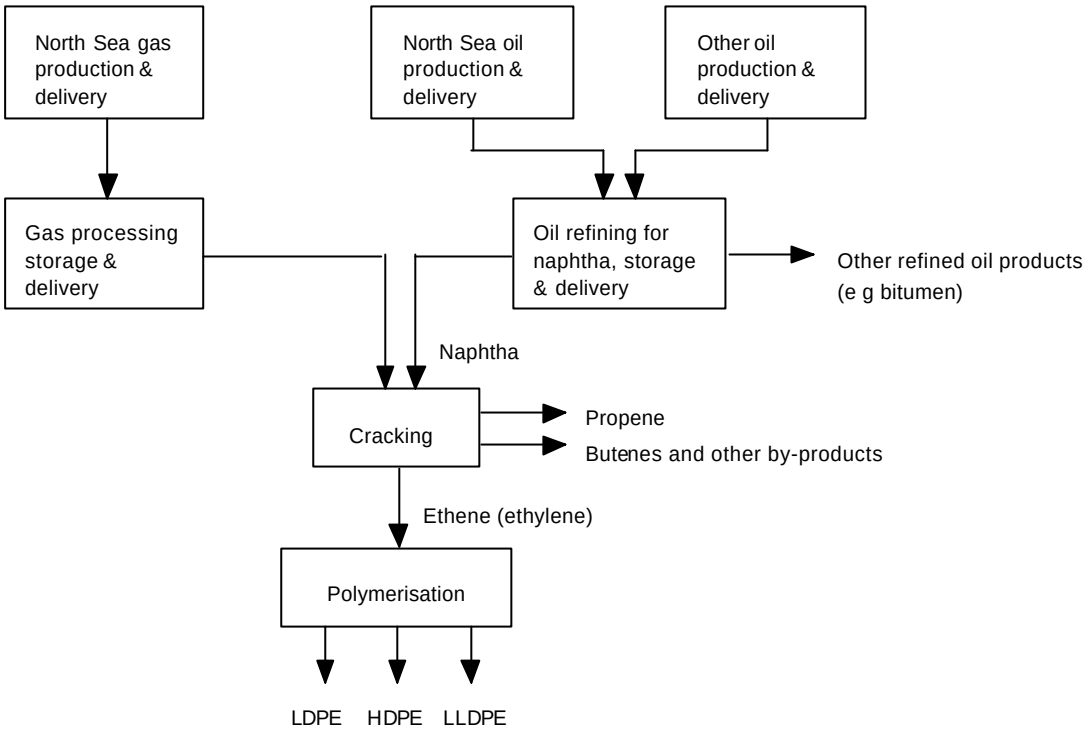
Both horizontally and vertically aggregated

Technology

Short technology descriptor
Production of polyethylene (all grades)

Technical content and functionality
The following major processes are included: North Sea gas extraction and delivery; North Sea crude oil extraction and delivery; crude oil extraction from other sources + average tanker transport of crude oil to Europe; oil refining for naphtha; cracking of naphtha to ethene, propene etc; polymerisation of ethylene to low density polyethylene (LDPE), high density polyethylene (HDPE) or linear low density polyethylene (LLDPE); conversion of resins to granules. Also electricity production, steam production and production of other raw materials have been included on a cradle to gate basis, i e all materials and energies have been traced back to the extraction of raw materials from the earth.

Technology picture



Operating conditions

Data were obtained from a total of 36 European ethylene polymerisation plants producing 4,5E6 tonnes of polyethylene of all grades: 10 plants produced 1,3E6 tonnes of HDPE, 22 plants produced 2,8E6 tonnes of LDPE, and 4 plants produced 0,36E6 tonnes of LLDPE. As the data are based on information from a large number of plants in different European countries, the operating conditions differ a lot.

If it was not known whether a plant specifically used North Sea gas or oil, or non-North Sea oil, as the primary feedstock, it was assumed that the mix of North Sea crude oil and non-North Sea crude oil into the refineries was the same as for all EC countries (around 1990), i e 15% derived from North Sea oil and 85% from non-North Sea sources. Only data from two oil wells outside the North Sea area were available.

When the ethylene sources for a polymerisation plant were known, site-specific data were used, otherwise average values. Most refineries and many polymerisation plants generate steam on-site and, in many instances, electricity is co-generated. Where plant details were not available, average values were used. For the electricity taken in from the public supply, the calculations have taken account of the country specific electricity production efficiency.

Valid time span

Start date	1989-01-01
Time span description	Data were collected around 1989-90

Valid geography

Area Name Europe

Area description

Probably most producers in EC (European Community) countries are represented for the forming of the data. No specific sites are revealed.

Data acquisition

Sampling Procedure

The initial set of data was collected by sending out a standard questionnaire to the producers. Data are average values weighted by the mass of polyethylene produced by each of the polymerisation plants.

Sampling Sites

No specific sites are mentioned

Number of Sites

36 ethylene polymerisation plants, 19 crackers, 4 refineries, 3 North Sea oil rig operators, 2 non-North Sea oil wells

Sample volume

Absolute	36 ethylene polymerisation plants producing 4,5E6 tonnes of polyethylene of all grades
Relative	Not stated

Inputs and outputs

Direction	Group	Receiving environment	Geographical location	Name	Property	Amount	Documentation
Input	Resource	Ground		**Name text** Coal	**Name** gross calorific value **Unit** MJ/kg **Amount** 28,0	**Name** Average **Unit** *Symbol or Name* MJ *Explanation* 1E6 J, SI unit **Parameter** *Name* Average *Value* 2,75	**Data collection** Calculated **Collection date** 1990 **Data treatment** Calculated from electricity consumption
Input	Resource	Ground	(North Sea + non-North Sea)	**Name text** Crude oil	**Name** gross calorific value **Unit** MJ/kg **Amount** 45,0	**Name** Average **Unit** *Symbol or Name* MJ **Parameter** *Name* Average *Value* 12,26	**Data collection** Calculated **Collection date** 1990 **Data treatment** Recalculated to specify the amount of feedstock that is used as fuel within system.
Input	Resource	Ground	(mainly North Sea)	**Name text** Natural gas	**Name** gross calorific value **Unit** MJ/m3 **Amount** 38,8	**Name** Average **Unit** *Symbol or Name* MJ **Parameter** *Name* Average *Value*20,96	**Data collection** Calculated **Collection date** 1990 **Data treatment** Recalculated to specify the amount of feedstock that is used as fuel within system.
Input	Resource	Ground		**Name text** Hydro power		**Name** Average **Unit** *Symbol or Name* MJ **Parameter** *Name* Average *Value* 0,46	**Data collection** Calculated **Collection date** 1990 **Data treatment** Calculated from electricity consumption
Input	Resource	Ground		**Name text** Nuclear power		**Name** Average **Unit** *Symbol or Name* MJ **Parameter** *Name* Average *Value* 1,53	**Data collection** Calculated **Collection date** 1990 **Data treatment** Calculated from electricity consumption.

Input	Resource	Ground		**Name text** Other		**Name** Average **Unit** *Symbol or Name* MJ **Parameter** *Name* Average *Value* 0,14	**Data collection** Calculated **Collection date** 1990 **Data treatment** Calculated from electricity consumption.
Input	Resource	Ground		**Name text** Coal	**Name** gross calorific value **Unit** MJ/kg **Amount** 28,0	**Name** Average **Unit** *Symbol or Name*MJ **Parameter** *Name* Average *Value* <0,01	**Data collection** Calculated **Collection date** 1990 **Data treatment** Recalculated to specify the amount of feedstock that is not used as fuel within system.
Input	Resource	Ground	(North Sea + non-North Sea)	**Name text** Oil **Specification of Name** = Crude oil	**Name** gross calorific value **Unit** MJ/kg **Amount** 45,0	**Name** Average **Unit** *Symbol or Name* MJ **Parameter** *Name* Average *Value* 23,57	**Data collection** Calculated **Collection date** 1990 **Data treatment** Recalculated to specify the amount of feedstock that is not used as fuel within system.
Input	Resource	Ground	(mainly North Sea)	**Name text** Gas **Specification of Name** = Natural gas	**Name** gross calorific value **Unit** MJ/m3 **Amount** 38,8	**Name** Average **Unit** *Symbol or Name* MJ **Parameter** *Name* Average *Value* 24,16	**Data collection** Calculated **Collection date** 1990 **Data treatment** Recalculated to specify the amount of feedstock that is not used as fuel within system.
Input	Resource	Ground		**Name text** Wood		**Name** Average **Unit** *Symbol or Name* MJ **Parameter** *Name* Average *Value* <0,01	**Data collection** Calculated **Collection date** 1990
Input	Resource	Ground		**Name text** Iron ore		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 200	**Data collection** Calculated **Collection date** 1990

Input	Resource	Ground		**Name text** Limestone **Specification of Name** = CaCO3		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 150	**Data collection** Calculated **Collection date** 1990
Input	Resource	Ground		**Name text** Water		**Name** Average **Unit** *Symbol or Name* kg **Parameter** *Name* Average *Value* 18	**Data collection** Calculated **Collection date** 1990
Input	Resource	Ground		**Name text** Bauxite		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 300	**Data collection** Calculated **Collection date** 1990
Input	Resource	Ground		**Name text** Sodium chloride **Specification of Name** = NaCl		**Name** Average **Unit** *Symbol or Name* g **Parameter** *Name* Average *Value* 7	**Data collection** Calculated **Collection date** 1990
Input	Resource	Ground		**Name text** Clay		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 20	**Data collection** Calculated **Collection date** 1990
Input	Resource	Ground		**Name text** Ferromanganese **Specification of Name** In ore		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* <1	**Data collection** Calculated **Collection date** 1990
Output	Emission	Air		**Name text** Dust **Specification of Name** = Particles		**Name** Average **Unit** *Symbol or Name* g **Parameter** *Name* Average *Value* 2	**Data collection** Calculated **Collection date** 1990

Output	Emission	Air		**Name text** Carbon monoxide **Specification of Name** = CO		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 800	**Data collection** Calculated **Collection date** 1990
Output	Emission	Air		**Name text** Carbon dioxide **Specification of Name** = CO2		**Name** Average **Unit** *Symbol or Name* kg **Parameter** *Name* Average *Value* 2,22	**Data collection** Calculated **Collection date** 1990 **Data treatment** Recalculated to include CO2 from combustion of feedstock used as fuel.It is assumed that 3,67 kg of CO2 is emitted on combustion of a fossil fuel containing 1 kg of carbon. For carbon content in fuels, see Modelling constants.
Output	Emission	Air		**Name text** Sulphur oxides **Specification of Name** = SO2 + SO3		**Name** Average **Unit** *Symbol or Name* g **Parameter** *Name* Average *Value* 7	**Data collection** Calculated **Collection date** 1990
Output	Emission	Air		**Name text** Nitrogen oxides **Specification of Name** = NOx		**Name** Average **Unit** *Symbol or Name* g **Parameter** *Name* Average *Value* 11	**Data collection** Calculated **Collection date** 1990
Output	Emission	Air		**Name text** Hydrogen chloride **Specification of Name** = HCl		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 60	**Data collection** Calculated **Collection date** 1990
Output	Emission	Air		**Name text** Hydrogen fluoride **Specification of Name** = HF		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 1	**Data collection** Calculated **Collection date** 1990

Output	Emission	Air		**Name text** Hydrocarbons **Specification of Name** = HC (unspecified)		**Name** Average **Unit** *Symbol or Name* g **Parameter** *Name* Average *Value* 21	**Data collection** Calculated **Collection date** 1990
Output	Emission	Air		**Name text** Aldehydes **Specification of Name** -		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 5	**Data collection** Calculated **Collection date** 1990
Output	Emission	Air		**Name text** Other organics **Specification of Name** (unspecified)		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 5	**Data collection** Calculated **Collection date** 1990
Output	Emission	Air		**Name text** Metals **Specification of Name** (unspecified)		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value*1	**Data collection** Calculated **Collection date** 1990
Output	Emission	Air		**Name text** Hydrogen **Specification of Name** = H2		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 1	**Data collection** Calculated **Collection date** 1990
Output	Emission	Water		**Name text** COD **Specification of Name** = chemical oxygen demand		**Name** Average **Unit** *Symbol or Name* g **Parameter** *Name* Average *Value* 1	**Data collection** Calculated **Collection date** 1990
Output	Emission	Water		**Name text** BOD **Specification of Name** = biological oxygen demand		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 150	**Data collection** Calculated **Collection date** 1990

Output	Emission	Water		**Name text** Acid as H+ **Specification of Name** = Acidification equivalent		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 70	**Data collection** Calculated **Collection date** 1990
Output	Emission	Water		**Name text** Nitrates **Specification of Name** = NO3-		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 5	**Data collection** Calculated **Collection date** 1990
Output	Emission	Water		**Name text** Metals **Specification of Name** (unspecified)		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 300	**Data collection** Calculated **Collection date** 1990
Output	Emission	Water		**Name text** Ammonium ions **Specification of Name** = NH4+		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 5	**Data collection** Calculated **Collection date** 1990
Output	Emission	Water		**Name text** Chloride ions **Specification of Name** = Cl-		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 120	**Data collection** Calculated **Collection date** 1990
Output	Emission	Water		**Name text** Dissolved organics **Specification of Name** = DOC? (unspecified)		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 20	**Data collection** Calculated **Collection date** 1990
Output	Emission	Water		**Name text** Suspended solids		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 400	**Data collection** Calculated **Collection date** 1990

Output	Emission	Water		**Name text** Oil		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 100	**Data collection** Calculated **Collection date** 1990
Output	Emission	Water		**Name text** Hydrocarbons **Specification of Name** = HC (unspecified)		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 100	**Data collection** Calculated **Collection date** 1990
Output	Emission	Water		**Name text** Phenol **Specification of Name** = C6H6O		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 1	**Data collection** Calculated **Collection date** 1990
Output	Emission	Water		**Name text** Dissolved solids **Specification of Name** = TDS? (unspecified)		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 400	**Data collection** Calculated **Collection date** 1990
Output	Emission	Water		**Name text** Phosphate **Specification of Name** = PO43-		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 5	**Data collection** Calculated **Collection date** 1990
Output	Emission	Water		**Name text** Other nitrogen **Specification of Name** = N-total		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 10	**Data collection** Calculated **Collection date** 1990
Output	Emission	Water		**Name text** Sulphate ions **Specification of Name** = SO42-		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 10	**Data collection** Calculated **Collection date** 1990

Output	Residues	Ground		**Name text** Industrial waste		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 3,1	**Data collection** Calculated **Collection date** 1990
Output	Residues	Ground		**Name text** Mineral waste		**Name** Average **Unit** *Symbol or Name* g **Parameter** *Name* Average *Value* 22	**Data collection** Calculated **Collection date** 1990
Output	Residues	Ground		**Name text** Slags and ash		**Name** Average **Unit** *Symbol or Name* g **Parameter** *Name* Average *Value* 7	**Data collection** Calculated **Collection date** 1990
Output	Residues	Ground		**Name text** Toxic chemicals		**Name** Average **Unit** *Symbol or Name* mg **Parameter** *Name* Average *Value* 70	**Data collection** Calculated **Collection date** 1990
Output	Residues	Ground		**Name text** Non-toxic chemicals		**Name** Average **Unit** *Symbol or Name* g **Parameter** *Name* Average *Value* 2	**Data collection** Calculated **Collection date** 1990
Output	Product	Technospehere		**Name text** Polyethylene (all grades) **Specification of name** The product is a mixtrure of different types of polytheylene.		**Name** Average **Unit** *Symbol or Name* kg **Parameter** *Name* Average *Value* 1	**Data collection** Calculated **Collection date** 1990 **Data treatment** The output is the functional unit for the process.

Modelling and validation

Intended application

The general purpose of the study was to demonstrate the commitment of APME to improve the environmental impact of the processes, from extraction of oil to granulate.

The more detailed purposes of APME's eco-profiles were:
1) to provide APME member companies with information which will highlight potential areas for improving manufacturing processes,
2) to provide valuable inventory data for downstream users of plastics, such as packaging manufacturers, who will be able to produce their own eco-balance assessments (i e LCAs) of individual products.

Information sources

- APME (Association of Plastics Manufacturers in Europe) member companies provided data by filling in the inventory questionnaire.
- Operators of North Sea oil rigs and oil wells outside the North Sea area, refineries, crackers.
- Energy statistics.

Modelling principles

Data selection principle

Site-specific data have been used when available.
Average values have been used in other cases.

Adaptation principles

The CO2 emissions to air have been calculated from the consumption of fossil fuels in the different processes. Since feedstock waste materials arising during production are used as fuels in the processes, the amounts of supplied feedstock inputs (oil and gas) should be adjusted for these residues. In the present data set, the feedstock inputs have indeed been reduced, and the fuel inputs and CO2 emissions have been increased correspondingly, in order to account for the amounts of feedstock estimated to be used as fuel.

Modelling constants

Name	Gross calorific value (energy content) of oil
Value	45,0 MJ/kg
Name	Gross calorific value (energy content) of natural gas
Value	38,3 MJ/m3 (54,1 MJ/kg)
Name	Gross calorific value (energy content) of coal
Value	28,0 MJ/kg

Name Percentage carbon in oil
Value 85,7%

Name Percentage carbon in gas
Value 75,0%

Name Percentage carbon in coal
Value 80.0%

Modelling choices

Criteria for excluding elementary flows As the level of detail in data supplied by the producers varied significantly from one producer to another, the level of detail in the final result is governed, to a great extent, by the returned data with the lowest level of detail. For instance, hydrocarbon emissions are presented as Hydrocarbons, although some producers provided data for individual hydrocarbons.

Criteria for excluding intermediate product flows
Outer packaging materials for the final products and metallic catalysts used in polymerisation have been excluded.

Criteria for externalising processes
Production of additives such as antioxidants, dyes and fillers have been excluded. The system boundaries for extraction of crude oil and gas, oil refining and cracking are not stated in detail, while the system boundaries for electricity production are not stated at all. Hence, it is not known what subsystems have been excluded.

Allocations performed

Allocated co-products
Products (oil and gas) from the North Sea oil rigs.
Refinery products.
Products from the crackers.

Allocation explanation
Inputs and outputs to/from the North Sea oil rigs have been partitioned between the different products on the basis of the calorific values of the products.
Inputs and outputs to/from the refineries have been partitioned across all usable or saleable refinery products on the basis of mass. This also applies to the products from the crackers.

Data quality statement

European average data for polyethylene production on a cradle to gate basis, issued by APME (Association of Plastics Manufacturers in Europe), and produced in association with four independent experts on LCA (eco-balance analysis). As a large number of producers have participated in the study, the data should be fairly representative for production of polyethylene in Europe.
However, it should be borne in mind that data for some supplying processes are based on only a few plants. For instance, only data from two non-North Sea oil wells were available.

The source and quality of data for public electricity production are not stated.

The accuracy of the data for air and water emissions varies for the different emissions. In general, more accurate information are available on those emissions statutorily regarded as having a more severe effect on the environment. This is because they are more closely measured in order to satisfy the local pollution regulations. Conversely, many of the non-regulated emissions are usually estimates. A large number of emissions have been aggregated into general groups, e g Metals, Hydrocarbons, Dissolved organics.

Validation

Method

An independent panel of experienced eco-balance (LCA) practitioners supervised the study and developed the methodology for collecting, analysing and presenting the inventory data.

Validator

The members of the panel: Ian Boustead, Paul Fink, Horst Langowski, Gustav Sundström.

Administrative information

Identification number

CPM_ISO/TS14048_WorkExamples_90

Registration authority

CPM (Center for Environmental Assessment of Product and Material Systems), Chalmers University of Technology, Göteborg, Sweden

Version number

1

Data commissioner

APME

Data generator

Ian Boustead, Vince Matthews (co-ordinator)

Data documentor

XXXXXXX

Date completed

1999-11-01

Publication

"Eco-profiles of the European plastics industry", Report 2: "Olefin feedstock sources" and Report 3: "Polyethylene and polypropylene", I Boustead, PWMI (European Centre for Plastics in the Environment), APME (Association of Plastics Manufacturers in Europe), 1993

Access restrictions
Public

Data documentation of process

Process

Process description

Name

Production of semichemical fluting

Class

Name
210 Manufacture of paper and paper products
Reference to nomenclature
International Standard Industrial Classification of all economic activities, ISIC rev 3. Statistical Papers, Series M, No 4, Rev 3, United Nations, New York 1990 ST/ESA/STAT/SER.M/4/REV.3

Quantitative reference

Type	Reference flow
Name	Saleable semichemical fluting (nsp)
Unit	Ton net
Amount	1

Technical scope

Gate to gate

Aggregation type

Horizontally aggregated

Technology

Short technology descriptor
European average of production of semichemical fluting, based on sulfite pulp.

Technical content and functionality
The studied system includes the processing of raw material (wood), pulping and stock preparation, and paper production. The paper is produced in large modern mills.

Processing raw material
The process for the production of semichemical fluting starts with wood coming from the forest to the mill, either as pulpwood logs or as wood chips. The pulpwood logs have to be debarked and chipped before further processing. This is done by passing a barking drum and a chipper.

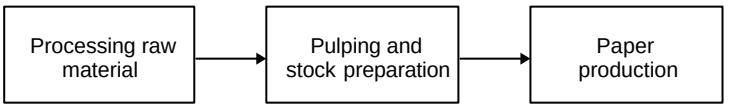
Pulping and stock preparation
The wood is processed with the semichemical cooking process. It is a slightly alkaline process with sodiumsulfite and sodium carbonate as active cooking

chemicals. The pulp yield is normally around 80%. The pulp produced is defiberized in refiners, screened and washed before being sent to the paper mill.

Paper production
At the paper mill, the pulp is mechanically treated in beaters to improve fibre-to-fibre bonding and strength of the paper. The pH-level is adjusted and some additives are added to facilitate the paper production. Functional chemicals, fillers and other pulp (i.e. recovered paper) may also be added to give the paper the properties required. Finally the pulp slurry is screened and diluted before being sent to the head box of the paper machine. The paper is formed from the head box onto the wire and dewatered by action of gravity and suction. The paper is further dewatered in the press section and the final drying takes place in the drying section of the machine with steam heated cylinders. The final dryness is approx. 92%. After the paper machine there is slitter winder where the big jumbo reel from the paper machine is rewound and cut down to customer reel formats. Finally the reels are weighed, marked, labelled, and prepared for shipment to the customer, the corrugated board industry.

Transports
Internal transports are included in the energy input

Technology picture



Operating conditions Normal

Valid time span

Start date 1996
End date 2000
Time span description
The data are based on weighted average data for 1996. Publication of next database is expected by the end of year 2000.

Valid geography

Area Name Europe
Area description
The mills are located in Austria, Finland, France, Italy, Norway, Portugal, and Sweden.

Data acquisition

Sampling Procedure
Questionnaires were sent out to all mills producing semichemical fluting in Europe.
Sampling Sites
Austria, Finland, France, Italy, Norway, Portugal, and Sweden.

Sample volume

Absolute	The participating mills had a total production of 2,941,000 ton net saleable paper in 1996. The mills had a yearly production of 78,000 – 625,000 ton net saleable paper each.
Relative	The sites produces together more than 90% of the total annual production of corrugated base papers from primary fibres in Europe.

Inputs and outputs

NB Only selected Inputs and outputs have been documented

Direction	Group	Receiving environment	Geographical location	Related external system	Name	Property	Amount	Documentation
Input	Raw material	Technosphere	Europe	**Origin or destination** Forest or saw mill **Information reference** Mill specific	**Name text** Wood **Reference to nomenclature** Company specific	**Name** Bone dry weight **Unit** Ton **Amount** 45% of transported total wet weight	**Name** Weighted average **Unit** *Symbol or Name* ton **Parameter** *Name* Weighted average *Value* x	
Input	Raw material	Technosphere	Europe	**Origin or destination** Pulp mill **Information reference** Mill specific	**Name text** Brown pulp **Reference to nomenclature** Company specific	**Name** Bone dry weight **Unit** Ton **Amount** 45% of transported total wet weight	**Name** Weighted average **Unit** *Symbol or Name* ton **Parameter** *Name* Weighted average *Value* x	
Input	Energy	Technosphere	Europe	**Origin or destination** Fuel producer **Information reference** Producer specific	**Name text** Fossil fuel **Reference to nomenclature** Company specific		**Name** Weighted average **Unit** *Symbol or Name* GJ **Parameter** *Name* Weighted average *Value* x	**Data treatment** Lower heat value is used
Input	Energy	Technosphere	Europe	**Origin or destination** Fuel producer **Information reference** Producer specific	**Name text** Renewable fuels **Reference to nomenclature** Company specific		**Name** Weighted average **Unit** *Symbol or Name* GJ **Parameter** *Name* Weighted average *Value* *x*	**Data treatment** Lower heat value is used
Input	Energy	Technosphere	Europe	**Origin or destination** Country grid **Information reference** Producer specific	**Name text** Electricity **Reference to nomenclature** Company specific		**Name** Weighted average **Unit** *Symbol or Name* GJ **Parameter** *Name* Weighted average *Value* x	

Input	Ancillary	Technosphere	Europe	**Origin or destination** Supplier **Information reference** Producer specific	**Name text** Ca(OH)2 **Reference to nomendature** Company specific	**Name** dry weight **Unit** kg **Amount** x	**Name** Weighted average **Unit** *Symbol or Name* kg **Parameter** *Name* Weighted average *Value* x	
Input	Ancillary	Technosphere	Europe	**Origin or destination** Supplier **Information reference** Producer specific	**Name text** H2SO4 **Reference to nomenclature** Company specific	**Name** dry weight **Unit** kg **Amount** x	**Name** Weighted average **Unit** *Symbol or Name* kg **Parameter** *Name* Weighted average *Value* x	
Input	Ancillary	Technosphere	Europe	**Origin or destination** Supplier **Information reference** Producer specific	**Name text** MgO **Reference to nomenclature** Company specific	**Name** dry weight **Unit** kg **Amount** x	**Name** Weighted average **Unit** *Symbol or Name* kg **Parameter** *Name* Weighted average *Value* x	
Input	Ancillary	Technosphere	Europe	**Origin or destination** Supplier **Information reference** Producer specific	**Name text** Na2CO3 **Reference to nomenclature** Company specific	**Name** dry weight **Unit** kg **Amount** x	**Name** Weighted average **Unit** *Symbol or Name* kg **Parameter** *Name* Weighted average *Value* x	
Input	Ancillary	Technosphere	Europe	**Origin or destination** Supplier **Information reference** Producer specific	**Name text** NaOH **Reference to nomenclature** Company specific	**Name** dry weight **Unit** kg **Amount** xxx	**Name** Weighted average **Unit** *Symbol or Name* kg **Parameter** *Name* Weighted average *Value* x	
Output	Product	Technosphere	Europe		**Name text** Semichemical fluting **Reference to nomenclature** Company specific	**Name** Average moisture content **Unit** % **Amount** 9	**Name** Weighted average **Unit** *Symbol or Name* kg **Parameter** *Name* Weighted average *Value* x	

Modelling and validation

Intended application

This database is part of an environmental project undertaken by FEFCO (Federation Européenne des Fabricants de Carton Ondulé), GO (Groupement Européenne des Fabricants de Papiers Ondulé), and KI (Kraft Institute). The purpose of the project is to provide the industry and its customers the up-to-date knowledge, based on facts, concerning the impact of the industry on the environment.

Information sources

Specific sites

Modelling principles

Data selection principle

To include all semichemical fluting mills which are members in Kraft Institute.

Adaptation principles

All answers are taken into account. A few of the requested data could not be supplied by all the participants. In this case the weighted average may not be representative, because it is based on a limited number of data. This will be noted in the exchange specific documentation.

Modelling constants

Name	g CO2/MJ natural gas
Value	xxx
Name	g NOx/MJ natural gas
Value	xxx
Name	g particles/MJ natural gas
Value	xxx

Modelling choices

Criteria for excluding elementary flows

Emissions to air

Emissions from fuel combustion (transport, electricity generation for the public grid) outside the mill are not included in the data.

All emissions to air from the sites have been reported. For dust, TRS (H2S), NOx and SOx the figures from the paper mills are mostly based on measurements. For CO2 the figures reported are based on calculations and reported separately for fossil and biomass origin.

Some mills could report emissions of CO but most of the mills were unable to give reliable information and therefore CO figures have been omitted. In the questionnaire filled in by the mills a number of other emissions were asked for like N2O, NH3, CH4, aldehydes, Pb, Hg etc. The mills were unable to report any figures probably

because there are no measurements. These substances are not expected to be emitted from integrated pulp and paper mills based on wood as a raw material.
Emissions in the steam from the drying section of the paper machines are not included.

Emissions to water:
In the questionnaire filled in by the mills a number of emissions were asked for like oils, nitrates, acids, AOX, chlorate, chlorides, borates, phenol, Hg, Pb etc. Not all the mills were able to report figures probably because there are no or too few measurements. Therefore only COD, BOD5 and suspended solids are reported because these are based on data from all the mills in addition to the total volume of the effluent waters.

Criteria for externalising processes
The following operatings have been excluded:
- Forestry, i.e. wood production
- Transports of raw materials and energyware to the mills
- Production of raw materials such as chemicals etc.
- The production and use of the corrugated board box

Allocations performed

Allocation explanation
Allocation between paper grades is done according to mass of produced paper grade.

Data quality statement

The data for the production of the four major paper grades, semichemical fluting, kraftliner, testliner and wellenstoff, and for the production of corrugated board were collected directly from the producers and checked by technical experts.

For this project technical experts from the industry have worked together with LCA experts to provide a database that is based on both technical knowledge of paper production and requirements for LCA studies.

Validation

Method	Mass balance
Procedure	A mass balance of dry material input and outputs was calculated for the individual mills.
Result	If the input and output of material did not balance (within a range of + or - 5%) mills were asked to investigate their data and give corrected figures.
Method	Benchmarking
Procedure	The data per ton nsp for each paper product were compared by technical experts from all the participating mills to investigate if variation of the data could be explained by differences in the applied technology.
Result	Data that could not be explained were rechecked to make sure that the data from the individual mills were correct.
Validator	Technical experts from all the participating mills.

Other information

The database is available for interested parties with the restriction that the data may only be used for environmental studies such as Life Cycle Inventory Analysis, Life Cycle Impact Assessment as separate steps or as a whole Life Cycle Assessment *until a next update of the database is available.*

The database may only be used for environmental studies regarding product development and improvement and the comparison of the entire system of corrugated board packaging with that of other materials. *The database may not be used for comparisons between the production of primary fibre and recovered fibre based materials as such.*

Administrative information

Identification number

CPM_ISO/TS14048_WorkExamples_91

Registration authority

CPM (Center for Environmental Assessment of Product and Material Systems), Chalmers University of Technology, Göteborg, Sweden

Version number

1

Data commissioner

FEFCO, Groupement Ondulé, Kraft Institute

Data generator

FEFCO, Groupement Ondulé, Kraft Institute

Data documentor

XXXXXXXX

Date completed

December 1997

Publication

FEFCO, Groupement Ondulé, Kraft Institute, 1997:
"European Database for Corrugated Board, Life Cycle Studies"

Copyright

Access restrictions

Public

Data documentation of process

Process

Process description

Name

Wood room at a pulp mill

Class

Name
210 Manufacture of paper and paper products
Reference to nomenclature
International Standard Industrial Classification of all economic activities, ISIC rev 3. Statistical Papers, Series M, No 4, Rev 3, United Nations, New York 1990 ST/ESA/STAT/SER.M/4/REV.3

Quantitative reference

Type	Reference flow
Name	Wood chips
Unit	m^3solid
Amount	1

Technical scope

Unit operation

Aggregation type

Non aggregated

Technology

Short technology descriptor
De-icing, dry barking in drums, washing, chipping, screening, storage before digesters, treatment of waste water

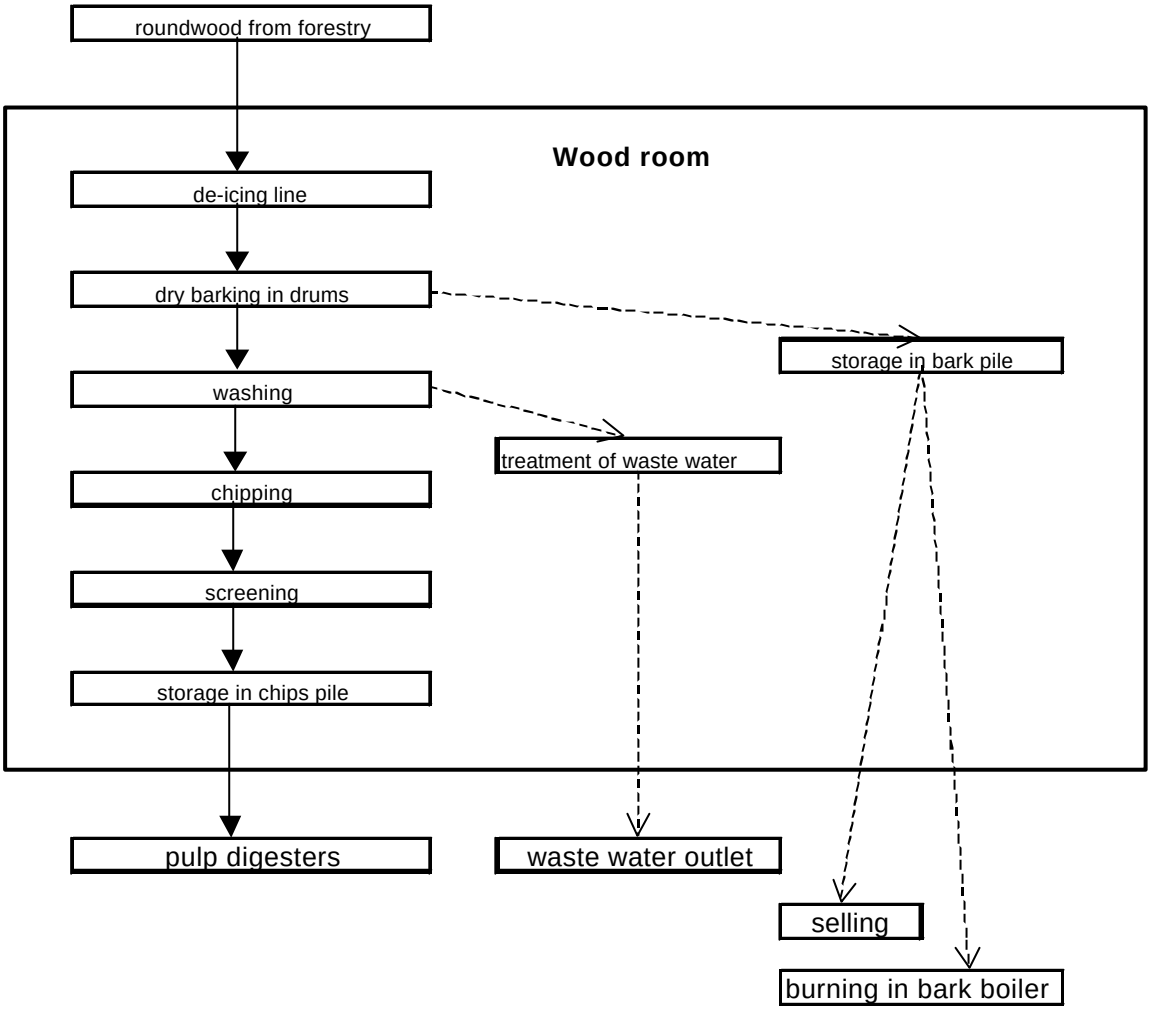
Technical content and functionality
The wood room is divided into two identical lines. Line one handles hardwood and line two softwood.

During winter time it is necessary to de-ice roundwood, otherwise the barking would demand to much energy, and this is done with water, with a temperature of x-y°C, from scrubbers. The de-icing is common for both lines. Dry barking drums are employed and it is known that more electricity is consumed for hardwood than for softwood, but the difference is not measured today. The roundwood is washed thoroughly after the barking drums. In all lines there are identical chipper machines of y kW each, in operation all around the clock.

All soft wood chips are screened before they leave the wood room. Covered conveyour belts are used for transports of chips. There are five vehicles in the wood room, three for handling of roundwood and two for handling of chips.

The only treatment of purchased chips at the wood room is the one performed by vehicles for handling of chips.The ready chips are stored in piles or in chip silos before they enter the digesters. There are about x volume-% of bark on every log and this amount is stored in a bark pile before it is sold or burnt in the bark boiler. Treatment of waste water from the wood room is included in this unit operation.

Technology picture



Operating conditions normal

Valid time span

Start date 1998-01-01
End date 1998-08-31
Time span description
The study ended because the pulp production lines at the pulp mill in question were switched after 98-08-31.

Valid geography

Area Name Sweden
Area description The process resides in the middle part of Sweden.
Sites Confidential

Inputs and outputs

Direction	Group	Receiving environment	Receiving environment specification	Geographical location	Related external system	Name	Amount	Documentation
Input	Raw material	Technosphere		Sweden	**Origin or destination** Forestry **Transport type** truck long distance	**Name text** Roundwood	**Name** mean **Unit** *Symbol or Name* m^3sub *Explanation* solid under bark **Parameter** *Name* mean *Value x*	**Data collection** Random sampling **Collection date** 98-01-01 –98-08-31 **Data treatment** Mean values out of y samples over the period. The sampling was made by the xxx organization. **Reference to data sources** XXX's manual from 1996.
Input	Energy	Technosphere		Sweden	**Origin or destination** Swedish grid **Transport type** Swedish distribution network	**Name text** Electricity	**Name** mean **Unit** *Symbol or Name* kWh **Parameter** *Name* mean *Value x*	**Data collection** Continuous sampling **Collection date** 97-11-30 **Data treatment** Mean values out of x samples. The sampling was made by yyy. **Reference to data sources** Official report published by yyy 98-03-20.
Output	Emission	Water	River	Sweden	**Origin or destination** Waste water outlet (recipient) **Transport type** Pipe	**Name text** COD	**Name**mean **Unit** *Symbol or Name* kg **Parameter** *Name*mean *Value x*	**Data collection** Continous sampling **Collection date** 98-07-21 **Data treatment** Mean values out of z samples. The sampling was made by qqq. **Reference to data sources** qqq's notes from 98-07-21.
Output	Product	Technosphere		Sweden	**Origin or destination:** Pulp digesters **Transport type** Conveyor belts	**Name text** Wood chips	**Name** mean **Unit** *Symbol or Name* m^3sub *Explanation* solid under bark **Parameter** *Name* mean *Value x*	**Data collection** Random sampling **Collection date** 98-01-01 –98-08-31 **Data treatment** Mean values out of q samples over the period. The sampling was made by zzz. **Reference to data sources** ZZZ's notes from 98-08-31.

Modelling and validation

Intended application

The aim of the modelling of this unit operation was to be able to perform life cycle assessment of three pulps produced at the plant in question.

Information sources

- Interviews with personnel at the plant.
- Internal reports.
- Standards SS-EN ISO 14040-14041 and ISO/FDIS 14042 –14043.

Modelling principles

Data selection principle
Site-specific data about the unit operation situated at own plant

Adaptation principles
Any data gaps should be filled with best available data from literature or databases.

Modelling choices

Criteria for excluding elementary flows
The parameters presented were chosen because they are of general interest and because the basis for them is relatively good.

Criteria for externalising processes
Production and maintenance machinery, and heating of offices were excluded.

Validation

Method	Inventory data reviewed.
Procedure	Critical review.
Result	These data are appropriate for decision making.
Validator	*rrr sss.*

Administrative information

Identification number

CPM_ISO/TS14048_WorkExamples_92

Registration authority

CPM (Center for Environmental Assessment of Product and Material Systems), Chalmers University of Technology, Göteborg, Sweden

Version number

1

Data commissioner

Company’s environmental department.

Data generator

bbb ccc

Data documentor

ddd eee

Date completed

1999-12-20

Publication

bbb ccc, “LCA of three pulps produced at the xxx mill”

Access restrictions

Public

Data documentation of process

Process

Process description

Name

Production of Wine Ethanol Fuel (ETAMAX D), including grape cultivation and wine production

Class

Name
2429 Manufacture of other chemical products n.e.c.
Reference to nomenclature
International Standard Industrial Classification of all economic activities, ISIC rev 3. Statistical Papers, Series M, No 4, Rev 3, United Nations, New York 1990 ST/ESA/STAT/SER.M/4/REV.3

Quantitative reference

Type	Functional unit
Name	Wine ethanol fuel
Unit	kg
Amount	1

Technical scope

Cradle to gate

Aggregation type

Vertically aggregated

Technology

Short technology descriptor
Production of wine ethanol fuel from grapes, including production of additives.

Technical content and functionality
ETAMAX D is the term used for pure ethanol fuel used for buses in Sweden in 1998. The fuel consists of (in percentage by weight):

95 % Ethanol made from European wine surplus	(90,2 %)
Beraid 3540 (ignition improver)	(7%)
Methyl tert-butyl ether (denaturation agent)	(2%)
Iso-butanol (denaturation agent)	(0,5%)
Morpholine (corrosion inhibitor)	(125 ppm)

Grape cultivation, wine manufacturing and distillation of wine to ethanol take place in Italy. The raw ethanol from the distillation is shipped to Sweden where it is distilled further to reduce its aldehyde and sulphur content. When the concentration of ethanol has reached 95%, the fuel is mixed with the additives.

Emissions and energy demands for the following processes are included:

-Harvesting and spreading of fertilisers during the grape cultivation (the grapes are cultivated in northern Italy and most of the harvesting is done by hand, the fertilisers are spread with different types of agricultural machines).

-Production of fertilisers (the fertilisers are produced in Italy)

-Wine production (only electricity is used for the process which includes all the steps from grinding to barrel packing)

-Production of help chemicals for wine production (the chemicals are produced in Italy)

-Distillation (the wine is distilled in a one column distillation plant, which requires steam and electricity, partly produced from biogas from the grape shales and branches)

-Purification (the raw ethanol is distilled to a higher alcohol concentration, steam and electricity is required for the process)

-Production of fuel additives

-Combustion of fuel in bus engine (the fuel is combusted in a Scania bus engine, specially developed for ethanol fuel)

-Transports (50% filling coefficient)

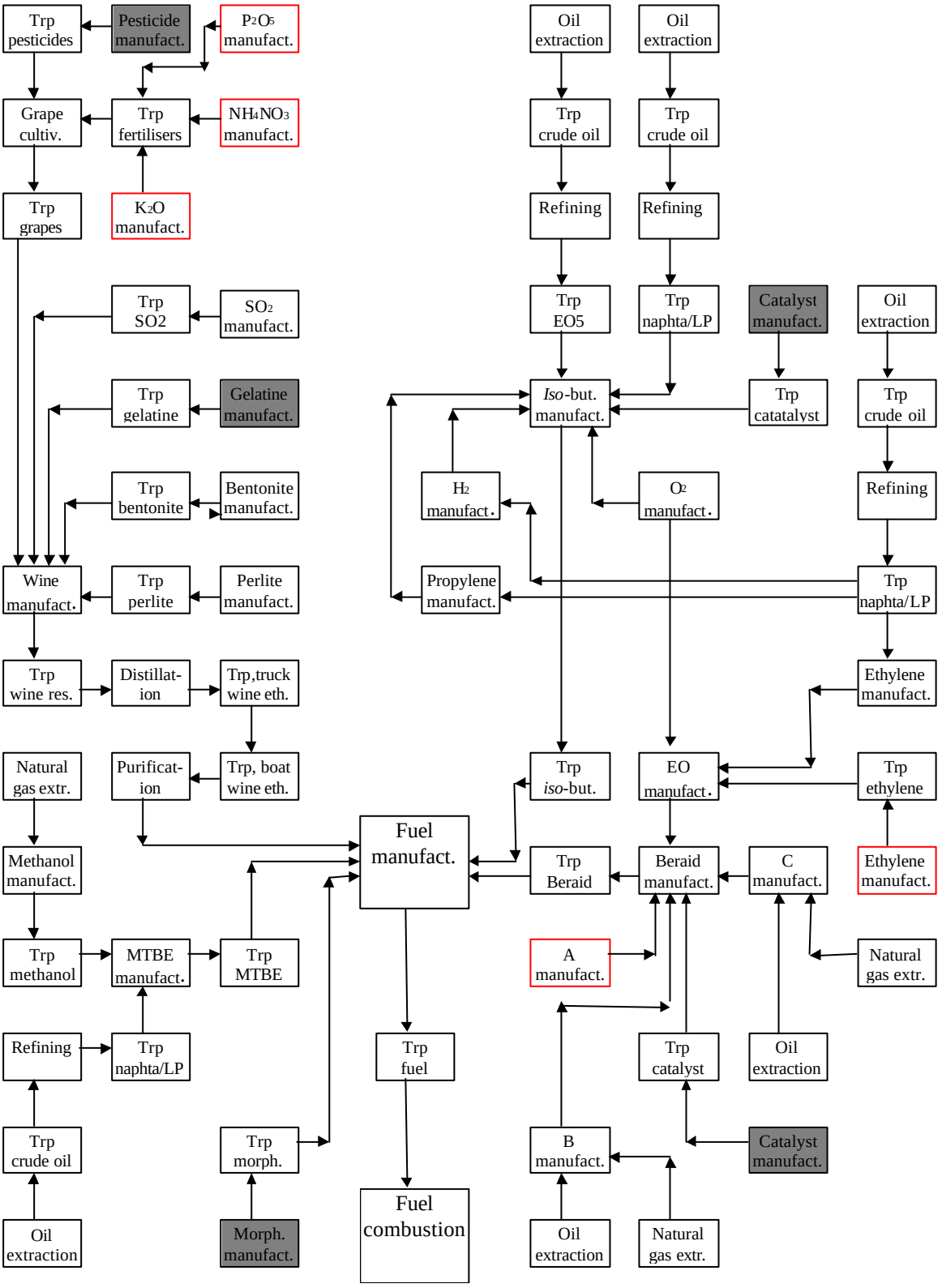
All energy sources are traced back to the extraction of energy raw material. For the processes in Sweden, the petrochemical raw material extraction is assumed to take place in Norway. For raw materials connected to energy use in other countries, a world average is used.

The electricity profile is based on the electricity profile for each country respectively. The electricity raw materials are traced back to the extraction in the same way as energy raw material not used for electricity production.

Technology picture

Processes which are not accounted for

Processes where all LCA data from the "cradle" are included



Valid time span

Start date 1998
End date 1998
Time span description
All data are for the wine ethanol fuel situation of 1998. Some data were extracted in 1997, but most of them in 1998. Exceptions are energy data which date back to 1993 (energy raw material extraction) and 1995 (electricity profiles).

Valid geography

Area Name SE IT
Area description
The study is based on production and consumption of ETAMAX D in Sweden. The ethanol is produced in Italy. All additives are produced in Sweden, except for morpholine, which is not accounted for.

Inputs and outputs

Direction	Group	Receiving environment	Geographical location	Related external system	Name	Amount	Documentation
							Documentation covering all inputs and outputs **Data collection** Derived, unspecified **Collection date** 1993-1998 **Data treatment** LCI data are taken from the literature reference. The calculations were carried out by an LCA software tool. **Reference to data sources** XXXXX
Input	Resource	Ground			**Name text** Crude oil	**Name** Absolute **Unit** *Symbol or Name* MJ **Parameter** *Name* Absolute *Value* 21,9	
Input	Resource	Ground			**Name text** Natural gas	**Name** Absolute **Unit** *Symbol or Name* MJ **Parameter** *Name* Absolute *Value* 10,0	
Input	Resource	Ground			**Name text** Biomass	**Name** Absolute **Unit** *Symbol or Name* MJ **Parameter** *Name* Absolute *Value* 6,0	
Input	Resource	Ground			**Name text** Coal	**Name** Absolute **Unit** *Symbol or Name* MJ **Parameter** *Name* Absolute *Value* 0,52	

Input	Resource	Ground			**Name text** Uranium ore	**Name** Absolute **Unit** *Symbol or Name* g **Parameter** *Name* Absolute *Value* 46,6	
Input	Resource	Ground	Italy		**Name text** Grapes	**Name** Absolute **Unit** *Symbol or Name* kg **Parameter** *Name* Absolute *Value* 11,2	
Output	Emission	Air	Global		**Name text** CO2	**Name** Absolute **Unit** *Symbol or Name* kg **Parameter** *Name* Absolute *Value* 1,87	
Output	Emission	Air			**Name text** NOx	**Name** Absolute **Unit** *Symbol or Name* kg **Parameter** *Name* Absolute *Value* 16,1	
Output	Emission	Air			**Name text** HC	**Name** Absolute **Unit** *Symbol or Name* g **Parameter** *Name* Absolute *Value* 1,5	
Output	Emission	Air			**Name text** CO	**Name** Absolute **Unit** *Symbol or Name* g **Parameter** *Name* Absolute *Value* 2,3	
Output	Emission	Air			**Name text** Particles	**Name** Absolute **Unit** *Symbol or Name* g **Parameter** *Name* Absolute *Value* 0,8	

Output	Emission	Air			**Name text** SO2	**Name** Absolute **Unit** *Symbol or Name* g **Parameter** *Name* Absolute *Value* 7	
Output	Product	Technosphere	Sweden	**Origin or destination** The fuel is used in buses in Stockholm and Örnsköldsvik in Sweden. **Transport type** The fuel is transported by truck to Stockholm.	**Name text** ETAMAX D	**Name** Absolute **Unit** *Symbol or Name* kg **Parameter** *Name* Absolute *Value* 1	

Modelling and validation

Intended application

The purpose was to study the production of wine ethanol fuel for buses in order to track down where the largest environmental charges could be found. Since the ethanol and the ignition improver are the major components of the fuel, it was of interest to focus on their environmental impact. The commissioner of the study (Company) might have a possibility to affect the production of the ignition improver.

The more detailed purpose was;
-To identify the environmental impacts of using ethanol fuel for buses, and compare the results to already existing LCA:s on other fuels. The report displays a comparison of wine ethanol fuel to diesel, natural gas and ethanol from wheat and wood.
- To track down the steps in the life-cycle with the largest environmental impacts
- To identify the contribution of the ignition improver to the total environmental impacts
- To use the results of the study as an indication to where to find improvement possibilities.

The intended user of the result is Company XX

Information sources

- Data has been collected from specific suppliers and sites mainly in Italy and Sweden.
- All production data have been obtained from technicians or sales managers of the different companies involved.

Modelling principles

Data selection principle
Site-specific data is preferred but if that is not available literature data or modelled data is used if considered necessary.

Modelling choices

Criteria for excluding elementary flows
The fact that emissions on different geographical places can have different effects on the environment has not been accounted for.

Only CO2 emissions with fossil origin are accounted for.

The influence on ground and water is only dealt with in steps where data could be obtained, and are therefore not comprehensive. Only the emissions to air are complete, why these data are the only ones presented.

Criteria for externalising processes
The following processes have not been included in the study:
- Production of machines, industrial plants and infrastructure
- Production of pesticides and the emissions from pesticides from the grape cultivation

- Production and emissions from morpholine (fuel additive)
- Production and emissions of chemicals used for the distillation process

Allocations performed

Allocation explanation

Allocation is made on a mass basis, where allocation has been applied, i.e. on fertiliser production and cracker product production. The basis for allocation was chosen because it was considered equal in relevance to other possible bases (for example energy basis), but easier to apply.

Data quality statement

In order to receive reliable data for wine ethanol, several distilleries, wine producers and grape cultivators were visited on the sites of production. Data for the grape cultivation have the highest uncertainties due to the fact that weather conditions and cultivation areas (flat or hilly cultivation) will strongly affect the fertiliser and fuel use.

Many data originates from reports to authorities and environmental reports. An exception is the production of Beraid 3540. During the production of this additive, measurements were carried out on site. Discussions with technicians at Company XX have been carried out to a greater extent than for other companies involved.

Data for electricity, where the electricity have been bought from the state net, is based on the electricity profile for the country in question (profile from 1995). The energy raw materials for electricity production are traced back to the extraction in the same way as for fuels which are not used for electricity production. For petrochemical raw materials used in Sweden, the raw material extraction is assumed to take place in Norway. For petrochemical raw materials used in other parts of the world, a world average is used.

Data for transportation are average data for long distance transports in Sweden, applicable for trucks produced 1995 or later. Since most raw materials are bulk chemicals, quite new catalyst equipped vehicles and empty returns are assumed. For transportations in Italy, older trucks without catalysts are assumed. For the boat transport of raw ethanol from Italy to Sweden, the data were collected from the particular shipping company.

Validation

Method Review of thesis

Procedure

The report on the study of wine ethanol fuel is the result of a Master of Science thesis carried out in co-operation with Company XX and University YY. XXXX at University YY, who is mentioned as reviewer of the study, was the examiner of the final thesis.

Other information

The data from the study are applicable for the fuel ETAMAX D, if all the ethanol in the fuel is produced from surplus wine from Italy. It is possible to add emission data from a specific bus driven on ETAMAX D in the purpose of studying the environmental impact from that particular bus.

It is also possible to compare the wine ethanol fuel to other fuels. If this is done, the boundaries and allocation methods of the compared studies must be the same as for the wine ethanol fuel study. If the boundaries and allocation differ for different studies, these studies can not be considered comparable.

It was shown that one of the largest single environmental impacts of the life-cycle of wine ethanol fuel was the transport of the raw ethanol from Italy to Sweden. Choosing a different transport, for example a boat with cleaning devices for exhaust gas, would strongly affect the result. The high fuel consumption during the grape cultivation is also an important contributing factor for the result, and it must be recognised that grape cultivation probably is carried out in different ways in different parts of the world.

There are other fuels where wine ethanol is a component, but ETAMAX D is the only pure ethanol fuel in Sweden today (1998). The ethanol in ETAMAX D does not necessarily have to come from wine, though this is the origin of ethanol used in bus fuel at present time.

Administrative information

Identification number

CPM_ISO/TS14048_WorkExamples_93

Registration authority

CPM (Center for Environmental Assessment of Product and Material Systems), Chalmers University of Technology, Göteborg, Sweden

Version number

1

Data commissioner

Company XX

Data generator

XXXXXXXXXXX

Data documentor

XXXXXXXXXXX

Date completed

1999-01-20

Publication

XXXXXXXXXXX

Access restrictions

Public

Data documentation of process

Process

Process description

Name

Surface mounting of printed board assembly (PBA)

Class

Name
3210 Manufacture of electronic valves and tubes and other electronic components
Reference to nomenclature
International Standard Industrial Classification of all economic activities, ISIC rev 3. Statistical Papers, Series M, No 4, Rev 3, United Nations, New York 1990 ST/ESA/STAT/SER.M/4/REV.3

Quantitative reference

Type	Reference flow
Name	Printed board assembly (PBA)
Unit	pieces
Amount	1

Technical scope

Gate to gate

Aggregation type

Non aggregated

Technology

Short technology descriptor
Surface mounted electronic card production in southern Sweden

Technical content and functionality
The plant is a highly modern facility. The total area of the factory is 28200 m2 (265 000 square feet). The studied system includes one production line for a typical surface mounted printed board assembly (PBA) used in private branch exchanges (PBX).

The steps in production of this PBA are:

1. Goods reception.
At this unit all materials, chemicals and components used in the processes in the factory arrive.
The goods are unpacked and sorted into different boxes and the electrical components are stored in unit 2, i.e. the store for electrical components. The waste arising consists of cardboard, metal clips, hard and soft plastics. The component manufacturers use these materials when they pack their products. A tractor is used

for transporting packaging material. The tractor of the sort farmers use, that is equipped with a diesel engine. We have not included this transport in this gate-to-gate system.

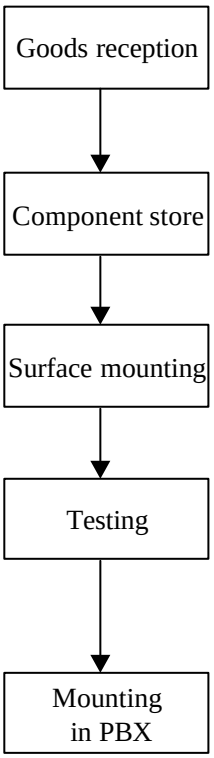
2. Store for components.
Here all components and materials later used in manufacturing of the PBA are stored. A so called "pater noster"- work sorts the boxes with the different components. The components are stored in wood boxes and maybe some plastic material is added. The boxes circulate.

3. Surface Mounting.
In this technology surface mounted devices (SMDs) are soldered to bonding pads on the surface of the substrate by screen printing in a robot mounting process. Surface mounted components are mounted in the paste as by its stickiness holds the components firm during mounting and into the reflow soldering.

4. Testing
Here printed board assemblies are tested to reveal possible errors.

5. Mounting in PBX
The PBA´s are mounted in the system a customer has ordered.

Technology picture



Operating conditions Normal

Valid time span

Start date 1997
End date 1997
Time span description
Figures based on environmental report for 1997, i.e. the figures are valid only for that specific year.

Valid geography

Area description Southern Sweden
Sites Production plant

Data acquisition

Sampling Procedure Data was collected at the production plant
Sampling Sites Production plant
Number of Sites 1
Sample volume
Absolute X pieces during 1997

Inputs and outputs

Direction	Group	Receiving environment	Geographical location	Related external system	Name	Amount	Documentation
Input	Raw material	Technosphere	Southern Sweden	**Origin or destination** Solder cream distributor **Transport type** Long distance truck from Gothenburg	**Name text** Solder cream **Reference to nomenclature** Company specific	**Name** Typical **Unit** *Symbol or Name* g **Parameter** *Name* Typical *Value* x	**Data collection** Unspecified **Collection date** 1997-1998 **Data treatment** According to the contract manufacturers environmental report, a total use of XX kg solder cream (in this case tin 62 %, lead 25,5 % ,silver 2 %, glycol diether 6,825 %, modified harts 3,675 % by weight) was used during 1997. The share per SMD PBA is approximately x g, considering the annual production of SMD T pieces of SMD PBA´s were produced during 1997. **Reference to data sources** Contract manufacturer environmental report for 1997
Input	Raw material	Technosphere	Southern Sweden	**Origin or destination** Lead melting factory **Transport type** Long distance truck from factory	**Name text** Solder **Reference to nomenclature** Company specific	**Name** Typical **Unit** *Symbol or Name* g **Parameter** *Name* Typical *Value* x	**Data collection** Unspecified **Collection date** 1997-1998 **Data treatment** According to The contact manufacturer environmental report, a total use of a kg solder (in this case a tin/lead alloy consisting of 63 weight % tin and 37 weight % lead) was used during 1997. The share per SMD PBA is approximately b g, considering the annual production of SMD Tpieces of SMD PBA´s were produced during 1997. Almost every gram of solder used is fixed on the PBA. The waste of solder is due to oxidation of the solder so it goes bad and has to be discarded of that reason. **Reference to data sources** Contract manufacturer environmental report for 1997

Output	Emission	Air	Southern Sweden		**Name text** Pb	**Name** Typical **Unit** *Symbol or Name* g **Parameter** *Name* Typical *Value* x	**Data collection** Random samples **Collection date** 1997-1998 **Data treatment** According to The contact manufacturer environmental report, XX kg lead was emitted to air during 1997 from the two factories in Karlskrona. The share per SMD PBA is approximately x g, considering the annual production of SMD PBA´s. T SMD PBA´s were produced during 1997. The amount of lead emitted has been distributed on the products for which lead is used as solder material. *Sampling method* Air borne particles were collected on a cellulose acetate filter (pore diameter 0,8 µm) with the aid of reciprotor pumps and an airflow of app. 12 dm^3/minute. The sample volume was measured with the aid of a gas vessel (“gasur”). The measurement did take place in the outflow opening on the roof (3 samples). For comparison one sample was gathered in the surrounding air on the roof about 15 meters from the outflow opening. The filters were dissolved in concentrated nitric acid (HNO_3) and were analysed using inductively coupled plasma (ICP)-mass spectroscopy (MS). **Reference to data sources** Contract manufacturer environmental report for 1997 and examination report from an investigation 28/4 1997 aiming at determining the amount of lead emitted to air.

Input	Energy	Technosphere	Southern Sweden	**Origin or destination** Swedish electricity producer **Transport type** Electricity distribution network	**Name text** Electricity	**Name** Typical **Unit** *Symbol or Name* MJ **Parameter** *Name* Typical *Value* x	**Data collection** Continous measurement **Collection date** 1997-1998 **Data treatment** For the factory where the SMD PBA´s are manufactured we assumed the following distribution of the electricity consumption: The factory consumed A MWh during 1997. Office areas: B % Final mounting: B % Mounting of radio base stations for DECT: B % Mounting of digital phones (D3): B % Mounting of MD printed board assemblies: B % Logistics department: C % . We found it reasonable to assume a bigger consumption of energy for the production lines and the biggest consumption for the "MD board lines" and the "D3 line". We set a base value of E Wh for DECT radio base stations and D MWh for MD PBA´s and D3 Logistics department: C* (A-2D-E) Office areas: B* (A-2D-E) Final mounting: B* (A-2D-E) Mounting of radio base stations for DECT: E + B* (A-2D-E) Mounting of digital phones (D3): D + B* (A-2D-E) Mounting of MD printed board assemblies: D + B* (A-2D-E). We also wanted to distribute the electricity consumption for Office and Logistics on the production: B* (A-2D-E) + C* (A-2D-E) Mounting of MD printed board assemblies: D + B* (A-2D-E) + C* (A-2D-E) + ((B* (A-2D-E) + C* (A-2D-E))/4 = D + (A-2D-E)((5B+C)/4) MWh. • D3 line • PBA line • RBS line • Final mounting. T pieces of SMD PBA´s were produced during 1997: D + (A-2D-E)((5B+C)/4) / T **Reference to data sources** Contract manufacturer environmental report for 1997

Modelling and validation

Intended application

The purpose was to map a specific factory from an environmental standpoint in a structured procedure so that a LCI model could be made for surface mounted printed board assemblies (PBA´s) used in private branch exchanges. The principle was to collect resource consumption data and emission data connected with the assembly of one PBA.

The data set is part in an LCA study for a private branch exchange. *The main purpose* of the study for the company is;

- *to learn, test and evaluate the LCA-methodology as a tool for environmental improvement* in the product design process, and to make up concrete product guidelines regarding design for environment (DfE) and
- *to evaluate environmental aspects in new design.*
- The relative importance for *different phases may also be an important input in the internal work with an Environmental Management System* for the company.

Also the aim is;

- *to collect and qualify data from suppliers and literature in order to build up a database* for this and future LCA activities and
- within the project, it is also *intended to analyse the possibilities to use the study as a base for future work regarding a type III ecolabeling* project within the company.

Information sources

Contract manufacturer environmental report

Modelling principles

Data selection principle

The original goal was to sample data from the specific production line in which SMD PBA´s are produced. We wanted to measure at each specific line but were not able to do that so instead we used another technique. Each line got its model with aid of total figures from the environmental report. We did not exclude any lines we initially wanted to be included in the study.

Modelling constants

Name	Areas of different production and office sectors.
Value	percentage of the total factory area

Modelling choices

Criteria for excluding elementary flows

Only the inputs and outputs mentioned in the environmental report were included.

Criteria for externalising processes

Some internal transports and shared resources are not allocated to this type of card.

Allocations performed

Allocation explanation

Distribution of total consumption of raw materials and emissions on certain production lines based on total production in each line. Every e.g. raw material type does not occur in every production line at the facility.
Total production figures have been used as factors.

Data quality statement

All data is based on the environmental report and interviews with production personnel.

Validation

Method	Mass balance
Procedure	Calculation on mass balance for chemicals
Result	For used chemicals the amount in does not exceed the amount out.
Validator	XXX, Company XX

Administrative information

Identification number

CPM_ISO/TS14048_WorkExamples_94

Registration authority

CPM (Center for Environmental Assessment of Product and Material Systems), Chalmers University of Technology, Göteborg, Sweden

Version number

1

Data commissioner

Company XX

Data generator

XXX, Company XX

Data documentor

XXX, Company XX

Date completed

1999-11-01

Copyright

XXX, Company XX

Access restrictions

Data can only be used within Company XX.

Data documentation of process

Process

Process description

Name

Silviculture of softwood

Class

Name
0200 Forestry, logging, and related service activities
Reference to nomenclature
International Standard Industrial Classification of all economic activities, ISIC rev 3. Statistical Papers, Series M, No 4, Rev 3, United Nations, New York 1990 ST/ESA/STAT/SER.M/4/REV.3

Quantitative reference

Type	Functional unit
Name	Softwood
Unit	m3sub (sub = solid under bark)
Value	1

Technical scope

Cradle to gate

Aggregation type

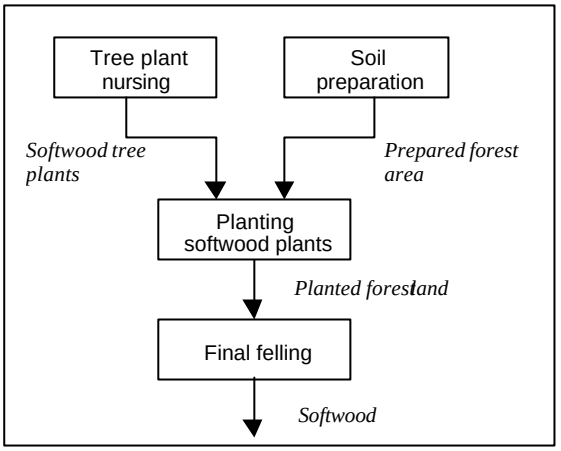
Vertically aggregated

Technology

Short technology descriptor
Silviculture in central Sweden

Technical content and functionality
This process describes the silviculture for softwood delivered at road side in central Sweden. Sivliculture includes tree plant nursing, preparation of the soil, planting and final felling of softwood. See the technology picture and the data documentation of each of the included processes for a further description.

Technology picture



Process contents

Included processes

CPM_ISO/TS14048_WorkExamples_96
CPM_ISO/TS14048_WorkExamples_97
CPM_ISO/TS14048_WorkExamples_98
CPM_ISO/TS14048_WorkExamples_99

Intermediate product flows

Source process	*Input and output source*	*Input and output destination*	*Destination process*
CPM_ISO/TS14048_WorkExamples_96	4	4	CPM_ISO/TS14048_WorkExamples_98
CPM_ISO/TS14048_WorkExamples_97	3	1	CPM_ISO/TS14048_WorkExamples_98
CPM_ISO/TS14048_WorkExamples_98	5	1	CPM_ISO/TS14048_WorkExamples_99

Operating conditions

Normal for all of the included process, except the process Planting softwood plants where only 70 % of the normal operating conditions where utilised.

Valid time span

Start date 1985
End date 1994
Time span description
The system that is described is assumed to be unchanged during the stated time span.

Valid geography

Area description Central Sweden
Sites Plant Nursery
Forest area in the county of Värmland in Sweden

Data acquisition

Sampling Procedure	The system is representative for large-scale softwood silviculture in central Sweden.
Sampling Sites	Plant Nursery Forest area in the county of Värmland in Sweden
Number of Sites	2

Inputs and outputs

Identification number	Direction	Group	Receiving environment	Receiving environment specification	Geographical location	Related external system	Name	Property	Amount	Documentation
										Documentation covering all flows **Data collection** Derived **Collection date** 1985-1994 **Data treatment** The data are aggregated and normalised according to the LCI methodology in ISO 14041:1998
1	Input	Raw material	Technosphere		Central Sweden	**Transport type** Truck, short distance	**Name text** Softwood tree seeds **Reference to nomenclature** Company specific		**Name** Typical **Unit** *Symbol or Name* kg *Explanation* SI-unit **Parameter** *Name* Typical *Value* XXXX	
2	Input	Energy	Technosphere		Central Sweden		**Name text** Diesel **Reference to nomenclature** Company specific	**Name** Thermal value **Unit** MJ/kg **Amount** 43,43 **Name** Density **Unit** kg/dm3 **Amount** 0,81	**Name** Typical **Unit** *Symbol or Name* MJ *Explanation* SI-unit **Parameter** *Name* Typical *Value* XXXX	
3	Input	Energy	Technosphere		Central Sweden		**Name text** Electricity **Reference to nomenclature** Company specific		**Name** Typical **Unit** *Symbol or Name* kWh **Parameter** *Name* Typical *Value* XXX	

4	Non-flow-related aspect	Area	Technosphere	Forestry production area before processing	Central Sweden		**Name text** Unprepared forest area **Reference to nomenclature** Company specific		**Name** Typical **Unit** *Symbol or Name* ha **Parameter** *Name* Typical *Value* XXX	
5	Input	Energy	Technosphere		Central Sweden	**Origin or destination** Petrol station in Värmland	**Name text** Gasoline		**Name** Typical **Unit** *Symbol or Name* MJ **Parameter** *Name* Typical *Value* XXX	
6	Non-flow-related aspect	Area	Technosphere	Forestry production area after processing	Central Sweden	**Origin or destination** Soil preparation	**Name text** Clear-cut forest area **Reference to nomenclature** Company specific		**Name** Typical **Unit** *Symbol or Name* ha **Parameter** *Name* Typical *Value* XXX	
7	Output	Product	Technosphere		Central Sweden	**Origin or destination** Pulp and paper mill in the county of Värmland, Sweden	**Name text** Softwood **Reference to nomenclature** Company specific		**Name** Typical **Unit** *Symbol or Name* m3sub *Explanation* Cubic metres solid under bark **Parameter** *Name* Typical ***Value*** 1	

Modelling and validation

Intended application

The purpose is to supply LCA-data for forestry, to be used in further studies of wood products. The specific aim was to update an earlier study from 1988.

The purpose was also to compare traditional silviculture (soil preparation, tree plant nursing and planting) with natural regeneration i.e. the forest area is regenerated via natural seeding.

Information sources

See data documentation for each of the included processes in this system

Modelling principles

Data selection principle
System representative for large-scale softwood silviculture in central Sweden.

Modelling choices

Criteria for excluding elementary flows
Emissions caused by combustion of fuels are not included in the system.

Criteria for externalising processes
The following processes have been excluded:
- clearing of young forest
- fertilising
- thinning

For further information, see the data documentation of the included processes, respectively.

Data quality statement

No sensitivity analysis has been performed for the aggregated system. See also data quality statements in the data documentation for each of the included processes for comments.

Validation

Method	Critical review
Procedure	The methodology was reviewed with regard to ISO 14041:1998
Result	Approved
Validator	Mr XXX, LCA consultant

Other information

These data are valid for large-scale silviculture in central Sweden. It may also be used as an average for other parts of Sweden, where similar technology is used.

Administrative information

Identification number

CPM_ISO/TS14048_WorkExamples_95

Registration authority

CPM (Center for Environmental Assessment of Product and Material Systems), Chalmers University of Technology, Göteborg, Sweden

Version number

1

Data commissioner

XXXXXX

Data generator

XXXXXX

Data documentor

XXXXXX

Date completed

1994

Access restrictions

Parts of the system are confidential.

Data documentation of process

Process

Process description

Name

Tree plant nursing

Class

Name
0200 Forestry, logging, and related service activities
Reference to nomenclature
International Standard Industrial Classification of all economic activities, ISIC rev 3. Statistical Papers, Series M, No 4, Rev 3, United Nations, New York 1990 ST/ESA/STAT/SER.M/4/REV.3

Quantitative reference

Type	Reference flow
Name	Tree plants
Unit	pieces
Amount	1000

Technical scope

Gate to gate

Aggregation type

Vertically aggregated

Technology

Short technology descriptor
Large scale softwood tree plant nursing in central Sweden.

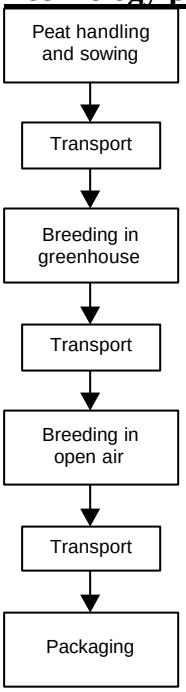
Technical content and functionality
From collected seed, plants are nursed in special green houses. This includes peat handling and sowing, internal transports, breeding in greenhouse, breeding in open air, and finally packing.

The following operations is included:

- Peat handling and sowing is done by two electrical machines (6 kW and 50% utilisation), sowing the seed in a peat filled plastic case. 5 plastic cases per 1000 plants are used 4 times before wasted.
- Transport of tree plants to greenhouse by tractor (60 kW and 50% utilisation).
- Breeding in greenhouse includes lighting and heating. Dimensions of the greenhouse: 2000 m2 and 8 m high. Capacity: 1500000 plants per greenhouse. The greenhouse is heated by combusting diesel oil. The plants are fertilised with nitrogen fertiliser.

- Transport from the greenhouse to outside cultivation, i.e. breeding in open air.
- Transport of tree plant to packaging room.
- Packing of plants is conducted by an electrical machine into cardboard boxes (6 kW)

Technology picture



Operating conditions Normal

Valid time span

Start date 1992-01-01
End date 1994-12-31
Time span description
The system that is described is assumed to be unchanged during the stated time span.

Valid geography

Area description
Central Sweden. The included processes are only valid in areas with similar climate as central Sweden.
Sites Plant Nursery

Data acquisition

Sampling Procedure
The specific site was chosen due to it was assumed to be representative for large scale softwood tree plant nursing in central Sweden. No other site was found in the area.
Sampling Sites Plant Nursery
Number of Sites 1
Sample volume
Absolute Not known
Relative Not known

Inputs and outputs

Identification number	Direction	Group	Receiving environment	Geographical location	Related external system	Name	Property	Amount	Documentation
1	Input	Energy	Technosphere	Central Sweden	**Origin or destination** Refinery in southern Sweden. **Transport type** Truck, long distance	**Name text** Diesel **Reference to nomenclature** Company specific	**Name** Thermal value **Unit** MJ/kg **Amount** 43,43 **Name** Density **Unit** kg/dm3 **Amount** 0,81	**Name** Range **Name** *Symbol or Name* MJ *Explanation* SI-unit **Parameter** *Name* Typical *Value* XX *Name* Max *Value* YY *Name* Min *Value* ZZ	**Data collection** Unspecified, expert outspoke **Collection date** 1994-02-24 **Data treatment** The value is derived from information regarding transportation and heating of the premises: *Transportation*: Tractor effect 60 kW, 50% efficiency on the motor (based on Technical report on tractor performance). 120 000 plants is transported per hour which gives the distribution energy XX MJ per 1000 plants. *Heating*: XX m3 diesel oil is used for heating XX million plants annually. The information is based on personal communication with Mr X. Thus XX MJ/1000 plants. **Reference to data sources** Mr X at Plant Nursery Technical report on tractor performance

2	Input	Energy	Technosphere	Central Sweden	**Origin or destination** Electricity Producer Inc. **Transport type** Electricity distribution network	**Name text** Electricity **Reference to nomenclature** Company specific		**Name** Range **Unit** *Symbol or Name* kWh **Parameter** *Name* Typical *Value* XX *Name* Max *Value* YY *Name* Min *Value* ZZ	**Data collection** Unspecified, expert outspoke **Collection date** 1994-02-24 **Data treatment** The value is derived from information regarding peat handling and sowing, illuminating the greenhouse and packing of the plants: *Peat handling and sowing:* Two electrical vehicles (6 kW and 50% efficiency) work 100 m2/h à 800 plants/m2, resulting in XX kWh/1000 plants. *Illuminating;* YYYYY kWh is used for illuminating XX million plants, resulting in XX kWh/1000 plants. *Packing of plants:* 6 kW/40 m2 per h à 800 plants per m2 resulting in XX kWh/1000 plants. **Reference to data sources** Mr X, Plant Nursery
3	Input	Raw material	Technosphere	Central Sweden	**Transport type** Truck, short distance	**Name text** Softwood tree seeds **Reference to nomenclature** Company specific		**Name** Typical **Unit** *Symbol or Name* kg *Explanation* SI-unit **Parameter** *Name* Typical *Value* XX	**Data collection** Derived, statistics **Collection date** 1994 **Data treatment** Based on purchase statistics for Plant Nursery and personal communication with Mrs Y. **Reference to data sources** Internal report Mrs Y, Plant Nursery
4	Output	Product	Technosphere	Central Sweden	**Origin or destination** Forest area in central Sweden **Transport type** Truck, short distance	**Name text** Softwood tree plants **Reference to nomenclature** Company specific		**Name** Typical **Unit** *Symbol or Name* p *Explanation* Pieces **Parameter** *Name* Typical *Value* 1000	**Data treatment** The reference flow for the process.

Modelling and validation

Intended application

The purpose is to supply LCA-data for forestry, to be used in further studies of wood products. The aim was to update an earlier study from 1988. This process is to be used for the plant nursing part, representative for forestry in central Sweden. This is the first step in the silviculture process, which has four steps:
1. Plant nursing
2. Soil preparation
3. Planting
4. Final felling

The purpose was also to compare traditional silviculture (soil preparation, tree plant nursing and planting) with natural regeneration i.e. the forest area is regenerated via natural seeding.

Information sources

- Mr X, environmental co-ordinator at Plant Nursery
- Mrs Y at the economics department at Plant Nursery
- Technical report on tractor performance, 1990, Tractor manufacturer

Modelling principles

Data selection principle

Data representative for large-scale softwood tree plant nursing in central Sweden.

Modelling constants

Name	Utilisation of electrical machinery for peat handling and sowing
Value	50%
Name	Utilisation of tractor motor during transport to greenhouse
Value	50%

Modelling choices

Criteria for excluding elementary flows

All elementary flows from the combustion of fuels are excluded.

Criteria for excluding intermediate product flows

Use of cardboard boxes has been excluded due to lack of data.

Criteria for externalising processes

The following systems have been excluded:

- Personnel facilities
- Transport from the tree plant packaging to planting in forest
- Maintenance of the equipment

Data quality statement

The main source of information, Mr X, has been working for several years at the investigated site and has a vast experience of the activities at the site and the business.

Validation

Method	Benchmarking
Procedure	Data was compared with a similar system from a different part of Sweden.
Result	The data that is presented was found to be reasonable. No changes were made.
Validator	Mr X at a plant nursery in the northern part of Sweden

Other information

This process may also be representative for large-scale softwood tree plant nursing in the whole of Scandinavia. However, the data user should be aware that the energy use for heating etc. varies depending on the climate.

Administrative information

Identification number

CPM_ISO/TS14048_WorkExamples_96

Registration authority

CPM (Center for Environmental Assessment of Product and Material Systems), Chalmers University of Technology, Göteborg, Sweden

Version number

1

Data commissioner

XXXXXX

Data generator

XXXXXX

Data documentor

XXXXXX

Date completed

1994-02-24

Publication

Not published elsewhere

Access restrictions

Access to numerical data on inputs and outputs is available on permission from Mr X, environmental co-ordinator at Plant Nursery

Data documentation of process

Process

Process description

Name

Soil preparation

Class

Name
0200 Forestry, logging, and related service activities
Reference to nomenclature
International Standard Industrial Classification of all economic activities, ISIC rev 3. Statistical Papers, Series M, No 4, Rev 3, United Nations, New York 1990 ST/ESA/STAT/SER.M/4/REV.3

Quantitative reference

Type	Reference flow
Name	Prepared soil to be used for forestry
Unit	hectare
Amount	1

Technical scope

Gate to gate

Aggregation type

Non aggregated

Technology

Short technology descriptor
Large scale central Sweden soil preparation

Technical content and functionality
Preparation of the soil is done mechanically by tractors and specially designed vehicles removing the topmost layer down to the mineral soil in patches or strips.

Operating conditions
Normal

Valid time span

Start date	1985
End date	1992

Time span description
The stated time span refers to the time period during which data for the process was collected.

Valid geography

Area description	Central Sweden
Sites	Forest area in Värmland.

Data acquisition

Sampling Procedure

A specific machine was studied due to it was assumed to be representative for machines in use in large-scale soil preparation in central Sweden.

Sampling Sites	Forest area in Värmland
Number of Sites	1

Inputs and outputs

Identification number	Direction	Group	Receiving environment	Receiving environment specification	Geographical location	Related external system	Name	Property	Amount	Documentation
1	Input	Energy	Technosphere		Central Sweden	**Origin or destination** Diesel producer in southern Sweden **Transport type** Truck, long distance	**Name text** Diesel **Reference to nomenclature** Company specific	**Name** Thermal value **Unit** MJ/kg **Amount** 43,43 **Name** Density **Unit** kg/dm3 **Amount** 0,82	**Name** Mean **Unit** *Symbol or Name* MJ *Explanation* SI-unit **Parameter** ***Name*** Mean *Value* XXX	**Data collection** Derived, unspecified **Collection date** 1985 - 1992 **Data treatment** According to ABC, 22,5 l diesel/hour is used to prepare 0,5 ha/hour, i.e. XX l diesel/ha. **Reference to data sources** ABC"Technical report on the efficiency of soil preparation machine", 1985
2	Non-flow-related aspect	Area	Technosphere	Forestry production area before processing	Central Sweden		**Name text** Unprepared forest area **Reference to nomenclature** Company specific		**Name** Typical **Unit** *Symbol or Name* ha **Parameter** ***Name*** Typical *Value* XXX	
3	Non-flow-related aspect	Area	Technosphere	Forestry production area after processing	Central Sweden		**Name text** Prepared forest area **Reference to nomenclature** Company specific		**Name** Typical **Unit** *Symbol or Name* ha **Parameter** ***Name*** Typical *Value* XXX	

Modelling and validation

Intended application

The purpose is to supply LCA-data for forestry, to be used in further studies of wood products. The aim was to update an earlier study from 1988. This process is to be used for the soil preparation, representative for forestry in central Sweden. This is the second step in the silviculture process, which has four steps:

1. Plant nursing
2. Soil preparation
3. Planting
4. Final felling

The purpose was also to compare traditional silviculture (soil preparation, tree plant nursing and planting) with natural regeneration i.e. the forest area is regenerated via natural seeding.

Information sources

XXXXXXX "Technical report on the efficiency of soil preparation machine", 1985

Modelling principles

Data selection principle

Data representative for large scale soil preparation in central Sweden.

Modelling constants

Name	Prepared forest area (ha) per litre used diesel
Value	0,02 ha/litre

Modelling choices

Criteria for excluding elementary flows

Emissions caused by diesel combustion are not included in the process.

Criteria for excluding intermediate product flows

The use of lubricating oil used in the machine has not been considered due to unreliable basic data.

Criteria for externalising processes

Clear-cutting of the ground is not included. This has been described in a separate activity: "Final felling".

Data quality statement

The technical report on which the data is based is from 1985 and it is probably not representative today, due to changes in the efficiency on newer models of soil preparation machines. There was however no more recent material available.

Validation

Method	Proof-reading of documentation
Procedure	Read the technical report on which the data is based and check that the documentation in this format is consistent with the original source.
Result	The documentation was found to be consistent
Validator	XXXXXX

Other information

The efficiency of the soil preparation is highly dependent of the soil quality. The data user should therefore take this into consideration if the process is to be used for other types of forest areas.

Administrative information

Identification number

CPM_ISO/TS14048_WorkExamples_97

Registration authority

CPM (Center for Environmental Assessment of Product and Material Systems), Chalmers University of Technology, Göteborg, Sweden

Version number

1

Data commissioner

XXXXXXX

Data generator

XXXXXXX

Data documentor

XXXXXXX

Date completed

1992

Publication

XXXXXXX

Access restrictions

Confidential

Data documentation of process

Process

Process description

Name

Planting softwood plants

Class

Name
0200 Forestry, logging, and related service activities
Reference to nomenclature
International Standard Industrial Classification of all economic activities, ISIC rev 3. Statistical Papers, Series M, No 4, Rev 3, United Nations, New York 1990 ST/ESA/STAT/SER.M/4/REV.3

Quantitative reference

Type	Reference flow
Name	Planted forest land
Unit	Hectare
Value	1

Technical scope

Gate to gate

Aggregation type

Vertically aggregated

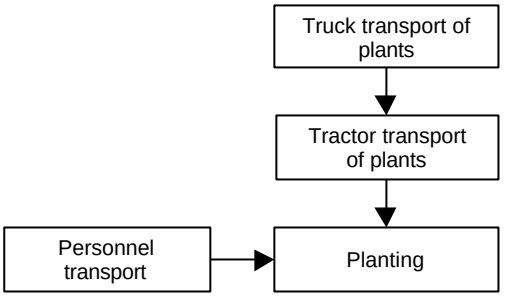
Technology

Short technology descriptor
Large scale planting of softwood plants in central Sweden

Technical content and functionality
Planting softwood tree seedlings includes transport of tree plant to the forest and plantation. The transport is done by a truck transporting the plants from the plant nursery to the forest (40000 plant per truckload) and by a tractor in the forest (30kW).

The plantation is done manually using a plantation tube and demands labour to be transported to the forest. This transportation is included; a car takes the shift to the forest: 0,10 l diesel/km.

Technology picture



Operating conditions

Due to a union strike within the truck drivers only about 70 % of the normal capacity of truck transportation was utilised.

Valid time span

Start date 1994
End date 1994
Time span description

Due to the union strike in 1994, the process is only valid for this year (see operating conditions).

Valid geography

Area description Central Sweden
Sites Forest area in the county of Värmland, Sweden.

Data acquisition

Sampling Procedure

Specific transports were studied due to it was assumed to be representative for large scale planting of softwood tree plants in central Sweden.
Sampling Sites Forest area in the county of Värmland, Sweden.
Number of Sites 1

Inputs and outputs

Identification number	Direction	Group	Receiving environment	Receiving environment specification	Geographical location	Related external system	Name	Amount	Documentation
1	Non-flow-related aspect	Area	Technosphere	Forestry production area before processing	Central Sweden	**Origin or destination** Soil preparation	**Name text** Prepared forest area **Reference to nomenclature** Company specific	**Name** Typical **Unit** *Symbol or Name* ha **Parameter** *Name* Typical *Value* 1	
2	Input	Energy	Technosphere		Central Sweden	**Origin or destination** Petrol station in Värmland	**Name text** Diesel	**Name** Normal distribution **Unit** *Symbol or Name* MJ **Parameter** *Name* s^2 *Value* XX *Name* µ *Value* XX	**Data collection** Monitored, discrete **Collection date** 1994-02-24 **Data treatment** The number of transported plants, and the diesel use are recorded for each trip both for the truck and the tractor transport. **Reference to data sources** Internal quality system.
3	Input	Energy	Technosphere		Central Sweden	**Origin or destination** Petrol station in Värmland	**Name text** Gasoline	**Name** Typical **Unit** *Symbol or Name* MJ **Parameter** ***Name*** Typical *Value* XXXX	**Data collection** Derived, unspecified **Collection date** 1994-02-24 **Data treatment** Derived from a technical paper for the tractor. A 30 kW gasoline engineed tractor transports 3300 plants in average 300 meters. Velocity: 50 m/min. The total distance (600 m) takes 12 minutes, or 0,2 hours.
4	Input	Raw material	Technosphere		Central Sweden	**Origin or destination** Tree plant nursing	**Name text** Softwood tree plants **Reference to nomenclature** Company specific	**Name** Range **Unit** *Symbol or Name* p *Explanation* Pieces **Parameter** *Name* Min *Value* XX *Name* Max *Value* XX	**Data collection** Unspecified, expert outspoke **Collection date** 1994-02-24 **Data treatment** Based on information supplied by XXXX, expert in silviculture at the University in XXXX. **Reference to data sources** XXXX, University of XXXX

5	Non-flow-related aspect	Area	Technosphere	Forestry production area after processing	Central Sweden		**Name text** Planted forest land	**Name** Typical **Unit** *Symbol or Name* ha **Parameter** *Name* Typical *Value* 1	**Collection date** 1994-02-24 **Data treatment** All inputs and outputs have been normalised to this flow.

Modelling and validation

Intended application

The purpose is to supply LCA-data for forestry, to be used in further studies of wood products. The aim was to update an earlier study from 1988. This process is to be used for the planting part, representative for forestry in central Sweden. This is the third step in the silviculture process, which has four steps:

1. Plant nursing
2. Soil preparation
3. Planting
4. Final felling

The purpose was also to compare traditional silviculture (soil preparation, tree plant nursing and planting) with natural regeneration i.e. the forest area is regenerated via natural seeding.

Information sources

Internal quality system
Technical paper for tractor
XXXX, expert in silviculture at the University in XXXX

Modelling principles

Data selection principle
Data representative for large-scale softwood tree planting in central Sweden.

Modelling constants

Name	Transport distance from tree plant nursing to forest
Value	50 km
Name	gasoline tractor engine effect
Value	30 kW
Name	Velocity of gasoline engined tractor
Value	50 m/min.

Modelling choices

Criteria for excluding elementary flows
Emissions caused by combustion of diesel are not included.

Criteria for excluding data categories
Maintenance material for the vehicles used in the system have been excluded, due to lack of data.

Criteria for externalising processes
Personnel facilities, e.g. heating of lunch cabin have been excluded, due to that the contribution is considered to be neglectable.

Other information

The transport distances are representing an average for central Sweden. If the process is to be used to represent planting in other parts of Sweden, the transport distances may vary, e.g. the transport distances are greater in the northern part of Sweden.

Administrative information

Identification number

CPM_ISO/TS14048_WorkExamples_98

Registration authority

CPM (Center for Environmental Assessment of Product and Material Systems), Chalmers University of Technology, Göteborg, Sweden

Version number

1

Data commissioner

XXXXXXXX

Data generator

XXXXXXXX

Data documentor

XXXXXXXX

Date completed

1994

Access restrictions

Public

Data documentation of process

Process

Process description

Name

Final felling

Class

Name
0200 Forestry, logging, and related service activities
Reference to nomenclature
International Standard Industrial Classification of all economic activities, ISIC rev 3. Statistical Papers, Series M, No 4, Rev 3, United Nations, New York 1990 ST/ESA/STAT/SER.M/4/REV.3

Quantitative reference

Type	Functional unit
Name	Softwood
Unit	m3sub (sub = solid under bark)
Value	1

Technical scope

Gate to gate

Aggregation type

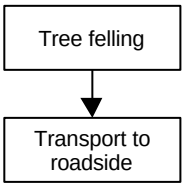
Non aggregated

Technology

Short technology descriptor
Large scale final felling of softwood in central Sweden

Technical content and functionality
The softwood is harvested using a processor that cuts the tree, removes the branches and piles the logs. The logs are transported to the roadside by a specially designed vehicle. All wood is assumed to be taken at the same time.

Technology picture



Operating conditions Normal

Valid time span

Start date 1992-01-15
End date 1994-02-24
Time span description
The data collected are representative for the time period 1992-1994.

Valid geography

Area description Central Sweden
Sites Forest area in the county of Värmland, Sweden

Data acquisition

Sampling Procedure
Only one site was studied due to the limited time allowed for the project.

Inputs and outputs

Identification number	Direction	Group	Receiving environment	Receiving environment specification	Geographical location	Related external system	Name	Property	Amount	Documentation
1	Non-flow-related aspect	Area	Technosphere	Forestry production area before processing	Central Sweden	**Origin or destination** Planting softwood plants	**Name text** Planted forest land **Reference to nomenclature** Company specific	**Name** Age of forest **Unit** Year **Amount** 80	**Name** Mean **Unit** *Symbol or Name* ha **Parameter** *Name* Mean *Value* XX	
2	Input	Energy	Technosphere		Central Sweden	**Origin or destination** Not known	**Name text** Diesel **Reference to nomenclature** Company specific	**Name** Thermal value **Unit** MJ/kg **Amount** 43,43	**Name** Mean **Unit** *Symbol or Name* MJ **Parameter** *Name* Mean *Value* XX	**Data collection** Unspecified, expert outspoke **Collection date** 1994-02-24 **Data treatment** According to the processor operator, 1,0 l diesel is used for felling 1 m3sub
3	Non-flow-related aspect	Area	Technosphere	Forestry production area after processing	Central Sweden	**Origin or destination** Soil preparation	**Name text** Clear-cut forest area **Reference to nomenclature** Company specific		**Name** Mean **Unit** *Symbol or Name* ha **Parameter** *Name* Mean *Value* XX	
4	Output	Product	Technosphere		Central Sweden	**Origin or destination** Pulp and paper mill in southern Sweden **Transport type** Truck, long distance	**Name text** Softwood **Reference to nomenclature** Company specific		**Name** Typical **Unit** *Symbol or Name* m3sub *Explanation* Cubic metres solid under bark **Parameter** *Name* Typical ***Value*** 1	

Modelling and validation

Intended application

The purpose is to supply LCA-data for forestry, to be used in further studies of wood products. The aim was to update an earlier study from 1988. This process is to be used for the final felling part, representative for forestry in central Sweden. This is the last step in the silviculture process, which has four steps:
1. Plant nursing
2. Soil preparation
3. Planting
4. Final felling

The purpose was also to compare traditional silviculture (soil preparation, tree plant nursing and planting) with natural regeneration i.e. the forest area is regenerated via natural seeding.

Information sources

Processor operator at a specific forest company

Modelling principles

Data selection principle

Data representative for large-scale softwood tree felling in central Sweden.

Modelling choices

Criteria for excluding elementary flows

Emissions caused by combustion of fuels are not included.

Criteria for externalising processes

The following processes are excluded:
- Clearing, fertilizing and thinning of the forest area
- Personnel facilities, e.g. heating of lunch cabin

Data quality statement

The technique described by the process is acquired from a handbook for Swedish forestry from 1980, but is still assumed to be representative.

Validation

Method	Cross-check with other source
Procedure	The information from a handbook for Swedish forestry was compared with the information supplied by a processor operator in a specific forest company
Result	The data supplied by the processor operator was used to describe this process.
Validator	XXXXXXXXX

Other information

These data are valid for large scale final felling in forestry in central Sweden. It may also be used as an average for other parts of Sweden, where similar technology is used.

Administrative information

Identification number

CPM_ISO/TS14048_WorkExamples_99

Regsitration authority

CPM (Center for Environmental Assessment of Product and Material Systems), Chalmers University of Technology, Göteborg, Sweden

Version number

1

Data commissioner

XXXXXXXXX

Data generator

XXXXXXXXX

Data documentor

XXXXXXXXX

Date completed

1994

Access restrictions

Public