APENDIX 1. Inventory data

In Appendix 1 all data sheets that were created in SimaPro 7.1 for the study, as part of the inventory, are listed. The information is presented in the same format as in the software.

Life Cycles

The life cycle data sheets illustrate the composition of the studied product systems.

Parameters

In order to make the change of certain parameters simpler, the SimaPro software can work with parameters. The parameters used in this study are listed. The input parameters were varied in the sensitivity analyses.

Formula

To make the use of parameters possible some data sheets include formula rather than just one number. In the list of parameters the figures used are listed. In the data sheets in the Appendix the parameters used in the "base scenario" are used, and the results of the formula thus reflect the "base scenario".

Processes

Each process sheet listed in this Appendix consists of a description of the process (the name of the process in bold). After the description follows the inventory input and output:

Products

Listing the product(s) resulting from the process

Avoided products

Listing any avoided products. The avoided products will have their own data sheet, presented in this Appendix if it was created for this study, or presented in the original data source if not.

Resources

Listing resources from nature to the process

Materials/fuels and Electricity/heat

Listing raw materials and energy. These inputs will have their own data sheet, presented in this Appendix if it was created for this study, or presented in the original data source if not.

Emissions to air, to water, to soil

Listing emissions to nature

Waste to treatment

Listing different treatment of waste from the process. These treatment options will have their own data sheet, presented in this Appendix if it was created for this study, or presented in the original data source if not.

Final waste flows; Non material emissions, Social issues and Economic issues

These headings appear in the data sheets, but are not used for the data inventoried for this study.

Data from other sources (secondary data) are not presented in detail here. Most of these data are from Ecoinvent 2.0, and these are marked with grey in the Appendix. More information on Ecoinvent 2.0 data can be found in Frischknecht et al. (2007).

Some of the secondary data were slightly modified to better suit the study, e.g. to reflect Swedish conditions. These modifications are listed at the end of the Appendix.

Modifications made in process sheets

All the processes listed below are Ecoinvent 2.0 processes which have been slightly modified to better suit the scope of the study. The modifications made are explained and the original processes can be found in Ecoinvent 2.0.

Process name: Disposal, plastic, consumer electronics, 15.3% water, to municipal incin swe con
Process name before modification: Disposal, plastic, consumer electronics, 15.3% water, to municipal incineration/CH U
Modification made:
Known outputs to technosphere. Avoided products
Electricity 3,4 MJ
District heating SE av 28,2 MJ

Comment: Modified using Swedish efficiency 0,91 (Uppenberg et al., 2001), lower heating value and 11% electricity 89% heat (Avfall Sverige, 2008).

Process name: Disposal, polyethylene, 0.4% water, to municipal incineration/Swe con
Process name before modification: Disposal, polyethylene, 0.4% water, to municipal incineration/CH U
Modification made:
Known outputs to technosphere. Avoided products
Electricity 4,16 MJ
District heating SE av 34,5 MJ

Comment: Modified using Swedish efficiency 0,91 (Uppenberg et al., 2001), lower heating value and 11% electricity 89% heat (Avfall Sverige, 2008).

Process name: Disposal, polyurethane, 0.2% water, to municipal incineration/Swe con
Process name before modification: Disposal, polyurethane, 0.2% water, to municipal incineration /CH U
Modification made:
Known outputs to technosphere. Avoided products
Electricity 3 MJ
District heating SE av 24,9 MJ

Comment: Modified using Swedish efficiency 0,91 (Uppenberg et al., 2001), lower heating value and 11% electricity 89% heat (Avfall Sverige, 2008).

Process name: Disposal, packaging cardboard, 19.6% water, to municipal incineration/CH U - Swe conditions

Process name before modification: Disposal, packaging cardboard, 19.6% water, to municipal incineration/CH U
Modification made:
Known outputs to technosphere. Avoided products
Electricity 1,59 MJ
District heating SE av 12,9 MJ

Comment: Modified using Swedish efficiency 0,91 (Uppenberg et al., 2001), lower heating value and 11% electricity 89% heat (Avfall Sverige, 2008).

Process name: Disposal, paper, 11.2% water, to municipal incineration/CH U Swe conditions

Process name before modification: Disposal, paper, 11.2% water, to municipal incineration/CH U
Modification made:
Known outputs to technosphere. Avoided products
Electricity 1,38 MJ
District heating SE av 11,45 MJ
Comment: Modified using Swedish efficiency 0,91 (Uppenberg et al., 2001), lower heating value and 11% electricity 89% heat (Avfall Sverige, 2008).

Process name: Tin, at regional storage/kg/RER primary production avoided

Process name before modification: Tin, at regional storage/kg/RER
processes include the mining, blasting and beneficiation. Processes thereafter are not included due to lack of knowledge of the differences as compared to the processing of scrap tin. Process included, as described in the Eco-invent reports on Metals: Underground mining and

Process name: Transport, freight, rail/RER U, NORDEL el

Process name before modification:

Transport, freight, rail/RER U

Modification made:

The electricity mix used for operation was changed to Nordel

Process name: Use, computer, desktop with LCD monitor, home use/RER U - active use electr. mix

Process name before modification: Use, computer, desktop with LCD monitor, home use/RER U

Modification made:

The processes were changed to

Use, computer, desktop with LCD monitor, active mode/RER U electr. mix
Use, computer, desktop with LCD monitor, off mode/RER U electr. mix
Use, computer, desktop with LCD monitor, sleep/standby mode/RER U electr. mix

Process name: Use, computer, desktop with LCD monitor, active mode/RER U electr. mix

Process name before modification: Use, computer, desktop with LCD monitor, active mode/RER U

Modification made:

The electricity mix was changed to "Electricity at grid, varied in book project"

Process name: Use, computer, desktop with LCD monitor, off mode/RER U electr. mix

Process name before modification: Use, computer, desktop with LCD monitor, off mode/RER U

Modification made:

The electricity mix was changed to "Electricity at grid, varied in book project"

Process name: Use, computer, desktop with LCD monitor, sleep/standby mode/RER U electr. mix

Process name before modification: Use, computer, desktop with LCD monitor, sleep/standby mode/RER U

Modification made:

The electricity mix was changed to "Electricity at grid, varied in book project"

Process name: Use, computer, desktop, with LCD monitor, office use/RER U exl. electricity

Process name before modification: Use, computer, desktop, with LCD monitor, office use/RER U

Modification made:

The processes were changed to

Use, computer, desktop with LCD monitor, sleep/standby mode/RER U exl. electricity
Use, computer, desktop with LCD monitor, active mode/RER U exl. electricity
Use, computer, desktop with LCD monitor, off mode/RER U exl. electricity

Process name: Use, computer, desktop with LCD monitor, sleep/standby mode/RER U exl. electricity

Process name before modification: Use, computer, desktop with LCD monitor, sleep/standby mode/RER U

Modification made:

The electricity use is set to zero as this is accounted for separately

Process name: Use, computer, desktop with LCD monitor, active mode/RER U exl. electricity

Process name before modification: Use, computer, desktop with LCD monitor, active mode/RER U

Modification made:

The electricity use is set to zero as this is accounted for separately

Process name: Use, computer, desktop with LCD monitor, off mode/RER U exl. electricity

Process name before modification: Use, computer, desktop with LCD monitor, off mode/RER U

Modification made:

The electricity use is set to zero as this is accounted for separately

Process name: Use, printer, laser jet, b/w, per kg printed paper/RER U excl. electricity

Process name before modification: Use, printer, laser jet, b/w, per kg printed paper/RER U

Modification made:

The electricity use is set to zero as this is accounted for separately

Appendix 1. Inventory data

Life cycles

Life cycle, paper book incl return 14%
Life cycle, paper book internet 0,5% returns
Life cycle, paper book incl return 14% holmen paper
Life cycle, paper book internet 0,5% returns holmen paper
Life cycle, e-book

Common parameters

Processess used in several life cycles

Editorial work, paper book
Electricity at grid, varied in book project
District heating SE average
Heat from waste incineration CHP, allocation energy
Heat from waste incineration, allocation energy
Use of internet (hubs, routers, switches, cables)
Use of internet modem

Processes used in paper book life cycles

Paper for book production with woodfree inset incl 14% returns
Paper for book production with woodfree inset incl 0,5% returns
Paper for book produktion with inset from Holmen incl. 14% returns
Paper for book production with inset from Holmen incl 0,5% returns
Holmen Book Cream (wood-containing uncoated machine finished)
Offset print and assembly of book
Printing plate
Energy consumption at offset printing
Printing plate developer NO DATA
3,6,9-tetraoxatetrakosan-1-ol
Glue, no impact
Distribution and storage paper book, trad average, incl. 14% returns
Distribution and storage paper book, internet average incl.0,5% returns
Samdistribution warehouse
Morgongåva, internet book store warehouse
Distribution paper book, medel trad incl.14% returns
Distribution paper book 0,5% return
Home delivery Economic
Home delivery First class
Book shop
Adlibris, internet book store
Book user, internet
Book user transport
Waste treatment of books traditional
Waste treatment of books internet incl.0,5% returns
Recycling paper
Recycling corrugated board
Recycling cardboard

Processes used in e-book life cycle

Production, e-book reader
E-ink display part NO DATA
Editorial work + internet bookstore, e-book
E-book reader distribution
E-book user internet
Waste treatment e-book reader
Recycling Aluminium
Recycling Barite NO DATA
Recycling Chromium NO DATA
Recycling Copper
Recycling Gold
Recycling Lead
Recycling Nickel
Recycling magnecium NO DATA
Recycling molybdenum NO DATA
Recycling Palladium
Recycling talantum NO DATA
Recycling of steel
Recycling Tin
Recycling Zink
Recycling of Polystyrene, incl benefits and costs

Life cycle, paper book incl return 14%

Materials/Assemblies	Amount	Unit	Comment
Processes	Amount	Unit	Comment
Editorial work, paper book	1	p	1 p = one book
Paper for book production with woodfree inset incl 14% returns	1	p	1 p = one book
Offset print and assembly of book	1/0,86 = 1,16	p	The offset print process is only calculated for the books sold and not for the returns. Here in the life cycle the 14% returs are taken into account.
Distribution and storage paper book, trad average, incl. 14% returns	1	p	1 p = one book
Book store	1	p	1 p = one book
Book user transport	1	p	1 p = one book
Waste treatment of books traditional incl. 14% returns	(Inset/0,86+Cover/0,86+FoE/0,86+Hardcover/0,86)/3000 = 0,712	kg	0,712 kg = one book plus 14 weight-% in retuned books allocated to the sold book

Life cycle, paper book internet 0,5% returns

Materials/Assemblies	Amount	Unit	Comment
Processes	Amount	Unit	Comment
Editorial work, paper book	1	p	1 p = calculated for one book
Paper for book production with woodfree inset incl 0,5% returns	1	p	1 p = calculated for one book
Offset print and assembly of book	1/0,995 = 1,01	p	The offset print process is only calculated for the books sold and not for the returns. Here in the life cycle the 0,5% returs are taken into account.
Distribution and storage paper book, internet average incl.0,5% returns	1	p	1 p = calculated for one book
Adlibris, internet book store	1	p	1 p = calculated for one book
Book user, internet	1/0,995 = 1,01	p	The "Book user, internet" process is calculated for the books sold and not for the returns. Here in the life cycle the 0,5% returs are taken into account.
Book user transport	1	p	1 p = calculated for one book one book
Waste treatment of books internet incl.0,5% returns	(Inset/0,995+Cover/0,995+FoE/ 0,995+Hardcover/0,995)/3000 = 0,615	kg	0,615 kg = one book plus 0,5 weight-% in returned books allocated to the sold book

Life cycle, paper book incl return 14% wood-containing paper

Materials/Assemblies	Amount	Unit	Comment

Processes	Amount	Unit	Comment
Editorial work, paper book	1	p	1 p = one book
Paper for book produktion with inset from Holmen incl. 14% returns	1	p	1 p = one book, the specific Holmen paper is wood-containing
Offset print and assembly of book	1/0,86 = 1,16	p	not for the returns. Here in the life cycle the 14% returs are taken into account.
Distribution and storage paper book, trad average, incl. 14% returns	1	p	1 p = one book
Book store	1	p	1 p = one book
Book user transport	1	p	1 p = one book
Waste treatment of books traditional incl. 14% returns	(Inset/0,86+Cover/0,86+FoE/0,86+Hardcover/0,86)/3000 = 0,712	kg	0,712 kg = one book plus 14 weight-% in retuned books allocated to the sold book

Life cycle, paper book internet 0,5% returns, wood-containing paper

Materials/Assemblies	Amount	Unit	Comment
Processes	Amount	Unit	Comment
Editorial work, paper book	1	p	1 p = calculated for one book
Paper for book produktion with inset from Holmen incl. 0.5% returns	1	p	1 p = calculated for one book, the specific Holmen paper is wood-containing
Offset print and assembly of book	1/0,995 = 1,01	p	The offset print process is only calculated for the books sold and not for the returns. Here in the life cycle the 0,5% returs are taken into account.
Distribution and storage paper book, internet average incl.0,5% returns	1	p	1 p = calculated for one book
Adlibris, internet book store	1	p	1 p = calculated for one book
Book user, internet	1/0,995 = 1,01	p	The "Book user, internet" process is calculated for the books sold and not for the returns. Here in the life cycle the 0,5% returs are taken into account.
Book user transport	1	p	1 p = calculated for one book one book
Waste treatment of books internet incl.0,5% returns	(Inset/0,995+Cover/0,995+FoE/ 0,995+Hardcover/0,995)/3000 = 0,615	kg	0,615 kg = one book plus 0,5 weight-% in returned books allocated to the sold book

Life cycle, e-book

Materials/Assemblies	Amount	Unit	Comment
Production, e-book reader	(1-Life_long)*1/2/Ebook_year = 0,0208	p	Approximation: Life lenght of the e-book reader 2 years. User reads 2 books per mounth.
Production, e-book reader	Life_long*1/5/Ebook_year = 0	p	Approximation: Life lenght of the e-book reader 5 years. User reads 2 books per mounth.

Processes	Amount	Unit	Comment
Editorial work, paper book	1	p	Calculated for ONE e-book
Editorial work+ internet bookstore, e-book based on Adlibris and Elib	1	p	Calculated for ONE e-book
E-book reader distribution	(1-Life_long)*1/2/Ebook_year = 0,0208	p	Approximation: Life lenght of the e-book reader 2 years. User reads 2 books per mounth.
E-book reader distribution	Life_long*1/5/Ebook_year = 0	p	Approximation: Life lenghtof the e-book reader 5 years. User reads 2 books per mounth.
E-book user	1	p	Calculated for ONE e-book
Waste treatment e-books	1	p	

Input parameters

Name	*Value*	*Distribution*	*Comment*
Trans_person	2	Undefined	Distance in kilometers for picking up the book by car.
Life_long	0	Undefined	Life time of the e-reader. 1 = 5 years, 0 = 2 years
El_SE	1	Undefined	Different choice of electricity mix, Swedish average
El_Nordel	0	Undefined	Different choice of electricity mix, NORDEL
El_wind	0	Undefined	Different choice of electricity mix, wind power as a BraMiljöval choice (environmental label)
Ebook_year	24	Undefined	Number of books read per year
ewaste	0,75	Undefined	Share of e-waste that reaches the recycling system

Calculated parameters

Name	*Expression*	*Comment*
AndelBokBonnier	145/1224148797 = 1,18E-7	Share of total income that is related to the one book studied here. The total income is defined as the income of the activities at one specific location as it is to be used for allocating energy use at this location. F-price book: 145 SEK. Income Bonnier "located in the same house" 2008: 1224148797 SEK
AndelBokInterne	145/617600000 = 2,35E-7	Share of total purchase that is related to the one book studied here. F-price book: 145 SEK. Total purchase Adlibris + Elib 2008: 617600000 SEK
AndelEbok	90/617600000 = 1,46E-7	Share of total purchase that is related to the one book studied here. F-price e-book: ~ 90 SEK. Total purchase Adlibris + Elib 2008: 617600000 SEK
Inset	1487,2896 = 1,49E3	Weight of the specific paper of the inset, per 3000 books
FoE	47,51064 = 47,5	Weight of the specific paper of the paper before and after the inset, per 3000 books
Cover	47,5722 = 47,6	Weight of the specific paper of the cover, per 3000 books
Hardcover	254,07864 = 254	Weight of the specific paper of the hard cover, per 3000 books

Process

Category type	Use
Process identifier	Institut14515700003
Type	Unit process
Process name	**Editorial work, paper book**
Time period	2005-2009
Geography	Europe, Western
Technology	Mixed data
Representativeness	Data from a specific process and company
Date	2008-12-11
Record	Clara Borggren
Generator	Personal contact with Merete Lind and Anders Andersson, Bonnierförlagen
Literature references	
Collection method	Information from Bonnierförlagen, personal contact Merete Lind and Anders Andersson.
Comment	Editorial and administrative work at Bonnierförlagen calculated for 3000 books. Since it was not possible to calculate the editorial work specifically for this book in exact number of computers used, time spent or other work needed when producing a book we decided to use one books monetary share of total income during 2008 as approximation for allocation (see Parameters). This share (called "AndelBokBonnier") was then mulitiplied with the total electricity, total district heating and total tapwater used at Bonnierförlagen during 2008. The same share was also mulitiplied with Bonnierförlagen's total travel (only by air) during the same year. Also included in the calculations are the A4-papers used for proof reading, and the waste management of these papers where it is assumed that 73% goes to recycling and 27% to municipal incineration.
Allocation rules	

Products

Editorial work, paper book	3000	p	100	not defined	Editorial work

Avoided products

Resources

Materials/fuels

Paper, woodfree, uncoated, at integrated mill/RER U	5,39	kg	Proof-sheets. 80g/m2. 360 A4 pages per proof. Approximation ~ 3 proof copies
Use, printer, laser jet, b/w, per kg printed paper/RER U excl. Electricity	5,39	kg	Printing of three proof copies.
Electricity at grid, varied in book project	AndelBokBonnier*920000*3000 = 327	kWh	1,18E-07: share of one book. Calculated from the income of one book divided by the income from all titles during 2008, 920000 kWh: Total electricity consumption at Bonnierförlagen during 2008
District heating SE average	AndelBokBonnier*1787*3000 = 0,635	MWh	1,18E-07: share of one book. Calculated from the income of one book divided by the income from all titles during 2008. 1787 MWh: Total district heating consumption at Bonnierförlagen during 2008
Tap water, at user/RER S	AndelBokBonnier*2600000*3000 = 924	kg	1,18E-07: share of one book. Calculated from the income of one book devided by the income from all titles during 2008. 2 600 000 kg: Total water consumption at Bonnierförlagen during 2008
Transport, aircraft, passenger, Europe/RER U	AndelBokBonnier*637434*3000 = 227	personkm	Information from Merete Lind about Bonnierförlagen staff's travel.
Electricity/heat			
Emissions to air			
Emissions to water			
Emissions to soil			
Final waste flows			
Non material emissions			
Social issues			
Economic issues			
Waste to treatment			
Recycling paper/RER U incl. benefits and costs	0,73*5,39 = 3,93	kg	

Disposal, paper, 11.2% water, to municipal incineration/CH U Swe conditions	0,27*5,39 = 1,46	kg

Process

Category type	Energy
Process identifier	Institut14515700105
Type	Unit process
Process name	**Electricity at grid, varied in book project**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Date	2009-05-06
Record	Åsa Moberg
Generator	
Literature references	
Collection method	
Comment	This process sheet is made to enable the variation of electricity mixes in the study. In the "base" case Swedsih electricity mix is assumed. This assumption is tested in sensitivity analyses where Nordel (Nordic electricity mix) and windpower respectively is tested. For the windpower 8.8% distribution losses are added as suggested in the Ecoinvent Energy report. (The other two electricity mixes are provided "at grid" including losses).
Allocation rules	

Products

Electricity at grid, varied in book project	1	kWh	100	not defined	Others\Electricity mix

Avoided products

Resources

Materials/fuels

Electricity/heat

Electricity, medium voltage, at grid/SE U	El_SE*1 = 1	kWh	
Electricity, medium voltage, production NORDEL, at grid/NORDEL U	El_NORDEL*1 = 0	kWh	
Electricity, at wind power plant/RER U	El_wind*1,088 = 0	kWh	8,8% distribution losses (Ecoinvent Energy report)

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Energy
Process identifier	Institut14515700099
Type	Unit process
Process name	**District heating SE average**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Date	2009-04-30
Record	Åsa Moberg
Generator	
Literature references	
Collection method	Information from Svenska Fjärrvärmeföreningen (Sonya Trad, 2009 and Fjärrvärmeverksföreningen, 2009)on share of district heating produced in CHP plants ("Andel värme producerad i kraftvärme") and on the fuel mix of Swedish district heating during 2007. The fuel mix was aggregated by us to the three main fuels: biofuel (57%), fossil fuel (22%) and waste (20%). This aggregation was made due to limited data availability for the fossil fuel natural gas CHP and oil for only heat producing plants. The share of heat provided from CHP and not from CHP was calculated as 57% and 43 % respectively. This is a rough description of average district heating in Sweden, which is used as an indication since more detailed information was not available for this screening study.
Comment	This very rough estimation of Swedish district heating should not be used if district heating is a main process in a study.
Allocation rules	

Products

District heating SE average	1	MJ	100	not defined	Heat\District heating

Avoided products

Resources

Materials/fuels

Electricity/heat

Heat, at cogen 6400kWth, wood, emission control, allocation energy/CH U	0,57*0,57 = 0,325	MJ	57% biofuel, 57% heat from CHP
Heat, at cogen 500kWe lean burn, allocation energy/CH S	0,22*0,57 = 0,125	MJ	22% fossil, 57% heat from CHP
Heat from waste incineration CHP, allocation energy	0,20*0,57 = 0,114	MJ	20% waste, 57% heat from CHP
Heat, mixed chips from forest, at furnace 1000kW/CH S	0,57*0,43/2 = 0,123	MJ	57% biofuel, 43% heat not from CHP, assumed half from forest/half from industry
Heat, mixed chips from industry, at furnace 1000kW/CH S	0,57*0,43/2 = 0,123	MJ	57% biofuel, 43% heat not from CHP, assumed half from forest/half from industry
Heat, light fuel oil, at industrial furnace 1MW/RER S	0,22*0,43 = 0,0946	MJ	22% fossil, 43% heat not from CHP
Heat from waste incineration, allocation energy	0,20*0,43 = 0,086	MJ	20% waste, 43% heat not from CHP

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Energy
Process identifier	Institut14515700100
Type	
Process name	**Heat from waste incineration CHP, allocation energy**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Date	2009-04-30
Record	Åsa Moberg
Generator	
Literature references	
Collection method	
Comment	Waste incineration plants: An efficiency of 0.91 for CHP (combined heat and power) plants fuelled by household waste was used (Uppenberg et al., 2001). Figures on electricity and heat produced from Swedish waste incineration plants in 2007 were used to get an estimate of the respective proportions of electricity and heat produced (Avfall Sverige, 2008). (0,12:1; electricity:heat). According to the underlying Ecoinvent data Lower heating value is 11.74 MJ/kg and 60.4% of the carbon is biogenic.
Allocation rules	No allocation between heat production and waste treatment - waste treatment here assumed to be zero burden

Products

Heat from waste incineration CHP, allocation energy	1	MJ	100	not defined	Cogeneration\Waste	CH data, SE efficiency

Avoided products

Resources

Materials/fuels

Electricity/heat

Emissions to air			
Emissions to water			
Emissions to soil			
Final waste flows			
Non material emissions			
Social issues			
Economic issues			
Waste to treatment			
Disposal, municipal solid waste, 22.9% water, to municipal incineration/CH S	1/(11,74*0,91*0,9) = 0,104	kg	Swedish efficiency 0.91. Lower heating value from Ecoinvent process 11.74 MJ/kg. 90% heat and 10% electriciity

Process

Category type	Energy
Process identifier	Institut14515700103
Type	Unit process
Process name	**Heat from waste incineration, allocation energy**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Multiple output allocation	Unspecified
Date	2009-04-30
Record	Åsa Moberg
Generator	
Literature references	
Collection method	
Comment	Waste incineration plants: An efficiency of 1.06 for plants fuelled by household waste was used (Uppenberg et al., 2001). According to the underlying Ecoinvent data Lower heating value is 11.74 MJ/kg and 60.4% of the carbon is biogenic.
Allocation rules	No allocation between heat production and waste treatment - waste treatment here assumed to be zero burden

Products

Heat from waste incineration, allocation energy	1	MJ	100	not defined	Cogeneration\Waste	CH data, SE efficiency

Avoided products

Resources

Materials/fuels

Electricity/heat

Emissions to air			
Emissions to water			
Emissions to soil			
Final waste flows			
Non material emissions			
Social issues			
Economic issues			
Waste to treatment			
Disposal, municipal solid waste, 22.9% water, to municipal incineration/CH S	1/(11,74*1,06) = 0,0804	kg	Swedish efficiency 1.06 (not CHP). Lower heating value from Ecoinvent process 11.74 MJ/kg. 100% heat

Process

Category type	Processing
Process identifier	Institut14515700143
Type	
Process name	**Paper for book production with woodfree inset incl 14% returns**
Time period	2005-2009
Geography	Europe, western
Technology	Average technology
Representativeness	Unspecified
Multiple output allocation	Unspecified
Date	2009-05-07
Record	Clara Borggren
Generator	Personal contact with Merete Lind, Bonnierförlagen and Pär Svärdsson, AdLibris
Literature references	
Collection method	Company specific data about paper and cardboard consumption for production of the book, from Merete Lind at Bonnierförlagen. Company specific data about returns from traditional bookstores to publisher, based on information from Håkan Rudels at Bonnierförlagen (provided by Pär Svärdson at AdLibris).
Data treatment	
Allocation rules	The 14% returs are allocated to the books sold.
Comment	When cutting the different paper qualities for the book, 18 weight-% of the paper produced goes to maculation. The maculated paper are recycled with material recovery. No data of maculation for the hardback carboard available; here the assumption was no maculation. During 2008 14% of the books delivered to traditional bookstores were returned to the publishers central warehouse (based on information from Bonnierförlagen, provided by Svärdson, 2009).

Products

Paper for book production with woodfree inset incl 14% returns	3000	p	100	not defined	Paper

Avoided products

Resources

Materials/fuels

Paper, woodfree, uncoated, at integrated mill/RER U	(Inset/0,86)*1,22 = 2,11E3	kg	Inset 80g/m2. 151mmx228mm. 18% to maculation.
Paper, woodfree, coated, at integrated mill/RER U	(Cover/0,86)*1,22 = 67,5	kg	Cover. 535mmx228mm (own estimation). 130g/m2. 18% to maculation
Paper, woodfree, uncoated, at integrated mill/RER U	(FoE/0,86)*1,22 = 67,4	kg	Paper for befor and after the inset. 151mmx228mm, 115g/m2. Woodfree uncoated. 2x4 pages.18% to maculation
Core board, at plant/RER U	Hardcover/0,86 = 295	kg	Cardboard. 151mmx228mm (own estimation) x 2mm (Lind, 2009). Front and back. 1230 g/m2 (Eska Graphic Board, 2009) No maculation included.
Electricity/heat			
Emissions to air			
Emissions to water			
Emissions to soil			
Final waste flows			
Non material emissions			
Social issues			
Economic issues			
Waste to treatment			
Recycling paper/RER U incl. benefits and costs	(Inset/0,86)*1,22-(Inset/0,86)+ (Cover/0,86)*1,22-(Cover/0,86)+ (FoE/0,86)*1,22-(FoE/0,86) = 405	kg	100% recycling

Process

Category type	Processing
Process identifier	Institut14515700144
Type	Unit process
Process name	**Paper for book production with woodfree inset incl 0,5% returns**
Time period	2005-2009
Geography	Europe, Western
Technology	Mixed data
Representativeness	Data from a specific process and company
Date	2009-05-07
Record	Clara Borggren
Generator	Personal contact with Merete Lind, Bonnierförlagen and Pär Svärdson, AdLibris
Literature references	
Collection method	Company specific data about paper and cardboard consumption for production of the book, from Merete Lind at Bonnierförlagen. Company specific data about returns, Pär Svärdsson at AdLibris.
Comment	When cutting the different paper qualities for the book, 18 weight-% of the paper produced goes to maculation. The maculated paper are recycled with material recovery. No data of maculation for the hardback carboard available; here the assumption was no maculation. During 2008 0.5% of the books purchased through an internet bookstore were returned to the publishers central warehouse (based on specific data from AdLibris).
Allocation rules	The paper production for 0,5% returs were allocated to the books sold.
System description	

Products

Paper for book production with woodfree inset incl 0,5% returns	3000	p	100	not defined	Paper

Avoided products

Resources

Materials/fuels

Paper, woodfree, uncoated, at integrated mill/RER U	(Inset/0,995)*1,22 = 1,82E3	kg	Inset 80g/m2. 151mmx228mm. 18% to maculation.

Paper, woodfree, coated, at integrated mill/RER U	(Cover/0,995)*1,22 = 58,3	kg	Cover. 535mmx228mm (own estimation). 130g/m2. 18% to maculation
Paper, woodfree, uncoated, at integrated mill/RER U	(FoE/0,995)*1,22 = 58,3	kg	Paper for before and after the inset. 151mmx228mm, 115g/m2. Woodfree uncoated. 2x4 pages. 18% to maculation
Core board, at plant/RER U	Hardcover/0,995 = 255	kg	Cardboard. 151mmx228mm (own estimation) x 2mm (Lind, 2009). Front and back. 1230 g/m2 (Eska Graphic Board, 2009) No maculation included.
Electricity/heat			
Emissions to air			
Emissions to water			
Emissions to soil			
Final waste flows			
Non material emissions			
Social issues			
Economic issues			
Waste to treatment			
Recycling paper/RER U incl. benefits and costs	(Inset/0,995)*1,22-(Inset/0,995)+ (Cover/0,995)*1,22-(Cover/0,995)+ (FoE/0,995)*1,22-(FoE/0,995) = 350	kg	100% recycling

Process

Category type	Processing
Process identifier	Institut14515700145
Type	Unit process
Process name	**Paper for book produktion with inset from Holmen incl. 14% returns**
Time period	2005-2009
Geography	Europe, Western
Technology	Mixed data
Representativeness	Data from a specific process and company
Date	2009-05-07
Record	Clara Borggren & Åsa Moberg
Generator	Personal contact with Merete Lind, Bonnierförlagen and Pär Svärdson, AdLibris
Literature references	
Collection method	Company specific data about paper and cardboard consumption for production of the book, from Merete Lind at Bonnierförlagen. Company specific data about returns from traditional bookstores to publisher, based on information from Håkan Rudels at Bonnierförlagen (provided by Pär Svärdson at AdLibris).
Data treatment	
Verification	
Comment	When cutting the different paper qualities for the book, 18 weight-% of the paper prod58(r)5.251.1rky Prth78(d)4.79007(s)-6.5176943(i)]TJ 182.3 0 Td 35.05558(
Allocation rules	The production and waste management of the 14% returns are allocated to the books sold.
System description	

Products

Paper for book produktion with inset from Holmen incl. 14% returns	3000	p	100	not defined	Paper

Avoided products

Resources

Materials/fuels				
Holmen Book Cream (wood-containing uncoated machine finished)		(Inset/0,86)*1,22 = 2,11E3	kg	Inset 80g/m2. 151mmx228mm. 18% to maculation.
Paper, woodfree, coated, at integrated mill/RER U		(Cover/0,86)*1,22 = 67,5	kg	Cover. 535mmx228mm (own estimation). 130g/m2. 18% to maculation
Paper, woodfree, uncoated, at integrated mill/RER U		(FoE/0,86)*1,22 = 67,4	kg	Paper for before and after the inset. 151mmx228mm, 115g/m2. Woodfree uncoated. 2x4 pages. 18% to maculation.
Core board, at plant/RER U		(Hardcover/0,86) = 295	kg	Cardboard. 151mmx228mm (own estimation) x 2mm (Lind, 2009). Front and back. 1230 g/m2 (Eska Graphic Board, 2009) No maculation included.
Electricity/heat				
Emissions to air				
Emissions to water				
Emissions to soil				
Final waste flows				
Non material emissions				
Social issues				
Economic issues				
Waste to treatment				
Recycling paper/RER U incl. benefits and costs	(Inset/0,86)*1,22-(Inset/0,86)+(Cover/0,86)*1,22-(Cover/0,86)+(FoE/0,86)*1,22-(FoE/0,86) = 405		kg	100% recycling

Process

Category type	Processing
Process identifier	Institut14515700144
Type	Unit process
Process name	**Paper for book production with inset from Holmen incl 0,5% returns**
Time period	2005-2009
Geography	Europe, Western
Technology	Mixed data
Representativeness	Data from a specific process and company
Date	2009-05-07
Record	Clara Borggren
Generator	Personal contact with Merete Lind, Bonnierförlagen and Pär Svärdsson, AdLibris
Literature references	
Collection method	Company specific data about paper and cardboard consumption for production of the book, from Merete Lind at Bonnierförlagen. Company specific data about returns, Pär Svärdsson at AdLibris.
Comment	When cutting the different paper qualities for the book, 18 weight-% of the paper produced goes to maculation (Linder, 2009). The maculated paper are recycled with material recovery. No data of maculation for the hardback carboard available; here the assumption was no maculation. During 2008 0.5% of the books delivered to internet bookstores were returned to the publishers central warehouse (based on information from AdLibris, provided by Svärdson, 2009).
Allocation rules	The production and waste management of the 0.5% returns are allocated to the books sold.

Products

Paper for book production with woodfree inset incl 0,5% returns	3000	p	100	not defined	Paper

Avoided products

Resources

Materials/fuels

Holmen Book Cream (wood-containing uncoated machine finished)	(Inset/0,995)*1,22 = 1,82E3	kg	Inset 80g/m2. 151mmx228mm. 18% to maculation.
Paper, woodfree, coated, at integrated mill/RER U	(Cover/0,995)*1,22 = 58,3	kg	Cover. 535mmx228mm (own estimation). 130g/m2. 18% to maculation
Paper, woodfree, uncoated, at integrated mill/RER U	(FoE/0,995)*1,22 = 58,3	kg	Paper for before and after the inset. 151mmx228mm, 115g/m2. Woodfree uncoated. 2x4 pages. 18% to maculation.
Core board, at plant/RER U	Hardcover/0,995 = 255	kg	Cardboard. 151mmx228mm (own estimation) x 2mm (Lind, 2009). Front and back. 1230 g/m2 (Eska Graphic Board, 2009) No maculation included.
Electricity/heat			
Emissions to air			
Emissions to water			
Emissions to soil			
Final waste flows			
Non material emissions			
Social issues			
Economic issues			
Waste to treatment			
Recycling paper/RER U incl. benefits and costs	(Inset/0,995)*1,22-(Inset/0,995)+ (Cover/0,995)*1,22-(Cover/0,995)+ (FoE/0,995)*1,22-(FoE/0,995) = 350	kg	100% recycling

Process

Category type	Material
Process identifier	Institut14515700096
Type	Unit process
Process name	**Holmen Book Cream (wood-containing uncoated machine finished)**
Time period	2005-2009
Geography	Europe, Western
Technology	Average technology
Representativeness	Data from a specific process and company
Date	2009-04-30
Record	Åsa Moberg
Generator	Holmen paper
Literature references	Holmen Paper 2008 Paper Profile Holmen Book
Collection method	Data provided by Holmen Paper. Paper Profile data are limited to selected site-emissions and electricity used. In addition to the Paper Profile, data on transport of material to the mill was used based on information from Rikard Nilsson, as provided by Annamaria Berglund, Holmen Paper, (personal communication March 2009). Data on production of supply material is lacking.
Comment	19% of FSC/PEFC certified fibres at the mill, with CoC certification according to the Paper Profile. This is not considered in the process sheet.
Allocation rules	

Products

Holmen Book Cream (wood-containing uncoated machine finished)	1000	kg	100	not defined	Paper+ Board\Paper profile data

Avoided products

Resources

Materials/fuels

Electricity/heat			
Electricity at grid, varied in book project	3079	kWh	
Transport, lorry >32t, EURO3/RER S	210	tkm	Transport of supply material (mainly wood) to the pulp or paper mill, average data for 2007. Data on transport of material to the mill based on information from Rikard Nilsson, as provided by Annamaria Berglund, Holmen Paper, (personal communication March 2009).
Transport, transoceanic freight ship/OCE S	59	tkm	Transport of supply material (mainly wood) to the pulp or paper mill, average data for 2007. Data on transport of material to the mill based on information from Rikard Nilsson, as provided by Annamaria Berglund, Holmen Paper, (personal communication March 2009).
Transport, freight, rail/RER U, NORDEL el	111	tkm	Transport of supply material (mainly wood) to the pulp or paper mill, average data for 2007. Data on transport of material to the mill based on information from Rikard Nilsson, as provided by Annamaria Berglund, Holmen Paper, (personal communication March 2009).
Emissions to air			
Sulfur dioxide	0,06	kg	
Nitrogen oxides	0,07	kg	
Carbon dioxide, fossil	29	kg	
Emissions to water			
COD, Chemical Oxygen Demand	7,4	kg	
AOX, Adsorbable Organic Halogen as Cl	0,01	kg	less than 0,01
Nitrogen, total	0,05	kg	
Phosphorus, total	0,01	kg	less than 0,01
Emissions to soil			
Final waste flows			
Waste, solid	0,79	kg	Solid waste landfilled 0,79 BDkg/tonne

Category type	Processing
Process identifier	Institut14515700019
Type	Unit process
Process name	**Offset print and assembly of book**
Time period	2005-2009
Geography	Europe, Western
Technology	Unspecified
Representativeness	Data from a specific process and company
Date	2009-01-20
Record	Clara Borggren
Generator	Personal contact Merete Lind, Bonnierförlagen och Alf Linder, Scandbook
Literature references	
Collection method	Information given by Bonnerförlagen AB, contact Merete Lind and Scandbook, contact Alf Linder. Calculated on 3000 books. The data are for a specific process at a specific company. The technique is coldset offset and the energy use is low compared to other printing (e.g. heatset offset). The data are limited to the informaton that was possible to get from one printing house and not all emissions are inventoried. Neither was all production of supply material available. Transport distances are for a specific case for this kind of book printed at the printing house in Falun, Sweden.
Comment	Included in the process: *Transport of the different paper qualities and the cardboard from the respective mills to the printing office. *Production of the printing plate *Use of computer before and in the printing process *Energy consumption during printing *Some of the printing chemicals (IPA, naphta) and printing colour *District heating for the building *Disposal of hazardous waste Waste paper from the printing process is handled as maculation in the paper process. Since not all the data were available the results from this process is uncertain.
Allocation rules	

Products

Offset print and assembly of book	3000	p	100	not defined	Paper	offset coldset

Avoided products

Resources

Materials/fuels			
Transport, lorry >32t, EURO4/RER S	Inset/1000*1,22*222 = 403	tkm	From Hallsta paper mill to Printing office in Falun (222 km)
Transport, lorry 16-32t, EURO3/RER S	Cover/1000*1,22*1200 = 69,6	tkm	Cover paper 56,1326 kg. 1200 km Äänekoski (Finland) - Falun
Transport, lorry 16-32t, EURO3/RER S	FoE/1000*1,22*500 = 29	tkm	Paper 112,123 kg. 500 km Lessebo - Falun
Transport, lorry 16-32t, EURO3/RER S	Hardcover/1000*1300 = 330	tkm	Transport of card board, 254,07864 kg. 1300 km. Groningen (Netherlands) - Falun
Printing plate	0,031*362 = 11,2	kg	0,031kg/page. 360 pages inset and 2 pages cover
Use, computer, desktop, with LCD monitor, office use/RER U active use electr. mix	45	min	Cover: 45 minutes control for test printing with lines
Use, computer, desktop, with LCD monitor, office use/RER U active use electr. mix	15	min	Cover: 15 minutes imposition.
Use, computer, desktop, with LCD monitor, office use/RER U exl. electricity	30	min	Cover: 30 minutes pate making, 4 KBA-plates. The energy use is included in the process "Energy consumption at offset printing"
Use, computer, desktop, with LCD monitor, office use/RER U active use electr. mix	15	min	Inset: 15 minutes imposition.
Use, computer, desktop, with LCD monitor, office use/RER U active use electr. mix	15	min	Inset: 15 minutes to create a PDF for approval and "1:a arksplotter" (swe).
Use, computer, desktop, with LCD monitor, office use/RER U exl. electricity	90	min	Inset: 90 minutes plate making, 16 Timsonplates. The energy use is included in the process "Energy consumption at offset printing"
Energy consumption at offset printing	142,54	kWh	Total energy consumption for the offset printing (excluding some computer use as listed above).
Printing plate developer NO DATA	0,003125*362 = 1,13	l	There is no printing developer in SimaPro.
Isopropanol, at plant/RER S	0,001*362*3000 = 1,09E3	g	Data from Scandbook. 0,001 g/page. Inset plus cover ~ 362 pages.
Printing colour, offset, 47.5% solvent, at plant/RER S	0,003*362*3000 = 3,26E3	g	Data from Scandbook. 0,003 g/page. Inset plus cover ~ 362 pages.
Water, decarbonised, at plant/RER S	0,0003*362*3000 = 326	g	For moisturing. Data from Scandbook. 0,0003 g/page. Inset plus cover ~ 362 pages.
3,6,9-tetraoxatetrakosan-1-ol NO DATA	20*3*0,005 = 0,3	g	cleansing for printer < 0,5 weight-%
Naphtha, at refinery/RER S	20*3*0,995 = 59,7	g	cleansing for printer < 100 weight-%
District heating SE average	660000/15000000*3000 = 132	kWh	District heating: 660 MWh/year. Total print volume: 15 million books per year.
Glue, no impact	13,314	kg	Glue for 3000 books
Electricity/heat			
Emissions to air			
Emissions to water			

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Disposal, hazardous waste, 25% water, to hazardous waste incineration/CH S	12000/15000000 = 0,0008	kg	12000 liter hazardous waste per 15 milion books

Process

Category type	Processing
Process identifier	Institut14515700020
Type	Unit process
Process name	**Printing plate**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Date	2009-01-20
Record	Åsa Moberg
Generator	
Literature references	
Collection method	
Comment	Only production of aluminium, not plate production. The recycling of used plates and the avoided production of virign aluminum is included.
Allocation rules	

Products

Printing plate	1	kg	100	not defined	Paper	Per page

Avoided products

Resources

Materials/fuels

Aluminium, production mix, at plant/RER U	1	kg	Aluminium used for producing the plates

Electricity/heat		
Emissions to air		
Emissions to water		
Emissions to soil		
Final waste flows		
Non material emissions		
Social issues		
Economic issues		
Waste to treatment		
Recycling aluminium/RER U incl. benefits and costs	1	kg

Process

Category type	Energy
Process identifier	Institut14515700022
Type	Unit process
Process name	**Energy consumption at offset printing**
Time period	2005-2009
Geography	Europe, Western
Technology	Mixed data
Representativeness	Data from a specific process and company
Date	2009-02-09
Record	Clara Borggren
Generator	
Literature references	
Collection method	Personal comtact with Merete Lind at Bonnierförlagen and Alf Linder at Scandbook.
Comment	Process includes: Energy consumption for the separate processes when printing 3000 books and for binding the finished
Allocation rules	

Products

Energy consumption at offset printing	142,54	kWh	100	not defined	Others	Energy consumption for printing and assembling 3000 books

Avoided products

Resources

Materials/fuels

Electricity at grid, varied in book project	24	kWh	Energy consumption for making 16 plates, per 3000 books
Electricity at grid, varied in book project	9	kWh	Energy consumption for KBA - cover printing press, per 3000 books
Electricity at grid, varied in book project	7,2	kWh	Energy consumption for making the binder, per 3000 books
Electricity at grid, varied in book project	7,2	kWh	Energy consumption for gilding (printing with gold) of books - makes the back stamp, per 3000 books

Electricity at grid, varied in book project	13	kWh	Energy consumption for laminating the cover, per 3000 books
Electricity at grid, varied in book project	31,2	kWh	Energy consumption for attaching the inset to the hardback, per 3000 books
Electricity at grid, varied in book project	7,74	kWh	Energy consumption for adhesive bindning av the inset, per 3000 books
Electricity at grid, varied in book project	43,2	kWh	Energy comsumption for printing the inset - Timson -, per 3000 book

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Material
Process identifier	Institut14515700046
Type	Unit process
Process name	**Printing plate developer NO DATA**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Date	2009-03-03
Record	Clara Borggren
Generator	
Literature references	
Collection method	
Comment	The process includes NO DATA, since we had no information about the chemicals in the developer only data on how much was used. Thus environmental impact from this substance is missing.
Allocation rules	

Products

Printing plate developer NO DATA	1	l	100	not defined	Chemicals\Others\Printing chemicals

Avoided products

Resources

Materials/fuels

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Material
Process identifier	Institut14515700038
Type	Unit process
Process name	**3,6,9-tetraoxatetrakosan-1-ol**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Date	2009-02-27
Record	Clara Borggren
Generator	
Literature references	
Collection method	No data available. Thus environmental impact from this substance is missing.
Comment	Chemical for cleansing of printer
Allocation rules	
System description	

Products

3,6,9-tetraoxatetrakosan-1-ol NO DATA	1	kg	100	not defined	Chemicals\Others\Printing chemicals

Avoided products

Resources

Materials/fuels

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Material
Process identifier	Institut14515700028
Type	Unit process
Process name	**Glue, no impact**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Date	2009-02-25
Record	Clara Borggren
Generator	
Literature references	
Collection method	
Comment	No data - information missing for glue production. Thus environmental impact from this substance is missing.
Allocation rules	
System description	

Products

Glue, no impact	1	kg	100	not defined	Chemicals\Others\Printing chemicals

Avoided products

Resources

Materials/fuels

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Category type	Transport
Process identifier	Institut14515700142
Type	Unit process
Process name	**Distribution and storage paper book, trad average, incl. 14% returns**
Time period	2005-2009
Geography	Europe, Western
Technology	Modern technology
Representativeness	Data from a specific process and company
Date	2009-03-12
Record	Clara Borggren
Generator	Personal contact with Lars-Gunnar Orrö at Samditribution and Pär Svärdsson at AdLibris.
Literature references	
Collection method	Personal contact with Lars-Gunnar Orrö, Samdistribution, Pär Svärdson, AdLibris. Distribution data from Schenker, Fredrik Goldbeck-Löwe. For transportation distance printing office to warehouse the map service at www.eniro.se was used.
Comment	Process includes: * Transport of the book by truck from the printing office to the central warehouse * District heating and electricity consumption at the warehouse during 2008 * Ditribution of the book to a bookstore in Sweden * Cardboard packaging assumed. 32 books per package (Lind, 2009). Own calculation and estimationon the amount of cardboard per package.
Allocation rules	
System description	

Products

Distribution and storage paper book, trad average, in	1	p	100	not defined	Book distribution

Avoided products

Resources

Materials/fuels				
Transport, lorry 16-32t, EURO3/RER S	(Inset/0,86+Cover/0,86+FoE/0,86+Hardcover/0,86)/1000*200/3000=0,142		tkm	Transportation of the book from the printing office to the central warehouse. Assumption eniro.se: 200 km Falun - Rosersberg. 1487,29+47,57+47,51+254,08 =1836,45 kg per 3000 books. In addition the extra 14% books produced (and returned) are added.
Samdistribution warehouse		1	p	Electricity use and district heating in the central warehouse during 2008. 1 p = calculation for one book
Distribution paper book, medel trad incl.14% returns		1	p	Ditribution of the book from the central warehouse to tbookstores all over Sweden. 1 p = calculation for one book
Corrugated board, mixed fibre, single wall, at plant/RER S		15	g	Packaging material for deliviering books. 32 book per box. Own estimation 15 g/book.
Emissions to air				
Emissions to water				
Emissions to soil				
Final waste flows				
Non material emissions				
Social issues				
Economic issues				
Waste to treatment				

Process

Category type	Transport
Process identifier	Institut14515700089
Type	Unit process
Process name	**Distribution and storage paper book, internet average incl.0,5% returns**
Time period	2005-2009
Geography	Europe, Western
Technology	Mixed data
Representativeness	Data from a specific process and company
Date	2009-03-12
Record	Clara Borggren
Generator	Personal contact with Lars-Gunnar Orrö at Samditribution and Pär Svärdsson at AdLibris.
Literature references	
Collection method	Personal contact with Lars-Gunnar Orrö, Samdistribution, Pär Svärdsson, AdLibris. Ditribution data from Schenker, Fredrik Goldbeck-Löwe. For transportation distance from printing office to warehouse the map service at www.eniro.se was used.
Comment	Process includes: * Transport of the book by truck from the printing office to the central warehouse * Transport of the book by truck from the central warehouse to internet warehouse in Morgongåva via reloading in Uppsala * District heating and electricity consumption at the central warehouse during 2008 * District heating and electricity consumption at the internet warehouse during 2008 * Ditribution of the book from the internet warehouse to an average pickup place (for packages) in Sweden. * Packaging for books distributed to the pick up place.
Allocation rules	

Products

Distribution and storage paper book, internet average incl.0,5% returns	1	p	100	not defined	Book distribution	For one book

Avoided products

Resources

Materials/fuels

Morgongåva, internet book store warehouse	1	p	Total electricity- and heat consumption during 2008 for Morgongåva warehouse
Samdistribution warehouse	1	p	Total electricity- and heat consumption at Samdistribution during 2008
Transport, lorry 16-32t, EURO3/RER S	(Inset/0,995+Cover/0,995+FoE/0,995+Hardcover/0,995)/1000*200/3000=0,123	tkm	eniro.se: 200 km Falun - Rosersberg. 1487,29+47,57+47,51+254,08 =1836,45 kg per 3000 books. In addition the extra 0.5% books produced (and returned) are added.
Distribution paper book, medel internet incl 0,5% returns	1	p	From Morgongåva to the pickup place for books bougth through internet.
Corrugated board, mixed fibre, single wall, at plant/RER S	(153/3)/0,995	g	Packaging material when delivering the books. One package (0.4095 m2) per 3 books (ref Pär Svärdson). Weight 153 g/package (Clara Borggren)
Transport, lorry 3.5-7.5t, EURO3/RER S	0,001*((Inset/0,995+Cover/0,995+FoE/0,995+Hardcover/0,995)/3000)*40	tkm	Transportation of the books from Central warehouse in Rosersberg to reloding in Uppsala = 40 km
Transport, lorry 7.5-16t, EURO3/RER S	0,001*((Inset/0,995+Cover/0,995+FoE/0,995+Hardcover/0,995)/3000)*40	tkm	From reloading in Uppsala to internet bookstore warehouse in Morgongåva = 40 km

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Use
Process identifier	Institut14515700063
Type	Unit process
Process name	**Samdistribution warehouse**
Time period	2005-2009
Geography	Europe, Western
Technology	Unspecified
Representativeness	Data from a specific process and company
Multiple output allocation	Unspecified
Date	2009-03-06
Record	Clara Borggren
Generator	
Literature references	
Collection method	Personal contact with Merete Lind and Anders Andersson at Bonnierförlagen and Lars-Gunnar Orrö at Samdistribution.
Comment	Included in the process: Energy and heat consumption for storage of one book at Bonnerförlagen's central storage Samdistribution. One books monetary share of Bonnerförlagens total income during 2008 was used to allocate the heat and energy to the book. The share was mulitiplied with the total electricity and total district heating used at Samdistribution during 2008.

Allocation rules

Products

Samdistribution warehouse	1	p	100	not defined	Book storage

Avoided products

Resources

Materials/fuels			
Electricity at grid, varied in book project	AndelBokBonnier*1505661 = 0,178	kWh	1,18E-07: share of one book. Calculated from the income of one book devided by the income from ALL titles during 2008. 1505661 kWh: Total electricity consumption at Samdistribution during 2008
District heating SE average	AndelBokBonnier*618470 = 0,0733	kWh	1,18E-07: share of one book. Calculated from the income of one book devided by the income from ALL titles during 2008. 618470 kWh: Total district heating consumption at Samdistribution during 2008
Electricity/heat			
Emissions to air			
Emissions to water			
Emissions to soil			
Final waste flows			
Non material emissions			
Social issues			
Economic issues			
Waste to treatment			

Process

Category type	Use
Process identifier	Institut14515700065
Type	Unit process
Process name	**Morgongåva, internet book store warehouse**
Time period	2005-2009
Geography	Europe, Western
Technology	Mixed data
Representativeness	Data from a specific process and company
Date	2009-03-06
Record	Clara Borggren
Generator	
Literature references	
Collection method	Personal contact with Pär Svärdson at AdLibris.
Data treatment	
Verification	
Comment	Included in the process: Energy- and heat consumption for storage of one book at AdLibris' warehouse in Morgongåva. One books monetary share of all of AdLibris purchases during 2008 was used to allocate the heat and energy to the sold book. The share was mulitiplied with the total electricity and total district heatingused at the warehouse in Morgongåva during 2008.
Allocation rules	
System description	

Products

Morgongåva, internet book store warehouse	1	p	100	not defined	Book storage

Avoided products

Resources

Materials/fuels

Electricity at grid, varied in book project	254000*AndelBokInterne = 0,0596	kWh	Electricity consumption during 2008 for Morgongåva storage
District heating SE average	360000*AndelBokInterne = 0,0845	kWh	Heat consumption during 2008 for Morgongåva storage

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Transport
Process identifier	Institut14515700151
Type	Unit process
Process name	**Distribution paper book, medel trad incl.14% returns**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Date	2009-03-12
Record	Clara Borggren
Generator	
Literature references	
Collection method	Personal contact with Pär Svärdson at AdLibris. Information from Schenker (Fredrik Goldbeck-Löwe) and Bonnierförlagen (Håkan Rudels).
Comment	Included in the process: * Distribution of one book from the warehouse to a traditional bookstore. Distribution in three steps by different trucks; distribution of books from the storage to the distribution centrl, long distance transportation and finally distribution to the traditional bookstore. Calculated for one book (0.612 kg) using total tonkilometer and total weight transported by Schenker for AdLibris as an estimation of the transport work needed per book. Included in the process is transportation to and from the book store for 14% return of all books during 2008, allocated to the sold books.
Allocation rules	The transpotation for the 14% returns of books are allocated to the sold book.

Products

Distribution paper book, medel trad incl.14% returns	1	p	100	not defined	Book distribution

Avoided products

Resources

Materials/fuels

Transport, lorry 3.5-16t, fleet average/RER S	0,017605828	tkm	Distribution
Transport, lorry >32t, EURO3/RER S	0,299812898	tkm	Long distance transport
Transport, lorry 16-32t, EURO3/RER S	0,343271645	tkm	To reload distribution center

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Transport
Process identifier	Institut14515700101
Type	Unit process
Process name	**Distribution paper book 0,5% return**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Date	2009-03-12
Record	Clara Borggren
Generator	
Literature references	
Collection method	Personal contact with Pär Svärdson at AdLibris. Information from Schenker (Fredrik Goldbeck-Löwe).
Data treatment	
Verification	
Comment	Included in the process: * Distribution of one book from the warehouse to a pickup place for packages. Distribution in three steps by different trucks; retreival from the storage, long distance transportation and finally distribution to the pick up place. Calculated for one book (0.612 kg) using total tonkilometer and total weight transported by Schenker for AdLibris as an estiamtion for total transport work needed per book. Included in the process is transportation for 0.5% return of all books during 2008, allocated to the sold books. The transpotation to and from the pick-up place for the 0.5% returned books are allocated to the sold books.

Allocation rules

System description

Products

Distribution paper book, medel internet incl 0,5% returns	1	p	100	not defined	Book distribution

Avoided products

Resources

Materials/fuels

Transport, lorry 3.5-16t, fleet average/RER S	0,013415073	tkm	Distribution
Transport, lorry >32t, EURO3/RER S	0,228447754	tkm	Long distance transport
Transport, lorry 16-32t, EURO3/RER S	0,261561917	tkm	To reload distribution center

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

The home delivery of paper books ordered via an Internet book store was modelled out side of SimaPro, but data and references are documented below.

Name	**Home delivery Economic**
Time period	2005-2009
Geography	Europe, Western
Technology	Mixed data
Representativeness	Mixed data
Date	2009-03-11
Record	Clara Borggren
Generator	
Literature references	
Collection method	Personal communication with Karolina Brick, Posten Meddelande AB (2009). The figures used are from EPDs: Posten Meddelande (2007a)
Comment	
	We have only tested the home delivery for the climate change potential, and thus only CO2-eq emissions are mentioned below.
	Included in the EPD data are fuels, including their production, as well as energy used in facilities and maintenace of vehicles.
Allocation rules	

Products

Home delivery	1	g		1 g of sent mail	

Resources		
Materials/fuels		
Electricity/heat		
Emissions to air	0,27	g CO2-eq
Emissions to water		
Emissions to soil		
Final waste flows		

Non material emissions

Social issues

Economic issues

Waste to treatment

Name	**Home delivery First Class**
Time period	2005-2009
Geography	Europe, Western
Technology	Mixed data
Representativeness	Mixed data
Date	2009-03-11
Record	Clara Borggren
Generator	
Literature references	
Collection method	Personal communication with Karolina Brick, Posten Meddelande AB (2009). The figures used are from EPDs: Posten Meddelande (2007b)
Comment	We have only tested the home delivery for the climate change potential, and thus only CO2-eq emissions are mentioned below. Included in the EPD data are fuels, including their production, as well as energy used in facilities and maintenace of vehicles.
Allocation rules	

Products

Home delivery	1	g		1 g of sent mail	

Resources

Materials/fuels

Electricity/heat

Emissions to air 0,5 g CO2-eq

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Use
Process identifier	Institut14515700064
Type	Unit process
Process name	**Book shop**
Time period	2005-2009
Geography	Europe, Western
Technology	Average technology
Representativeness	Data from a specific process and company
Date	2009-03-11
Record	Åsa Moberg
Generator	
Literature references	
Collection method	Information from one book store in a middle-sized Swedish town. Turnover SEK 8 264 000 and electricity (incl electricity for heat) 41 537 kWh, Bertil Kröjtz, personal communication (2009)
Comment	Only electricity use. Rough data based on one store only. Thus uncertain as average data.
Allocation rules	The energy use for one year is split on the sales (monetary). One book of the type studied has an average price of 270 SEK.

Products

Book store		1	p	100	not defined	Book storage	(One book, average price 270 SEK)

Avoided products

Resources

Materials/fuels

Electricity/heat

Electricity at grid, varied in book project	41637/8264000*270 = 1,36	kWh

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Use
Process identifier	Institut14515700068
Type	Unit process
Process name	**Adlibris, internet book store**
Time period	2005-2009
Geography	Europe, Western
Technology	Mixed data
Representativeness	Data from a specific process and company
Date	2009-03-06
Record	Clara Borrgren
Generator	
Literature references	
Collection method	Data collected from Adlibris. Contact persons: Pär Svärdson and Anna Christensen
Data treatment	
Verification	
Comment	Included in process: *Total electricity use for AdLibris office space during 2008 *Total district heating for AdLibris office space during 2008 * The staff's travel during 2008
Allocation rules	One books monetary share of all of AdLibris purchases during 2008 was used to allocate the heat, energy and staff travel to the sold book. The share was mulitiplied with the total electricity, total district heating and total travel at AdLibris' office during 2008.
System description	

Products

Adlibris, internet book store	1	p	100	not defined	Editorial work

Avoided products

Resources

Materials/fuels

Electricity at grid, varied in book project	84180*145/617600000 = 0,0198	kWh	84180 = electricity consumption during 2008. Total purchase during 2008 = 617,6 Mkr. F-price for one book: 145kr
Transport, long-distance train, SBB mix/CH U	940*25*145/617600000 = 0,00552	personkm	By train: STHLM-GBG roud trip ~ 940km. 25 times per year.
District heating SE average	47200*145/617600000 = 0,0111	kWh	118kWh/m2 and year (SCB). 400m2 = 47200 kWh/year.

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Use
Process identifier	Institut14515700076
Type	Unit process
Process name	**Book user, internet**
Time period	2005-2009
Geography	World
Technology	Mixed data
Representativeness	Theoretical calculation
Date	2009-03-11
Record	Clara Borggren
Generator	Åsa Moberg och Clara Borggren, KTH
Literature references	
Collection method	Approximations by Åsa Moberg och Clara Borggren, KTH
Comment	
Allocation rules	

Products

Book user, internet	1	p	100	not defined	Book user

Avoided products

Resources

Materials/fuels

Use, computer, desktop with LCD monitor, home use/RER U - active use electr. mix	7	min	Approximation of how long time it takes to buy a book on an internet bookstore. 7 minutes of computer use.

Use of internet (hubs, routers, switches, cables)	700	kB	Approximation of internet use. 8 new uploadings of internet websides.
Use of internet modem	7	min	Approximation of how long time it takes to buy a book on an internet bookstore. 7 minutes of modem use.

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Use
Process identifier	Institut14515700005
Type	Unit process
Process name	**Use of internet (hubs, routers, switches, cables)**
Time period	2005-2009
Geography	World
Technology	Average technology
Representativeness	Average from processes with similar outputs
Date	2009-03-05
Record	Åsa Moberg, KTH
Generator	Taylor and Koomey (2008) and personal communication with Jens Malmodin, Ericsson Research and Dag Lundén, TeliaSonera
Literature references	Taylor and Koomey, 2008

Collection method

Comment	Covers energy use for hubs, routers, switches as well as carbondioxide emissions from cable construction work. Data does not include production of equipment, except for cables. PC use and modem needs to be added, as well as server use and data storage. Servers and data storage are in this study covered in the processes on editorial work (as the total energy use of the companies are accounted for, including server energy use). The data on energy use for hubs, routers and switches are based on Taylor and Koomeys study concerning th U.S. and the cable figures are based on TeliaSoneras network.
Allocation rules	The total energy use of the internet infrastructure (here hubs,routers, switches) is divided between total data transferred based on MByte. Share of network cables produced and construction and dismantlig of cables in ground are calculated based on data transported (MByte).

System description

Products

Use of internet (hubs, routers, switches, cables)	1	kB	100	not defined	Internet

Avoided products

Resources

Materials/fuels

Copper cable (EUALEW)	900000/35/(37401857*1000000000) = 6,88E-13	km	900 000 km (TeliaSonera total copper cable length), 35 years life time (estimated by Dag Lundén, Telia Sonera). Total 37401857 TB/year transported in the network (80% of full capacity assumed to be used, 0,02% of the full capacity allocated to voice traffic). (Figures from 2007, personal communication Dag Lundén)
Optic fibre cable, 4-core	66000/35/(37401857*1000000000) = 5,04E-14	km	66 000 km (TeliaSonera total fibre cable elngth), 35 years life time (estimated by Dag Lundén). Total 37401857 TB/year transported (80% of full capacity assumed to be used, 0,02% of the full capacity allocated to voice traffic). (Figures from 2007, personal communication Dag Lundén)
Electricity/heat			
Electricity at grid, varied in book project	1,4/1000 = 0,0014	Wh	Taylor and Koomey (2008), lower figure of the span (9kWh/GB), from that servers and datastorage are excluded, as they are accounted for separately in this study. The Taylor and Koomey data illustrate 2006 conditions. Based on personal communication with Jens Malmodin (2009), the figure is halved to estimate the energy use per GB in 2008.
Emissions to air			
Carbon dioxide, fossil	5703110*(6,88E-13+5,04E-14) = 4,21E-6	g	Emissions equal to 1 km construction work (including design, construction and dismantlig but not cable production. Cradle to grave (not including cable). In ground: 5 703 110 g CO2eqv/km Information from Dag Lundén based on (Tingstorp 1998, reviewed by Lindroth 1999). According to Lundén the figure is on the higher side since many operations are done for several purposes. 6,88E-13+5,04E-14 km cable from calculation above.
Emissions to water			
Emissions to soil			
Final waste flows			
Non material emissions			
Social issues			
Economic issues			
Waste to treatment			

Process

Category type	Use
Process identifier	Institut14515700049
Type	Unit process
Process name	**Use of internet modem**
Time period	2005-2009
Geography	World
Technology	Average technology
Representativeness	Average of all suppliers
Date	2009-03-05
Record	Åsa Moberg
Generator	Jens Malmodin, Ericsson (personal communication, 2009)
Literature references	Findahl, 2007
Collection method	
Comment	Only electricity use, no production of modem. The modem is in active mode 24 hours per day. Average internet use per household is 160 min/day (Findahl, 2007) (assuming 2 persons per household). Thus the non-active:active electricity use is 9:1. Thus for every kWh of electricity used for active internet use, 9 additional kWh will be added for the share of non-active electricity use.
Allocation rules	

Products

Use of internet modem	1	hr	100	not defined	Internet	Active internet use time

Avoided products

Resources

Materials/fuels

Electricity/heat

Electricity at grid, varied in book project	9	Wh	Appr 9 W (Malmodin, 2009)
Electricity at grid, varied in book project	9*9 = 81	Wh	Share of electricity for modem non-active use time.

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Use
Process identifier	Institut14515700075
Type	Unit process
Process name	**Book user transport**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Date	2009-03-11
Record	Clara Borggren and Åsa Moberg
Generator	
Literature references	
Collection method	Assumption on travelling with passenger car to buy or pick-up a book or one e-book reader. The distance allocated to one book is varied through parameters.
Comment	As there is no information on average transport distance, mode and other activities made during the trip to the store, the figures are estimates aiming to give an indication of the magnitude of the impact of personal travel.
Allocation rules	
System description	

Products

Book user transport	1	p	100	not defined	Book user

Avoided products

Resources

Materials/fuels

Transport, passenger car, petrol, fleet average/RER U	Trans_person = 2	personkm	Assumption made in the project.

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Processing
Process identifier	Institut14515700148
Type	Unit process
Process name	**Waste treatment of books traditional**
Time period	2005-2009
Geography	Europe, Western
Technology	Unspecified
Representativeness	Data from a specific process and company
Date	2009-03-11
Record	Clara Borggren and Åsa Moberg
Generator	
Literature references	
Collection method	Personal contact with Lars-Gunnar Orrö, Samditribution, Solveig Malmström IL Recycling and Anders Hedenstedt, Avfall Sverige.
Comment	According to Lars-Gunnar Orrö at Samditribution (2009) all returns sent back to the central warehouse are sent to IL Recycling (except for those that the author wants back). 14% of all books distributed to traditional bookstores are sent back to a central warehouse Svärdson, 2009) and then to recycling, where 100% are recycled with material recovery (Malmström, 2009). The sold books, 86% of the distributed books, are sent to incineration at the end of their life since there is no material recycling initiative for hard back books in Sweden (Hedenstedt, 2009 and Sveriges avfallsportal 2009,).
Allocation rules	

Products

Waste treatment of books traditional incl. 14% returns	(Inset/0,86+Cover/0,86+FoE/0,86+Hardcover/0,86)/3000 = 0,712	kg	100	not defined	Waste

Avoided products

Resources

Materials/fuels

Transport, lorry 16-32t, EURO3/RER S	100*0,001*(Inset/0,86+Cover/0,86+FoE/0,86+Hardcover/0,86)/3000 = 0,0712	tkm	Transport to incineration plant. Approximation by Borggren and Moberg: Approximation distance = 100 km

Electricity/heat			
Emissions to air			
Emissions to water			
Emissions to soil			
Final waste flows			
Non material emissions			
Social issues			
Economic issues			
Waste to treatment			
Disposal, paper, 11.2% water, to municipal incineration/CH U Swe conditions	(1-0,14)*(Inset/0,86+Cover/0,86+FoE/0,86)/3000 = 0,527	kg	Assumption: the book user does not recycle the book.
Recycling paper/RER U incl. benefits and costs	0,14*(Inset/0,86+Cover/0,86+FoE/0,86)/3000 = 0,0859	kg	Malmström (2009): the returns are recycled. ~ 0,14%
Disposal, packaging cardboard, 19.6% water, to municipal incineration/CH U - Swe conditions	(1-0,14)*(Hardcover/0,86)/3000 = 0,0847	kg	Assumption: the book user does not recycle the book.
Recycling cardboard/RER U incl. benefits and costs	0,14*(Hardcover/0,86)/3000 = 0,0138	kg	IL Recycling: the returns are recycled. ~ 0,14%

Process

Category type	Processing
Process identifier	Institut14515700149
Type	Unit process
Process name	**Waste treatment of books internet incl.0,5% returns**
Time period	2005-2009
Geography	Europe, Western
Technology	Mixed data
Representativeness	Mixed data
Date	2009-03-11
Record	Clara Borggren
Generator	
Literature references	
Collection method	Assumptions by Åsa Moberg and Clara Borggren. Personal contact with Lars-gunnar Orrö, Samditribution, Solveig Malmström, IL Recycling and Anders Hedenstedt, Avfall Sverige.
Comment	Included in the process: * Transportation of the book to an incineration or recycling plant. Own assumption regarding distance. * Incineration of 99.5% of the book. * Recycling with material recovery for 0.5% of the book. * Incineration of 73% of the packaging carbord (Naturvårdsverket, 2008). * Recycling of 27% of the packaging cardboard (Naturvårdsverket, 2008). According to Lars-Gunnar Orrö (2009) all returns sent back to the central warehouse are sent to IL Recycling (except for those that the author wants back). 0.5% of all books distributed to internet bookstores are sent back to a central warehouse (Svärdson, 2009) and then to recycling, where 100% are recycled with material recovery (Malmström, 2009). The sold books, 99.5% of the distributed books, are sent to incineration since there is no recycling station for hard back books in Sweden (Hedenstedt, 2009 and Sveriges avfallsportal, 2009).
Allocation rules	

Products

Waste treatment of books internet incl.0,5% returns	(Inset/0,995+Cover/0,995+FoE/0,995+Hardcover/0,995)/3000 = 0,615	kg	100	not defined	Waste

Resources

Materials/fuels			
Transport, lorry 16-32t, EURO3/RER S	100*0,001*(Inset/0,995+Cover/0,995+ FoE/0,995+Hardcover/0,995)/3000+ 0,001*0,051/0,995 = 0,0616	tkm	Transport to incineration plant. Own approximation: 100 km
Electricity/heat			
Emissions to air			
Emissions to water			
Emissions to soil			
Final waste flows			
Non material emissions			
Social issues			
Economic issues			
Waste to treatment			
Disposal, paper, 11.2% water, to municipal incineration/CH U Swe conditions	(1-0,005)*(Inset/0,995+Cover /0,995+FoE/0,995)/3000 = 0,527	kg	Assumption: the book user does not recycle the book.
Recycling paper/RER U incl. benefits and costs	0,005*(Inset/0,995+Cover/0,995+ FoE/0,995)/3000 = 0,00265	kg	(Malmström, 2009) the returns are recycled. ~ 0,05%
Disposal, packaging cardboard, 19.6% water, to municipal incineration/CH U - Swe conditions	(1-0,005)*(Hardcover/0,995)/3000 = 0,0847	kg	Assumption: the book user does not recycle the book.
Recycling cardboard/RER U incl. benefits and costs	0,005*(Hardcover/0,995)/3000 = 0,000426	kg	Malmström (2009): the returns are recycled. ~ 0,05%
Recycling corrugated board/RER U incl. benefits and costs	((153/3)/0,995)*0,73 = 37,4	g	Assumption: 73% the packaging material (corrugated board) is usumed to be recycled with material recovery.
Disposal, packaging cardboard, 19.6% water, to municipal incineration/CH U - Swe conditions	((153/3)/0,995)*0,27 = 13,8	g	Assumption: 27% the packaging material (corrugated board) is usumed to be incinerated with enery recovery.

Process

Category type	Waste treatment
Process identifier	Institut14515700045
Type	Unit process
Process name	**Recycling of paper**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Date	2009-05-19
Record	Modified by Clara Borggren and Åsa Moberg to include the impact of recycling of waste paper and avoided impact of production of paper from virgin fibre.
Generator	PRé Consultants, 2007-12-11
Literature references	
Collection method	
Comment	Process sheet created to account for the benefits of avoiding virgin paper production as well as the costs of recycling paper. The recycled paper is assumed to replace virgin fibres in newsprint production.
Allocation rules	
System description	

Waste treatment

Recycling paper/RER U incl. benefits and costs	1,1734	kg	Paper	Recycling	The waste paper needed to produce one kg of recycled paper based on the figure in Ecoinvent Report No 11 on Paper and Board.

Avoided products

Paper, newsprint, 0% DIP, at plant/RER U	1	kg	Undefined		

Resources

Materials/fuels

Paper, recycling, with deinking, at plant/RER U	1	kg	Undefined		

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Input parameters

Calculated parameters

Process

Category type	Waste treatment
Process identifier	Institut14515700139
Type	Unit process
Process name	**Recycling of corrugated board**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Date	2007-12-11
Record	Modified by Clara Borggren and Åsa Moberg to include the impact of recycling of waste corrugated board and avoided impact of production of paper from virgin fibre.
Generator	PRé consultants, SH
Literature references	
Collection method	
Comment	Process sheet created to account for the benefits of avoiding virgin paper production as well as the costs of recycling paper. The recycled paper is assumed to replace virgin fibres in newsprint production. Accoridng to original sheet
Allocation rules	

Waste treatment

Recycling corrugated board/RER U incl. benefits and costs	1,03	g	Cardboard	Recycling	1,03:1 ratio from process Corrugated board, recycling fibre, single wall, at plant/RER U

Avoided products

Corrugated board, fresh fibre, single wall, at plant/RER S	1	g	Undefined		

Resources

Materials/fuels

Corrugated board, recycling fibre, single wall, at plant/RER U	1,03	g	Undefined		

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Input parameters

Calculated parameters

Process

Category type	Waste treatment
Process identifier	Institut14515700085
Type	Unit process
Process name	**Recycling of cardboard**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Date	2009-05-19
Record	Modified by Clara Borggren
Generator	2007-12-11 PRé consultants, SH
Literature references	
Collection method	
Comment	Comment in original process sheet "To include this benefit and cost the following data should be included: Core board should be used as avoided product and corrugated board, recycling fibre, single wall should be used as input from technosphere." 1,03:1 ratio from process Corrugated board, recycling fibre, single wall, at plant/RER U was used.
Allocation rules	
System description	

Waste treatment					
Recycling cardboard/RER U incl. benefits and costs	1,03	g	Cardboard	Recycling	1,03:1 ratio from process Corrugated board, recycling fibre, single wall, at plant/RER U
Avoided products					
Corrugated board, fresh fibre, single wall, at plant/RER S	1	g	Undefined		
Resources					
Materials/fuels					
Corrugated board, recycling fibre, single wall, at plant/RER U	1	g	Undefined		

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Input parameters

Calculated parameters

Parameters

Category type	Material
Type	Unit process
Process name	**Production, e-reader Sony PRS 505**
Time period	2005-2009
Geography	World
Technology	Modern technology
Representativeness	Data from a specific process and company
Date	2008-12-11
Record	Clara Borggren
Generator	Patrik Dai Javad, PDJ Development
Literature references	
Collection method	E-reader used was the Sony PRS 505. Patrik Dai Javad at PDJ Development disassembled the e-reader and specified all the different parts. To be able to calculate the contributions from the e-reader production as many parts as possible were linked to components (process data sheets) in the Ecoinvent 2.0 database.
Comment	Included in the process: * Production of the separate parts in a specific e-book reader. All the data were calculated for one e-reader. Not included in the calculations are: the Eink screen, a CD that came in the package and the energy consumption for putting together all the separate parts.
Allocation rules	

Products

Production, e-book reader	1	p	100	not defined	Electronics\E-book reader

Avoided products

Resources

Materials/fuels

Polyurethane, flexible foam, at plant/RER U	91	g	Soft Cover, Brown colored (leather imitation) 91 gram. 130mm x 180mm x 13mm
Packaging, corrugated board, mixed fibre, single wall, at plant/RER U	56	g	Paper Box (including paper / leaflets). 215mm x 153mm x 45mm. 56 gram
Cable, connector for computer, without plugs, at plant/GLO U	1,6	m	USB cable accessory (Mini-USB + USB connector types), 45 gram, length 1.6 meter
Polyethylene, HDPE, granulate, at plant/RER U	1	g	Memory Stick Pro plastic protection (dummy) card. 24mm x 32mm x 2mm. NO DATA on type of plastic - assumption HPDE.
Polyethylene, HDPE, granulate, at plant/RER U	1	g	SD Memory Card plastic protection (dummy) card. 20mm x 31mm x 1.6mm. Approx. 1gram. NO DATA on type of plastic - assumption HPDE.
Aluminium, production mix, at plant/RER U	10	g	Screws, Size M1.4 NO DATA. Approx. 1gram/pcs. Assumption: aluminium.
Polyethylene, HDPE, granulate, at plant/RER U	2	g	Upper ornamental plastic part. NO DATA on type of plastic - assumption HPDE.
Polyethylene, HDPE, granulate, at plant/RER U	2	g	Lower ornamental plastic part. NO DATA on type of plastic - assumption HPDE.
Aluminium, production mix, at plant/RER U	66	g	Aluminium chassi. 66 gram. 125 mm x 170 mm x 8 mm
Printed wiring board, surface mount, lead-free surface, at plant/GLO U	0,0023	m2	Flexfilm, Lead-free (Pb-free), 23cm2
Aluminium, production mix, at plant/RER U	8	g	Metallic frame part. Assumption: aluminium
Polyethylene, HDPE, granulate, at plant/RER U	5	g	Plastic buttons and (plastic) support material NO DATA
Battery, LiIo, rechargeable, prismatic, at plant/GLO U	0,012	kg	Battery Li-Ion 3.7V, 610mAh, Sony
Aluminium, production mix, at plant/RER U	6	g	Battery holder. Assumption: aluminuim
Cable, connector for computer, without plugs, at plant/GLO U	0,04	m	Battery cables, red and black, length 2cm
Connector, computer, peripherical type, at plant/GLO U	0,001	kg	Mini-USB jack SMD type connector, 1 grams
Connector, computer, peripherical type, at plant/GLO U	0,001	kg	DC-jack standard SMD type connector, 1 grams
Connector, computer, peripherical type, at plant/GLO U	0,001	kg	3.5mm audio standard type connector, 1 grams
Printed wiring board, surface mount, lead-free surface, at plant/GLO U	0,001	m2	Flexfilm type rigidflex, Pb-free, 2 grams, 10cm2
Connector, computer, peripherical type, at plant/GLO U	0,002	kg	Memory Stick Pro Duo connector / holder, 2 grams
Connector, computer, peripherical type, at plant/GLO U	0,002	kg	SD Card connector / holder, 2 grams
Printed wiring board, surface mount, lead-free surface, at plant/GLO U	0,002	m2	Flexfilm, Pb-free, 20cm2, 3 grams
Acrylonitrile-butadiene-styrene copolymer, ABS, at plant/RER U	15	g	Plastic frame part
E-ink display part NO DATA	1	p	NO DATA available
Aluminium, production mix, at plant/RER U	50	g	Metalic frame part. Approx. ~ 50 gram aluminuim

Connector, computer, peripherical type, at plant/GLO U	0,004	kg	ZIF type connectors, 1 grams, 4pcs
Integrated circuit, IC, logic type, at plant/GLO U	0,001	kg	Large IC, FPGA: Actel ProASIC 3 A3P125 100pin
Integrated circuit, IC, logic type, at plant/GLO U	0,001	kg	Large IC, Flash Memory Card Controller Ricoh R5C807 100pin
Integrated circuit, IC, memory type, at plant/GLO U	0,002	kg	Large Memory IC: Samsung DRAM K4M561633G, 2 pcs
Integrated circuit, IC, logic type, at plant/GLO U	0,001	kg	Large IC, Application Processor (CPU) MC9328, Motorola/Frescale
Integrated circuit, IC, logic type, at plant/GLO U	0,001	kg	Large IC, Hitachi Super Low Power 8-bit uC, H8/38004, 64 pin
Integrated circuit, IC, memory type, at plant/GLO U	0,001	kg	Large Memory IC, Spansion 16Mb Boot Flash S29AL016D90TFI02, TSOP-48
Integrated circuit, IC, memory type, at plant/GLO U	0,001	kg	Large Memory IC, Samsung K9F2G08 256Mb x 8 NAND Flash, TSOP-48
Integrated circuit, IC, logic type, at plant/GLO U	0,002	kg	Standard IC, LC244A, Texas Instruments Octal Buffer/Driver with tri-state, 20-pin TSOP, 2 pcs
Integrated circuit, IC, logic type, at plant/GLO U	0,001	kg	Standard IC, Epson S1R72V17 USB2 controller
Integrated circuit, IC, logic type, at plant/GLO U	0,001	kg	Standard IC, Asahi Kasei AK4356 DAC
Integrated circuit, IC, logic type, at plant/GLO U	0,001	kg	Standard IC, Texas Instruments digital temperature sensor TMP75
Integrated circuit, IC, logic type, at plant/GLO U	0,001	kg	Standard IC, 2904
Integrated circuit, IC, logic type, at plant/GLO U	0,001	kg	Standard IC, AMZ TI 71K
Integrated circuit, IC, logic type, at plant/GLO U	0,006	kg	Standard IC, Crystals, 1 gram, 6 pcs
Integrated circuit, IC, logic type, at plant/GLO U	0,01	kg	Standard IC, LDOs, 1 grams, 10 pcs
Diode, unspecified, at plant/GLO U	0,0002	kg	Standard comps, Diodes, 17 pcs, 0.0001kg/pcs
Transistor, unspecified, at plant/GLO U	0,004	kg	Standard comps, Transistors, 18pcs
Resistor, SMD type, surface mounting, at plant/GLO U	0,004	kg	Standard comps, Resistor arrays, 30 pcs
Inductor, low value multilayer chip type, LMCI, at plant/GLO U	0,004	kg	Standard comps, Inductors SMD, 0.0002 kg/pcs, 20pcs
Inductor, ring core choke type, at plant/GLO U	0,004	kg	Standards comps Inductors SMD Wirewound, 0.0010kg/pcs, 4pcs
Capacitor, Tantalum-, through-hole mounting, at plant/GLO U	0,001	kg	Standard comps, Capacitors Tantalium, 10 pcs
Capacitor, SMD type, surface-mounting, at plant/GLO U	0,04	kg	Standard comps, Capacitors Ceramic, weight 0.0002 kg/pcs, 200 pcs
Capacitor, SMD type, surface-mounting, at plant/GLO U	0,0006	kg	Standard comps, Capacitors Varistor, weight 0.0002 kg/pcs, 3 pcs
Resistor, SMD type, surface mounting, at plant/GLO U	0,04	kg	Standard comps, Resistors, 190 pcs
Resistor, SMD type, surface mounting, at plant/GLO U	0,0002	kg	Standard comps, Variable Resistor, 1 pcs
Resistor, SMD type, surface mounting, at plant/GLO U	0,0002	kg	Standard comps, Thermistor NTC, 1 pcs

Connector, computer, peripherical type, at plant/GLO U	0,0003	kg	Standard buttons, Reset button and volume buttons, 3 pcs
Printed wiring board, surface mount, lead-free surface, at plant/GLO U	0,0085	m2	PCB (PWB), multilayer main board, 4 or 6 layers assumed, area approx. 85cm2, Pb-free

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Material
Process identifier	Institut14515700104
Type	Unit process
Process name	**E-ink display part NO DATA**
Time period	2005-2009
Geography	World
Technology	Average technology
Representativeness	Data from a specific process and company
Date	2009-05-06
Record	Clara Borggren
Generator	
Literature references	
Verification	
Comment	The process includes NO DATA, since we had no information about the components or the production of the display. Thus environmental impact from this process is missing.
Allocation rules	

Products

E-ink display part NO DATA	1	p	100	not defined	Electronics\E-book reader

Avoided products

Resources

Materials/fuels

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Use
Process identifier	Institut14515700095
Type	Unit process
Process name	**Editorial work + internet bookstore, e-book**
Time period	2005-2009
Geography	Eorope, Wesern
Technology	Mixed data
Representativeness	Data from a specific company and process
Date	2008-12-11
Record	Clara Borggren
Generator	
Literature references	

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( )-5.05558(c)-6.51769(t)-5.05558(w)-1.45558(t)-5.05558pt pwtL T*[8

District heating SE average	118*400*90/617600000 = 0,00688	kWh	Adlibris 400 m2 lokalyta. 118kWh per m2 per year (SCB, 2007). F-price e-book = 90 SEK. Adlibris total Purchase during 2008 = 617,6 Mkr
Transport, long-distance train, SBB mix/CH U	940*25*90/617600000 = 0,00342	personkm	By train: STHLM-GBG round trip ~ 940km. 25 times per year.
Electricity at grid, varied in book project	84180*90/617600000 = 0,0123	kWh	84180 = electricity consumption for AdLibris and Elib during 2008
Desktop computer, without screen, at plant/GLO U	2*0,0013/80383 = 3,23E-8	p	Production of server; approx. 2 desktops without screen. Total E-book share of the server capacity = 0,0013. Number of e-book downloads dowloads during 2008: 80383
Transport, transoceanic freight ship/OCE U	2*0,0013/80383*0,0113*15000 = 5,48E-6	tkm	Transport of the server from Aisia to Europe.
Transport, lorry 16-32t, EURO3/RER U	2*0,0013/80383*0,0113*500 = 1,83E-7	tkm	Transport of the server from Europe to Sweden

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Transport
Process identifier	Institut14515700156
Type	Unit process
Process name	**E-book reader distribution**
Time period	2005-2009
Geography	World
Technology	Unspecified
Representativeness	Unspecified
Date	2009-05-20
Record	Clara Borggren
Generator	
Literature references	
Collection method	Assumptions made in the project.
Data treatment	
Verification	
Comment	Included in the process: * Transportation of one e-book reader from South East Asia to Sweden by boat to central Europe and then by truck to Sweden. * Personal tranport by car to buy the e-book reader at a store or get it at a pickup place for packages.
Allocation rules	
System description	

Products

E-book reader distribution	1	p	100	not defined	E-book distribution

Avoided products

Resources

Materials/fuels

Transport, transoceanic freight ship/OCE U	0,4/1000*15000 = 6	tkm	Transport of the e-book reader from Aisia to Europe.
Transport, lorry 16-32t, EURO3/RER U	0,4/1000*500 = 0,2	tkm	Transport of the e-book reader from Europe to Sweden
Book user transport	1	p	Assumption on travelling with passenger car to buy or pick-up one e-book reader. The distance allocated to one e-book reader is varied through parameters.

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Use
Process identifier	Institut14515700083
Type	Unit process
Process name	**E-book user internet**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Date	2009-03-12
Record	Clara Borggren
Generator	
Literature references	
Collection method	Personal contact with Sony, Bodil Stenholt, and Elib, Björn Waller, and assumptions of the project members.
Data treatment	
Verification	
Comment	Assumptions made in the project: Time to brows the internet bookstore's home page and buy the book = 7 minutes or 700 kB, and time to download the book = 1 minute. Information from Elib tells us that one e-book is approximately 1.5 MB Information fron Sony tells us that one charge of the e-book reader battery use's 2.5 Wh. Assumption in the project: One charge is needed to read one e-book on the e-book reader. Included in the process: * Computer use for purchasing and downloading one e-book * Internet use for purchasing and downloading one e-book * use of Internet modem during purchasing and downloading of one e-book * Electricity use for charging the battery, once for reading one e-book
Allocation rules	
System description	

Products

E-book user	1	p	100	not defined	Book user

Avoided products

Resources

Materials/fuels

Use, computer, desktop with LCD monitor, home use/RER U - active use electr. mix	7+1 = 8	min	Approximation: Time spent to buy the book = 7 min and time to download the book = 1 min.
Use of internet (hubs, routers, switches, cables)	700+1500 = 2200	kB	User activity at the homepage (700kB) of the internet book store plus downloading of the book, 1.5 MB
Use of internet modem	7+1 = 8	min	Approximation: Time spent to buy the book = 7 min and time to download the book = 1 min.
Electricity at grid, varied in book project	2,5	Wh	Charging the battery, Personal contact with Bodil Stenholt at Sony

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Processing
Process identifier	Institut14515700160
Type	Unit process
Process name	**Waste treatment e-book reader**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Date	2009-06-24
Record	Åsa Moberg
Generator	
Literature references	
Collection method	
Comment	This is a process sheet where the different waste flows are calculated based on the parameters set.
Allocation rules	

Products

Waste treatment e-books	1	p	100	not defined	Waste

Avoided products

Resources

Materials/fuels

Waste treatment of e-book device	(1-Life_long)*1/2/Ebook_year*ewaste = 0,0156	p	Approximation: Life lenght of the e-book reader 2 years.

Waste treatment of e-book device	Life_long*1/5/Ebook_year*ewaste = 0	p	Approximation: Life lenghtof the e-book reader 5 years.
Waste treatment of e-book packaging	(1-Life_long)*1/2/Ebook_year = 0,0208	p	Approximation: Life lenght of the e-book reader 2 years.
Waste treatment of e-book packaging	Life_long*1/5/Ebook_year = 0	p	Approximation: Life lenghtof the e-book reader 5 years.

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process	
Category type	Processing
Process identifier	Institut14515700087
Type	Unit process
Process name	**Waste treatment of e-book device**
Time period	2005-2009
Geography	Europe, Western
Technology	Average technology
Representativeness	Unspecified
Date	2009-03-12
Record	Clara Borggren
Generator	Personal contact with Patrik Dai Javad at pdj Development and Sverker Sjölin at Stena Techoworld
Literature references	
Collection method	Patrik Dai Javad took the e-reader apart and compared the parts with existing processes in Ecoinvent and weighed all the parts. Patrik Dai Javad provided us with a list of components. Sverker Sjölin told us which parts could be estimated to be recycled and which would be incinerated with energy recovery or sent to landfill.
Comment	Based on information from Sverker Sjölin and information for the e-reader production process, made together with Patrik Dai Javad, our modelling of the waste treatment gives that 48 weight-% of the e-reader is recycled, 29 weight-% incinerated with energy recovery and 23 weight-% is sent to landfill.
Allocation rules	
System description	

Products

Waste treatment of e-book device	1 p	100	not defined	Waste

Avoided products

Resources

Materials/fuels

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows			
Non material emissions			
Social issues			
Economic issues			
Waste to treatment			
Recycling aluminium/RER U incl. benefits and costs	134+34,734 = 169	g	
Disposal, Li-ions batteries, hydrometallurgical/GLO S	12	g	
Recycling Barite NO DATA	21,69	g	No recycling data available
Recycling Chromium NO DATA	0,043	g	No recycling data available
Recycling copper/RER U incl. benefits and costs	5,97+1,85+0,0056 = 7,83	g	
Recycling gold/RER U incl. benefits and costs	0,548	g	
Recycling lead/RER U incl. benefits and costs	1,509	g	
Recycling magnecium NO DATA	0,0367	g	No recycling data available
Recycling molybdenum NO DATA	0,0799	g	No recycling data available
Recycling nickel/RER U incl. benefits and costs	6,4678	g	
Recycling palladium/RER U incl. benefits and costs	0,1	g	
Recycling Pig iron/RER U incl benefits and costs	1,377	g	
Recycling silver/RER U incl. benefits and costs	3,008	g	
Recycling steel, low alloyedRER U incl. benefits and costs	1,02	g	
Recycling talantum NO DATA	0,375	g	No recycling data available
Recycling tin/RER U incl. benefits and costs	3,592	g	No recycling data available
Recycling Zink/RER U incl. benefits and costs	0,263	g	No recycling data available
Recycling PS/RER U incl benefits and costs	15	g	Used for ABS recycling
Disposal, polyethylene, 0.4% water, to municipal incineration/Swe con	11	g	
Disposal, polyurethane, 0.2% water, to municipal incineration/Swe con	91	g	
Disposal, plastics, mixture, 15.3% water, to sanitary landfill/CH S	45	g	
Disposal, aluminium, 0% water, to sanitary landfill/CH S	50	g	
Disposal, tin sheet, 0% water, to sanitary landfill/CH S	11,5	g	
Disposal, plastics, mixture, 15.3% water, to sanitary landfill/CH S	11,5	g	
Disposal, plastic, consumer electronics, 15.3% water, to municipal incin swe con	43,2	g	

Process

Category type	Waste treatment
Process identifier	Institut14515700094
Type	Unit process
Process name	**Recycling Aluminium**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Waste treatment allocation	Unspecified
Date	2009-05-19
Record	Modified by Clara Borggren
Generator	2007-12-11 PRé consultants, SH
Literature references	
Collection method	
Comment	Approximation used for system expansion, taking into account the avoidance of primary aluminum as aluminum is recycled. Ratio 1:1.01 was taken from the process Aluminium, secondary, from new scrap, at plant/RER U in ecoinvent 2.0
Allocation rules	

Waste treatment

Recycling aluminium/RER U incl. benefits and costs	1,01	kg	Aluminium	Recycling	Ratio from process Aluminium, secondary, from new scrap, at plant/RER U

Avoided products

Aluminium, primary, at plant/RER S	1	kg			

Resources

Materials/fuels

Aluminium, secondary, from new scrap, at plant/RER S	1	kg	

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Waste treatment
Process identifier	Institut14515700169
Type	Unit process
Process name	**Recycling Barite NO DATA**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Waste treatment allocation	Unspecified
Date	2009-07-09
Record	Clara Borggren
Generator	
Literature references	
Collection method	
Comment	This is an empty process since there is no information in SimaPro about recycling of Barite.
Allocation rules	
System description	

Waste treatment

Recycling Barite NO DATA	1	kg	All waste types	Recycling

Avoided products

Resources

Materials/fuels

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Waste treatment
Process identifier	Institut14515700170
Type	Unit process
Process name	**Recycling Chromium NO DATA**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Waste treatment allocation	Unspecified
Date	2009-07-09
Record	Clara Borggren
Generator	
Literature references	
Collection method	
Comment	This is an empty process since there is no information in SimaPro about recycling of Chromium.
Allocation rules	
System description	

Waste treatment

Recycling Chromium NO DATA	1	kg	All waste types	Recycling

Avoided products

Resources

Materials/fuels

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Waste treatment
Process identifier	Institut14515700109
Type	Unit process
Process name	**Recycling Copper**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Waste treatment allocation	Unspecified
Date	2009-05-07
Record	Åsa Moberg
Generator	
Literature references	
Collection method	
Comment	Approximation used for system expansion, taking into account the avoidance of primary copper as copper is recycled. As there was no information on the recycling efficiency, 1.105 was assumed based on the figure for steel and iron given in Ecoinvent 2.0.
Allocation rules	
System description	

Waste treatment

Recycling copper/RER U incl. benefits and costs	1,105	kg	Aluminium	Recycling	No information on the recycling efficiency, 1.105 assumed based on the figure for steel and iron.

Avoided products

Copper, primary, at refinery/GLO U	1	kg			

Resources			
Materials/fuels			
Copper, secondary, from electronic and electric scrap recycling, at refinery/SE U	1	kg	
Electricity/heat			
Emissions to air			
Emissions to water			
Emissions to soil			
Final waste flows			
Non material emissions			
Social issues			
Economic issues			
Waste to treatment			

Process

Category type	Waste treatment
Process identifier	Institut14515700110
Type	Unit process
Process name	**Recycling Gold**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Waste treatment allocation	Unspecified
Date	2009-05-07
Record	Åsa Moberg
Generator	
Literature references	
Collection method	
Comment	Approximation used for system expansion, taking into account the avoidance of primary gold as gold is recycled. As there was no information on the recycling efficiency, 1.105 was assumed based on the figure for steel and iron given in Ecoinvent 2.0.
Allocation rules	

Waste treatment

Recycling gold/RER U incl. benefits and costs	1,105	kg	Non-ferro	Recycling	No information on the recycling efficiency, 1,105 assumed based on the figure for steel and iron.

Avoided products

Gold, primary, at refinery/GLO U	1	kg			

Resources

Materials/fuels

Gold, secondary, at precious metal refinery/SE U	1	kg	

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Waste treatment
Process identifier	Institut14515700112
Type	Unit process
Process name	**Recycling Lead**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Waste treatment allocation	Unspecified
Date	2009-05-07
Record	Åsa Moberg
Generator	
Literature references	
Collection method	
Data treatment	
Verification	
Comment	Approximation used for system expansion, taking into account the avoidance of primary lead as lead is recycled. As there was no information on the recycling efficiency, 1.105 was assumed based on the figure for steel and iron given in Ecoinvent 2.0.
Allocation rules	
System description	

Waste treatment

Recycling lead/RER U incl. benefits and costs	1,105	kg	Non-ferro	Recycling	No information on the recycling efficiency, 1.105 assumed based on the figure for steel and iron.

Avoided products

Lead, primary, at plant/GLO S	1	kg	

Resources

Materials/fuels

Lead, secondary, from electronic and electric scrap recycling, at plant/SE S	1	kg	

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Waste treatment
Process identifier	Institut14515700115
Type	Unit process
Process name	**Recycling Nickel**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Waste treatment allocation	Unspecified
Date	2009-05-07
Record	Åsa Moberg
Generator	
Literature references	
Collection method	
Comment	Approximation used for system expansion, taking into account the avoidance of primary nickel as nickel is recycled. As there was no information on the recycling efficiency, 1.105 was assumed based on the figure for steel and iron given in Ecoinvent 2.0.
Allocation rules	

Waste treatment

Recycling nickel/RER U incl. benefits and costs	1,105	kg	Non-ferro	Recycling	No information on the recycling efficiency, 1.105 assumed based on the figure for steel and iron.

Avoided products

Nickel, primary, from platinum group metal production/ZA S	1	kg			

Resources			
Materials/fuels			
Nickel, secondary, from electronic and electric scrap recycling, at refinery/SE S	1	kg	
Electricity/heat			
Emissions to air			
Emissions to water			
Emissions to soil			
Final waste flows			
Non material emissions			
Social issues			
Economic issues			
Waste to treatment			

Process

Category type	Waste treatment
Process identifier	Institut14515700167
Type	Unit process
Process name	**Recycling magnecium NO DATA**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Waste treatment allocation	Unspecified
Date	2009-07-09
Record	Clara Borggren
Generator	
Literature references	
Collection method	
Comment	This is an empty process since there is no information in SimaPro about recycling of magnesium.
Allocation rules	

Waste treatment

Recycling magnecium NO DATA	1	kg	All waste types	Recycling

Avoided products

Resources

Materials/fuels

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Waste treatment
Process identifier	Institut14515700168
Type	Unit process
Process name	**Recycling molybdenum NO DATA**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Waste treatment allocation	Unspecified
Date	2009-07-09
Record	Clara Borggren
Generator	
Literature references	
Collection method	
Comment	This is an empty process since there is no information in SimaPro about recycling of molybdenum.
Allocation rules	
System description	

Waste treatment

Recycling molybdenum NO DATA	1	kg	All waste types	Recycling

Avoided products

Resources

Materials/fuels

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Waste treatment
Process identifier	Institut14515700116
Type	Unit process
Process name	**Recycling Palladium**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Waste treatment allocation	Unspecified
Date	2009-05-07
Record	Åsa Moberg
Generator	
Literature references	
Collection method	
Comment	Approximation used for system expansion, taking into account the avoidance of primary palladium as palladium is recycled. As there was no information on the recycling efficiency, 1.105 was assumed based on the figure for steel and iron given in Ecoinvent 2.0.
Allocation rules	

Waste treatment

Recycling palladium/RER U incl. benefits and costs	1,105	kg	Non-ferro	Recycling	No information on the recycling efficiency, 1.105 assumed based on the figure for steel and iron.

Avoided products

Palladium, primary, at refinery/ZA S	1	kg			

Resources

Materials/fuels

Palladium, secondary, at precious metal refinery/SE S	1	kg	

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Waste treatment
Process identifier	Institut14515700171
Type	Unit process
Process name	**Recycling talantum NO DATA**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Waste treatment allocation	Unspecified
Date	2009-07-09
Record	Clara Borggren
Generator	
Literature references	
Collection method	
Comment	This is an empty process since there is no information in SimaPro about recycling of talantum.
Allocation rules	

Waste treatment

Recycling talantum NO DATA	1	kg	All waste types	Recycling

Avoided products

Resources

Materials/fuels

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Waste treatment
Process identifier	Institut14515700111
Type	Unit process
Process name	**Recycling of steel**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Waste treatment allocation	Unspecified
Date	2009-05-07
Record	Åsa Moberg
Generator	
Literature references	
Collection method	
Comment	Approximation used for system expansion, taking into account the avoidance of primary pig iron as steel is recycled. Pig iron is used as avoided product and scrap iron is used as input from technosphere, as suggested in Eocinvent 2.0
Allocation rules	

Waste treatment

Recycling Pig iron/RER U incl benefits and costs	1,105	kg	Ferro metals	Recycling

Avoided products

Pig iron, at plant/GLO S	1	kg	

Resources

Materials/fuels

Iron scrap, at plant/RER S	1,105	kg	

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Waste treatment
Process identifier	Institut14515700122
Type	Unit process
Process name	**Recycling Silver**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Waste treatment allocation	Unspecified
Date	2009-05-07
Record	Åsa Moberg
Generator	
Literature references	
Collection method	
Comment	Approximation used for system expansion, taking into account the avoidance of primary silver as silver is recycled. As there was no information on the recycling efficiency, 1.105 was assumed based on the figure for steel and iron given in Ecoinvent 2.0.
Allocation rules	

Waste treatment

Recycling silver/RER U incl. benefits and costs	1,105	kg	Non-ferro	Recycling	No information on the recycling efficiency, 1.105 assumed based on the figure for steel and iron.

Avoided products

Silver, at regional storage/RER S	1	kg			

Resources

Materials/fuels

Silver, secondary, at precious metal refinery/SE S	1	kg	

Electricity/heat

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

Process

Category type	Waste treatment
Process identifier	Institut14515700117
Type	Unit process
Process name	**Recycling Steel, low alloyed**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Waste treatment allocation	Unspecified
Date	2009-05-07
Record	Åsa Moberg and Clara Borggren
Generator	
Literature references	
Collection method	Iron scrap-process is used as a rough estimation for handling Steel scrap. This process covers "collecting of new and old iron scrap, transport to scrap-yard, sorting and pressing to blocks". No information on further processing of primary steel as this may be similar to the processing of recycled steel.
Data treatment	
Verification	
Comment	
Allocation rules	
System description	

Waste treatment

Recycling steel, low alloyedRER U incl. benefits and costs	1,105	kg	Steel	Recycling

Avoided products

Pig iron, at plant/GLO S	1	kg	

Resources			
Materials/fuels			
Iron scrap, at plant/RER S	1,105	kg	
Electricity/heat			
Emissions to air			
Emissions to water			
Emissions to soil			
Final waste flows			
Non material emissions			
Social issues			
Economic issues			
Waste to treatment			

Process

Category type	Waste treatment
Process identifier	Institut14515700119
Type	Unit process
Process name	**Recycling Tin**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Waste treatment allocation	Unspecified
Date	2009-05-07
Record	
Generator	
Literature references	
Collection method	The mining and beneficiation of tin is avoided through recycling. No information on the recycling process. Iron scrap-process is used as a rough estimation for handling tin scrap. This process covers "collecting of new and old iron scrap, transport to scrap-yard, sorting and pressing to blocks". No information on further processing of primary tin as this may be similar to the processing of recycled tin.
Comment	
Allocation rules	

Waste treatment

Recycling tin/RER U incl. benefits and costs	1,105	kg	Non-ferro	Recycling

Avoided products

tin, at regional storage/kg/RER primary production avoided	1	kg	

Resources

Materials/fuels			
Iron scrap, at plant/RER S	1,105	kg	The handling of iron scrap is asssumed to be a possible estimation of handling tin scrap.
Electricity/heat			
Emissions to air			
Emissions to water			
Emissions to soil			
Final waste flows			
Non material emissions			
Social issues			
Economic issues			
Waste to treatment			

Process

Category type	Waste treatment
Process identifier	Institut14515700121
Type	Unit process
Process name	**Recycling Zink**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Waste treatment allocation	Unspecified
Date	2009-05-07
Record	Åsa Moberg
Generator	
Literature references	
Collection method	The mining and beneficiation of Zinc is avoided through recycling. No information on the recycling process. Iron scrap-process is used as a rough estimation for handling Zinc scrap. This process covers "collecting of new and old iron scrap, transport to scrap-yard, sorting and pressing to blocks". No information on further processing of primary zinc as this may be similar to the processing of recycled zinc.
Data treatment	
Verification	
Comment	
Allocation rules	
System description	

Waste treatment

Recycling Zink/RER U incl. benefits and costs	1,105	kg	Non-ferro	Recycling	No information on the recycling efficiency, 1.105 assumed based on the figure for steel and iron.

Avoided products

Zinc concentrate, at beneficiation/GLO S	1	kg	
Resources			
Materials/fuels			
Iron scrap, at plant/RER U	1,105	kg	Used as estimation for handling Zinc scrap
Electricity/heat			
Emissions to air			
Emissions to water			
Emissions to soil			
Final waste flows			
Non material emissions			
Social issues			
Economic issues			
Waste to treatment			

Process

Category type	Waste treatment
Process identifier	Institut14515700129
Type	Unit process
Process name	**Recycling of Polystyrene, incl benefits and costs**
Time period	Unspecified
Geography	Unspecified
Technology	Unspecified
Representativeness	Unspecified
Waste treatment allocation	Unspecified
Date	2007-12-11
Record	Åsa Moberg modified the process to include electricity used for recycling and the avoided prodcution of PS from virgin source (as sugggested in the original process sheet)
Generator	PRé Consultants, SH
Literature references	
Collection method	
Comment	Comment in original process: "This is an empty process because of the cut-off at recycling. The recycling benefit and costs are allocated to the production of the recycled PS. To include this benefit and cost the following data should be included: Polystyrene, expandable should be used as avoided product and 0,6 kWh electricity medium voltage should be used as input from technosphere. These are rough estimates and should not be used if recycling is important."
Allocation rules	

Waste treatment

Recycling PS/RER U incl benefits and costs	1	kg	PS	Recycling	0.9 efficiency as suggested for plastics recycling in BUWAL 250 (as presented in SimaPro)

Avoided products

Polystyrene, expandable, at plant/RER U	0,9	kg			

Resources

Materials/fuels

Electricity/heat

Electricity at grid, varied in book project	0,6	kWh	

Emissions to air

Emissions to water

Emissions to soil

Final waste flows

Non material emissions

Social issues

Economic issues

Waste to treatment

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