MDF

Environmental product declaration

UNILIN

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UNILIN

1. General

1.1 Company information / declaration owner

Manufacturer	UNILIN Group
Production Location	UNILIN Panels, Spanolux
Address	Rue de la Forêt 2, 6690 Vielsalm
E-mail	info@unilin.com
Website	www.unilin.com

1.2 EPD information

EPDs are not comparable when they are not created following the same method. This EPD was created following the method described below.

EPD for	MDF
Calculation number	EPD-NIBE-20210326-18330
Date of issue	14/12/2021
End of validity	14/12/2026
Version NIBE's EPD Application	v2.0
Version Environmental Profile database	v3.04 (2021-07-06)
PCR	NMD Determination method Environmental performance Construction works v1.0 July 2020

1.3 Scope of declaration

This is a cradle to grave with options EPD. The life cycle stages included are as shown below:

A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X	X

X = included MND = module not declared

Module A1 = Raw material supply	Module B2 = Maintenance	Module C1 = De-construction / Demolition
Module A2 = Transport	Module B3 = Repair	Module C2 = Transport
Module A3 = Manufacturing	Module B4 = Replacement	Module C3 = Waste Processing
Module A4 = Transport	Module B5 = Refurbishment	Module C4 = Final Disposal
Module A5 = Installation process	Module B6 = Operational energy use	Module D = Benefits and loads beyond the system boundaries
Module B1 = Emissions during use stage	Module B7 = Operational water use	

1.4 Verification of the declaration

CEN standard EN 15804+A2 serves as the core PCR. In compliance with ISO 14040:2006 and 14044:2006.
EPDs of construction products may not be comparable if they do not comply with NEN-EN15804 and additional PCR.

Independent verification of the declaration according to EN ISO 14025:2006.

☐ Internal ☑ External, by A.K. Jeeninga (Advieslab v.o.f.)

2. Product

2.1 Product description

General product description
Medium-density fibreboard (MDF) is a wood based panel that is produced from wood fibres. The board consists of a mix of wood fibres of different species that are bonded together by a thermohardening glue. The board is a single layer product with a homogeneous, fine core and surface layers that are densified to get the right surface quality.

Applications
MDF is often used as a base material in the furniture industry (kitchen, bathroom furniture, interior finishing) and for internal decoration. The surface allows many different types of coatings and surface finishes to be applied. The board is especially suited for applications where a fine core structure is needed.

Composition
Typical composition:

- 80-84 % wood: a mixture of hardwood and softwood fibres.
- 8-12 % binder: mainly (melamine) ureum formaldehyde glue.
- 4-8 % water.
- <2 % additives: wax, hardeners, ...

The carbon content of the panels equals about 44 %: 41 % biogenic carbon contained in the wood chips and 3 % fossil carbon contained in the binder. The wood is of course biobased, so the biobased content equals 80-84 %. This means that the panels store about 1009 kg atmospheric CO_2 (EN 16449:2014). The background datasets used to calculate the carbon footprint reported in this EPD assume that only 1100 kg atmospheric CO_2 is stored in the used wood, so this flow is slightly overestimated in the biogenic global warming potential results (GWP-b).

The panels are available with PEFC or FSC sustainable wood certificates.

Dimensions
Available from stock in various finishes, thicknesses and dimensions. Consult the complete UNILIN Panels stock range at www.unilinpanels.com. For our technical capabilities on custom thicknesses and dimensions, as well as minimum order requirements, please contact our sales team or email info.panels@unilin.com.

Technical properties

- Gross density: 600-730 kg/m^3.
- Moisture content: 4-8 %.

The EPD calculations were based on a density of 663 kg/m^3. Panels with different densities will yield slightly different results. E.g. transport impacts will be higher when opting for panels with higher densities and vice versa. The impact of different variants can be approximated assuming a linear relation between density and impact results.

Technical characteristics vary by product variant and thickness. For more detailed information, please consult our website: www.unilinpanels.com.

2.2 Description of the manufacturing process

Production

Manufacturing process

1. Round wood (logs and chips) are collected to produce MDF.
2. The bark is removed from the roundwood logs.
3. The logs are chopped to woodchips.
4. Woodchips from different species of wood are mixed and boiled.
5. The boiled woodchips are defibrated under high pressure in a refiner and then glue is applied.
6. The glued fibres are dried and a single layer fibremat is formed.
7. This fibremat is introduced in a press that compresses the mat under high pressure and temperature. In this way a board is fabricated.
8. The board is sanded, cut into panels and finished depending on the intended application.

Input and output data

2019 year total energy and material data were collected at the MDF plant in 2020 based on officially reported numbers and interviews with topic specialists.

The glue factory, Dynea, was taken into account based on 2020 data provided by the site manager and HSE manager. The impact of the different glue recipes was based on the ingredient lists of the individual recipes.

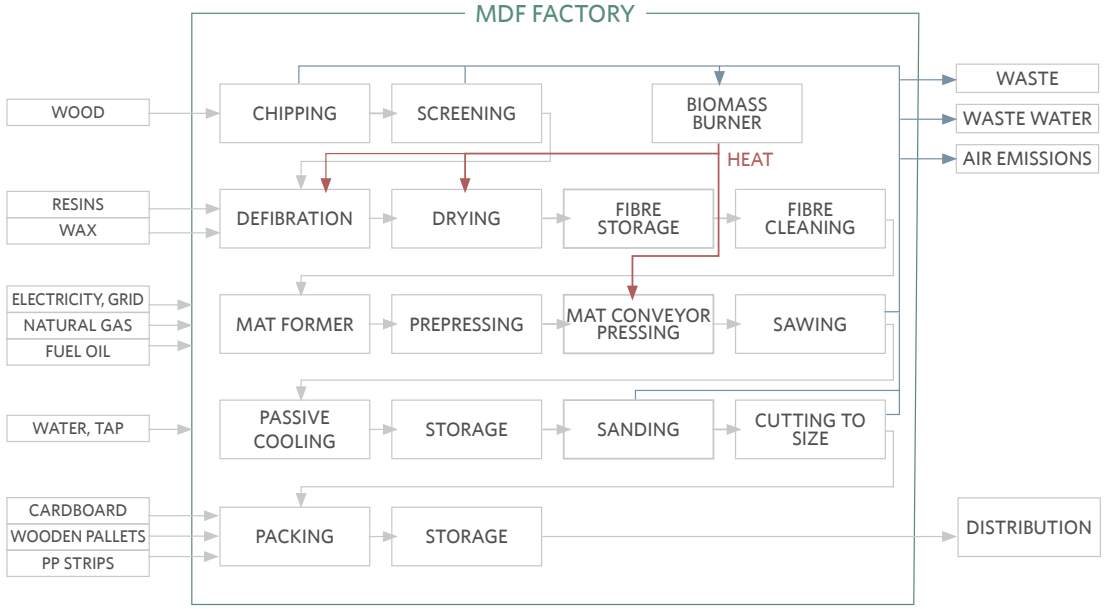
Moisture contents of in- and output streams are regularly measured. Intermediate moisture contents were estimated based on expert opinion, for as far as relevant for the calculations.

Energy consumption

The MDF plant covers about half of its energy needs by producing heat from waste wood streams produced on-site. The remaining energy needs are met using Belgian grid power and, to a much smaller extent, fuel oil and natural gas.

Production waste

Production waste is taken into account based on the year total waste data from the plant. Most of the production waste consists out of woody waste streams that are incinerated onsite for energy recovery. The burned wood waste streams function as an energy source, so they are included in the energy production models. They are not reported as part of the waste streams to avoid double counting.



Contruction

MDF panels are mostly used in the furniture and interior sectors. Before application, the panels are typically cut to size and possibly covered by a surface finishing coating, melamine or HPL layer.

Transport to the construction stage consists the following:

Transport conveyance	Distance	Weight x distance
Lorry (Truck), unspecified (default)	267 km	175.73 tkm

3. Calculation rules

3.1 Declared unit

m^3 MDF
One cubic meter of MDF panels. This FU is chosen to allow the EPD user to calculate the impact of the chipboard thickness of their choice as the panels are available in many different thicknesses.

3.2 Environmental profile and representativeness

The input data are representative for MDF, a product of UNILIN Group. The data are representative for Netherlands.

3.3 Cut-off criteria

Product Stage (A1-A3)
The production stage consists of the extraction of raw materials, transportation of the raw materials, processing the raw materials into materials and the production of the product. The required energy for production, ancillary materials, and production emissions are included. Energy and material in- and output data were collected at the UNILIN MDF factory (Spanolux) and the UNILIN glue factory (Dynea).

Construction process stage (A4-A5)
This stage consists the transport of the product from production plant to the construction site.

It also includes the loss of material during construction. The additional needed production, transport and end-of-life of the lost material during construction is included.

The end-of-life of packaging material up to the end-of-waste state or disposal of final residues is also included.

The installation of the product including manufacture, transportation and end-of-life of ancillary materials and any energy or water use required for installation or operation of the construction site are taken into account.

Use stage (B1-B3)
This stage consists of the impacts arising from components of the building and construction works during their use.

The stage also covers the combination of all planned technical and associated administrative maintenance actions during the service life to maintain the product installed in a building, in a construction works or its parts in a state in which it can perform its required functional and technical performance, as well as preserve the aesthetic qualities of the product. This will include preventative and regular maintenance activities.

Product replacement (B4) and renovation (B5) only apply when the product is considered in a lifespan (of a building, work , etc.).

Operational water and energy use are not considered.

End of life stage (C1-C4)
When the end of the life stage of the building is reached, the de-construction/demolition begins. This EPD includes de-construction/ demolition (C1), the necessary transport (C2) from the demolition site to the sorting location and distance to final disposal. The end of life stage includes the final disposal to landfill (C4), incineration (C3) and needed recycling processes up to the end-of-waste point (C3). Loads and benefits of recycling, re-use and exported energy are part of module D.

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The default end-of-life scenarios of the annex (november 2020) to the NMD Determination method v1.0 have been used for the various materials in the product

Benefits and Loads beyond the system boundary (Module D)
This stage contains the potential loads and benefits of recycling and re-use of raw materials/products. The loads contain the needed recycling processes from end-of-wastepoint up to the point-of-equivalence of the substituted primary raw material and a load for secondary material that will be lost at the end-of-life stage.

The loads and benefits of recycling and reuse are included in this module. The benefits are calculated based on the primary content and the primary equivalent.

In addition, the benefits of energy recovery are granted at this stage. The amount of avoided energy is based on the Lower Heating Values of the materials and the efficiencies of the incinerators as mentioned in the NMD Determination method v1.0 or EcoInvent 3.5 (2018).

3.4 Allocation

There is no allocation applied for the environmental profiles / datasets used in this LCA.

3.5 Source of background data

Description	Shortened name in application	Processes used	Source	Thirdparty verified	Comments
Raw material(s)					
1 m^3 MDF (excluding glue)					
Wood, from logs	Pulpwood, Pine, measured as solid wood under bark (490kg/m^3), SFM (DE)	1/490m^3 Pulpwood, softwood, measured as solid wood under bark {DE}| softwood forestry, pine, sustainable forest management | Cut-off, U	EcoInvent 3.6 (2019)	no	SimaPro process is per m^3. A density of 490kg/m^3 (dry wood density as stated in the EcoInvent dataset) is used to calculate the environmental profile for 1 kg.
Wood, from chips	Pulpwood, Pine, measured as solid wood under bark (490kg/m^3), SFM (DE)	1/490m^3 Pulpwood, softwood, measured as solid wood under bark {DE}| softwood forestry, pine, sustainable forest management | Cut-off, U	EcoInvent 3.6 (2019)	no	SimaPro process is per m^3. A density of 490kg/m^3 (dry wood density as stated in the EcoInvent dataset) is used to calculate the environmental profile for 1 kg.
Wax/paraffins	Paraffin | production (EU)	Paraffin {RER}| production | Cutoff, U	EcoInvent 3.6 (2019)	no	

Description	Shortened name in application	Processes used	Source	Thirdparty verified	Comments
38.7 kg UMF 10% (11G325)					
Methanol	Methanol | market for (GLO)	Methanol {GLO}| market for | Cut-off, U	EcoInvent 3.6 (2019)	no	
Urea	Urea, as N | production (EU)	Urea, as N {RER}| production | Cut-off, U	EcoInvent 3.5 (2018)	no	Dataset withholds 2,17kg Urea, because it's measured as N. The weight Unilin measures is kg Urea not N.
Melamine	Melamine | production (EU)	Melamine {RER}| production | Cut-off, U	NIBE/EcoInvent 3.6 (2019)	no	
Acetic Acid 40%, active matter	Acetic acid, without water, in 98% solution state | market for (GLO)	Acetic acid, without water, in 98% solution state {GLO}| market for | Cut-off, U	EcoInvent 3.5 (2018)	no	
Sodium hydroxide 25%, active matter	Sodium hydroxide, without water, in 50% solution state | market for (GLO)	Sodium hydroxide, without water, in 50% solution state {GLO}| market for | Cut-off, U	EcoInvent 3.5 (2018)	no	
Sodium acetate	NIBE Sodium acetate | market for (GLO)	NIBE Sodium acetate {GLO} | market for	EcoInvent 3.5 (2018)	no	Industrially made sodium acetate trihydrate is prepared by reacting acetic acid with sodium hydroxide using water as the solvent. Based on the mol mass of acetic acid and sodium hydroxide a combined process is modelled. The process contains 23/82 sodium hydroxide and 60/82 acetic acid.
Water	Water - Tap water	Tap water {RER}| market group for | Cut-off, U	EcoInvent 3.6 (2019)	no	
38.7 kg UMF 10% (11G325)					
Methanol	Methanol | market for (GLO)	Methanol {GLO}| market for | Cut-off, U	EcoInvent 3.5 (2018)	no	
Urea	Urea, as N | production (EU)	Urea, as N {RER}| production | Cut-off, U	EcoInvent 3.5 (2018)	no	
Melamine	Melamine | production (EU)	Melamine {RER}| production | Cut-off, U	NIBE/EcoInvent 3.6 (2019)	no	
Acetic Acid 40%, active matter	Acetic acid, without water, in 98% solution state | market for (GLO)	Acetic acid, without water, in 98% solution state {GLO}| market for | Cut-off, U	EcoInvent 3.5 (2018)	no	

Description	Shortened name in application	Processes used	Source	Thirdparty verified	Comments
Sodium hydroxide 25%, active matter	Sodium hydroxide, without water, in 50% solution state | market for (GLO)	Sodium hydroxide, without water, in 50% solution state {GLO}| market for | Cut-off, U	EcoInvent 3.5 (2018)	no	
Sodium acetate	NIBE Sodium acetate | market for (GLO)	NIBE Sodium acetate {GLO} | market for	EcoInvent 3.5 (2018)	no	Industrially made sodium acetate trihydrate is prepared by reacting acetic acid with sodium hydroxide using water as the solvent. Based on the mol mass of acetic acid and sodium hydroxide a combined process is modelled. The process contains 23/82 sodium hydroxide and 60/82 acetic acid.
Water	Water - Tap water	Tap water {RER}| market group for | Cut-off, U	EcoInvent 3.6 (2019)	no	
0.3 kg F**** 15% (11H331)					
Methanol	Methanol | market for (GLO)	Methanol {GLO}| market for | Cut-off, U	EcoInvent 3.5 (2018)	no	
Urea	Urea, as N | production (EU)	Urea, as N {RER}| production | Cut-off, U	EcoInvent 3.5 (2018)	no	Dataset withholds 2,17kg Urea, because it's measured as N. The weight Unilin measures is kg Urea not N.
Melamine	Melamine | production (EU)	Melamine {RER}| production | Cut-off, U	NIBE/EcoInvent 3.6 (2019)	no	
Acetic Acid 40%, active matter	Acetic acid, without water, in 98% solution state | market for (GLO)	Acetic acid, without water, in 98% solution state {GLO}| market for | Cut-off, U	EcoInvent 3.5 (2018)	no	
Sodium acetate	NIBE Sodium acetate | market for (GLO)	NIBE Sodium acetate {GLO} | market for	EcoInvent 3.5 (2018)	no	Industrially made sodium acetate trihydrate is prepared by reacting acetic acid with sodium hydroxide using water as the solvent. Based on the mol mass of acetic acid and sodium hydroxide a combined process is modelled. The process contains 23/82 sodium hydroxide and 60/82 acetic acid.
Water	Water - Tap water	Tap water {RER}| market group for | Cut-off, U	EcoInvent 3.6 (2019)	no	

Description	Shortened name in application	Processes used	Source	Thirdparty verified	Comments
Ancillary material(s)					
1 m^3 MDF (excluding glue)					
Vaporised moisture content from logs	Vaporised moisture/water content	Empty processs, onbehalve of calculating A2	n.a.	no	
Vaporised moisture content from glue	Vaporised moisture/water content	Empty processs, onbehalve of calculating A2	n.a.	no	
Tap water	Water - Tap water	Tap water {RER}| market group for | Cut-off, U	EcoInvent 3.6 (2019)	no	
Factory	Wooden board factory, organic bonded boards | construction (EU)	Wooden board factory, organic bonded boards {RER}| construction | Cut-off, U	EcoInvent 3.5 (2018)	no	
Lubricating and other mineral oils	Lubricating oil | production (EU)	Lubricating oil {RER}| production | Cut-off, U	EcoInvent 3.6 (2019)	no	
38.7 kg UMF 10% (11G325)					
Glue factory	Chemical factory, organics | construction (EU)	1p Chemical factory, organics {RER}| construction | Cut-off, U	EcoInvent 3.6 (2019)	no	
47.8 kg UF-E1 0% (11F350)					
Glue factory	Chemical factory, organics | construction (EU)	1p Chemical factory, organics {RER}| construction | Cut-off, U	EcoInvent 3.6 (2019)	no	
0.3 kg F**** 15% (11H331)					
Glue factory	Chemical factory, organics | construction (EU)	1p Chemical factory, organics {RER}| construction | Cut-off, U	EcoInvent 3.6 (2019)	no	

Description	Shortened name in application	Processes used	Source	Thirdparty verified	Comments
Energy use					
1 m^3 MDF (excluding glue)					
Heat from biomass	Heat, district or industrial, other than natural gas (BE)| heat and power cogeneration, wood chips, 6667 kW, state-of-the-art 2014	Heat, district or industrial, other than natural gas {BE}| heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014 | Cut-off, U	EcoInvent 3.5 (2018)	no	
Electricity	Electricity (BE) - medium voltage (1kV - 24kV)	Electricity, medium voltage {BE}| market for | Cut-off, U	EcoInvent 3.6 (2019)	no	
Natural gas	Gas, natural gas (incl. emissions)	NIBE 1m3 Heat, district or industrial, natural gas {Europe without Switzerland}| heat production, natural gas, at industrial furnace >100kW | Cutoff, U	EcoInvent 3.6 (2019)	no	
Fuel oil	Diesel, burned in machine (incl. emissions)	0095-pro&Diesel, gasolie, gebruik, liter (o.b.v. 35,8 MJ Diesel, burned in building machine {GLO}| processing | Cutoff, U)	NMD/EcoInvent 3.6 (2019)	no	The combustion emissions of diesel are included in the environmental profile.
38.7 kg UMF 10% (11G325)					
Heat (light fuel oil)	Heat production, light fuel oil, at boiler 10kW, nonmodulating (EU)	Heat, central or small-scale, other than natural gas {Europe without Switzerland}| heat production, light fuel oil, at boiler 10kW, non-modulating | Cut-off, U	EcoInvent 3.5 (2018)	no	The fuel oil can be used for several purposes, therefore the ' heat production, light fuel oil, at boiler 10kW, non-modulating' is used. Of the light fuel, at boiler process this is the 'worst case' option. The process is per MJ and Unilin has their amount available in liters. A conversion is needed; the process contains an input of 0,0249kg light fuel oil, and a density of 0,86kg/l is assumed. So 1 liter equals 1 / (0,0249/0,86) = 34,54 MJ.
Electricity	Electricity (BE) - medium voltage (1kV - 24kV)	Electricity, medium voltage {BE}| market for | Cut-off, U	EcoInvent 3.6 (2019)	no	

Description	Shortened name in application	Processes used	Source	Thirdparty verified	Comments
47.8 kg UF-E1 0% (11F350)					
Heat (light fuel oil)	Heat production, light fuel oil, at boiler 10kW, nonmodulating (EU)	Heat, central or small-scale, other than natural gas {Europe without Switzerland}| heat production, light fuel oil, at boiler 10kW, non-modulating | Cut-off, U	EcoInvent 3.5 (2018)	no	The fuel oil can be used for several purposes, therefore the ' heat production, light fuel oil, at boiler 10kW, non-modulating' is used. Of the light fuel, at boiler process this is the 'worst case' option. The process is per MJ and Unilin has their amount available in liters. A conversion is needed; the process contains an input of 0,0249kg light fuel oil, and a density of 0,86kg/l is assumed. So 1 liter equals 1 / (0,0249/0,86) = 34,54 MJ.
Electricity	Electricity (BE) - medium voltage (1kV - 24kV)	Electricity, medium voltage {BE}| market for | Cut-off, U	EcoInvent 3.6 (2019)	no	
0.3 kg F**** 15% (11H331)					
Heat (light fuel oil)	Heat production, light fuel oil, at boiler 10kW, nonmodulating (EU)	Heat, central or small-scale, other than natural gas {Europe without Switzerland}| heat production, light fuel oil, at boiler 10kW, non-modulating | Cut-off, U	EcoInvent 3.5 (2018)	no	The fuel oil can be used for several purposes, therefore the ' heat production, light fuel oil, at boiler 10kW, non-modulating' is used. Of the light fuel, at boiler process this is the 'worst case' option. The process is per MJ and Unilin has their amount available in liters. A conversion is needed; the process contains an input of 0,0249kg light fuel oil, and a density of 0,86kg/l is assumed. So 1 liter equals 1 / (0,0249/0,86) = 34,54 MJ.
Electricity	Electricity (BE) - medium voltage (1kV - 24kV)	Electricity, medium voltage {BE}| market for | Cut-off, U	EcoInvent 3.6 (2019)	no	

Packaging material(s)

1 m^3 MDF (excluding glue)					
Cardboard	Corrugated board, mixed fibres, single wall | market for (GLO)	Corrugated board box {GLO}| market for corrugated board box | Cut-off, U	EcoInvent 3.6 (2019)	no	
Wooden pallets	EUR-flat pallet | production (EU)	1p EUR-flat pallet {RER}| production | Cut-off, U	EcoInvent 3.6 (2019)	no	

Description	Shortened name in application	Processes used	Source	Thirdparty verified	Comments
Plastic strips	Polypropylene (PP), woven | Production (EU)	NIBE - Polypropylene (PP), woven	NIBE/EcoInvent 3.6 (2019)	no	The material itself is Polypropylene, granulate {RER}| production. For the drawing of polyester threads, the process extrusion foil is considered the most representative. For the weaving process, Weaving bast fibre has been used.
38.7 kg UMF 10% (11G325)					
47.8 kg UF-E1 0% (11F350)					
0.3 kg F**** 15% (11H331)					
Production emissions					
1 m^3 MDF (excluding glue)					
Formaldehyde	Emission to Air - Formaldehyde	characterisation factor of the substance per impact categorie	characterisation method	no	
38.7 kg UMF 10% (11G325)					
CO_2 from CO oxidation	Emission to Air - Carbon dioxide, fossil	characterisation factor of the substance per impact categorie	characterisation method	no	
Methanol	Emission to Air - Methanol	characterisation factor of the substance per impact categorie	characterisation method	no	
Dimethylether	Emission to Air - Dimethyl ether	characterisation factor of the substance per impact categorie	characterisation method	no	
Formaldehyde	Emission to Air - Formaldehyde	characterisation factor of the substance per impact categorie	characterisation method	no	
47.8 kg UF-E1 0% (11F350)					
CO_2 from CO oxidation	Emission to Air - Carbon dioxide, fossil	characterisation factor of the substance per impact categorie	characterisation method		
Methanol	Emission to Air - Methanol	characterisation factor of the substance per impact categorie	characterisation method	no	

Description	Shortened name in application	Processes used	Source	Thirdparty verified	Comments
Dimethylether	Emission to Air - Dimethyl ether	characterisation factor of the substance per impact categorie	characterisation method	no	
Formaldehyde	Emission to Air - Formaldehyde	characterisation factor of the substance per impact categorie	characterisation method	no	
0.3 kg F**** 15% (11H331)					
CO_2 from CO oxidation	Emission to Air - Carbon dioxide, fossil	characterisation factor of the substance per impact categorie	characterisation method		
Methanol	Emission to Air - Methanol	characterisation factor of the substance per impact categorie	characterisation method	no	
Dimethylether	Emission to Air - Dimethyl ether	characterisation factor of the substance per impact categorie	characterisation method	no	
Formaldehyde	Emission to Air - Formaldehyde	characterisation factor of the substance per impact categorie	characterisation method	no	

4. Results

4.1 Declared unit

Impact category	Unit	Total amount
Depletion of abiotic resources-elements	kg Sb	2.06E-3
Depletion of abiotic resources-fossil fuels	kg Sb	1.60E+0
Global warming	kg CO_2 Equiv.	1.71E+2
Ozone layer depletion	kg CFC-11 Equiv.	3.14E-5
Photochemical oxidants creation	kg Ethene Equiv.	1.45E-1
Acidification of soil and water	kg SO2 Equiv.	2.24E-1
Eutrophication	kg PO43- Equiv.	-2.12E-2
Human toxicity	kg 1.4 DB	3.78E+1
Ecotoxicity. fresh water	kg 1.4 DB	3.09E+0
Ecotoxicity. marine water (MAETP)	kg 1.4 DB	6.28E+3
Ecotoxicity. terrestric	kg 1.4 DB	3.36E-1
Acidification (AP)	mol H+ eqv.	1.82E-1
Global warming potential (GWP-total)	kg CO_2 eqv.	8.01E+1
Global warming potential - Biogenic (GWP-b)	kg CO_2 eqv.	-9.20E+1
Global warming potential - Fossil (GWP-f)	kg CO_2 eqv.	1.71E+2
Global warming potential - Land use and land use change (GWP-luluc)	kg CO_2 eqv.	9.51E-1
Ecotoxicity, freshwater (ETP-fw)	CTUe	-6.95E+3
Particulate Matter (PM)	disease incidence	1.55E-6
Eutrophication marine (EP-m)	kg N eqv.	1.20E-2
Eutrophication, freshwater (EP-fw)	kg P eqv.	8.95E-3

Impact category	Unit	Total amount
Eutrophication, terrestrial (EP-T)	mol N eqv.	-6.57E-1
Human toxicity, cancer (HTP-c)	CTUh	2.31E-6
Human toxicity, non-cancer (HTP-nc)	CTUh	-8.28E-7
Ionising radiation, human health (IR)	kBq U235 eqv.	2.88E+1
Land use (SQP)	Pt	3.24E+4
Ozone depletion (ODP)	kg CFC 11 eqv.	3.16E-5
Photochemical ozone formation - human health (POCP)	kg NMVOC eqv.	3.53E-1
Resource use, fossils (ADP-f)	MJ	4.57E+3
Resource use, minerals and metals (ADP-mm)	kg Sb-eqv.	2.06E-3
Water use (WDP)	m^3 world eqv.	1.84E+2

Parameter	Unit	A1	A2	A3
Renewable primary energy ex. raw materials	MJ	1.24E+4	9.98E-1	7.74E+2
Renewable primary energy used as raw materials	MJ	8.57E+3	0.00E+0	2.31E+1
Renewable primary energy total	MJ	1.24E+4	9.98E-1	7.74E+2
Non-renewable primary energy ex. raw materials	MJ	1.88E+3	8.47E+1	2.34E+3
Non-renewable primary energy used as raw materials	MJ	2.89E+2	0.00E+0	3.69E+1
Non-renewable primary energy total	MJ	2.10E+3	8.47E+1	2.34E+3
Use of secondary material	kg	0.00E+0	0.00E+0	0.00E+0
Use of renewable secondary fuels	MJ	0.00E+0	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	MJ	0.00E+0	0.00E+0	0.00E+0
Use of net fresh water	M^3	3.20E+0	9.71E-3	6.57E-1
Hazardous waste disposed	kg	3.31E-3	2.02E-4	2.18E-3
Non hazardous waste disposed	kg	6.06E+0	5.06E+0	9.97E+0

Parameter	Unit	A1	A2	A3
Radioactive waste disposed	kg	4.69E-3	5.24E-4	2.04E-2
Components for re-use	kg	0.00E+0	0.00E+0	0.00E+0
Materials for recycling	kg	0.00E+0	0.00E+0	1.86E-1
Materials for energy recovery	kg	0.00E+0	0.00E+0	0.00E+0
Exported energy	MJ	0.00E+0	0.00E+0	1.14E+1
Exported Energy Thermic	MJ	0.00E+0	0.00E+0	7.23E+0
Exported Energy Electric	MJ	0.00E+0	0.00E+0	4.20E+0

4.2 Product stage (A1 - 3)

- A1. raw material extraction and processing. processing of secondary material input (e.g. recycling processes
- A2. transport to the manufacturer
- A3. manufacturing

Impact category	Unit	A1	A2	A3
Depletion of abiotic resources-elements	kg Sb	9.11E-4	1.34E-4	5.56E-4
Depletion of abiotic resources-fossil fuels	kg Sb	9.87E-1	3.85E-2	4.46E-1
Global warming	kg CO_2 Equiv.	8.40E+1	5.24E+0	6.65E+1
Ozone layer depletion	kg CFC-11 Equiv.	1.45E-5	9.30E-	7 1.75E-5
Photochemical oxidants creation	kg Ethene Equiv.	1.67E-1	3.16E-3	3.06E-2
Acidification of soil and water	kg SO2 Equiv.	4.00E-1	2.30E-2	1.83E-1
Eutrophication	kg PO43- Equiv.	9.21E-2	4.53E-3	3.94E-2
Human toxicity	kg 1.4 DB	4.11E+1	2.21E+0	2.14E+1
Ecotoxicity. fresh water	kg 1.4 DB	2.55E+0	6.44E-2	5.25E-1
Ecotoxicity. marine water (MAETP)	kg 1.4 DB	4.36E+3	2.32E+2	1.21E+3

Impact category	Unit	A1	A2	A3
Ecotoxicity. terrestric	kg 1.4 DB	3.92E-1	7.80E-3	2.31E-1
Acidification (AP)	mol H+ eqv.	5.52E-1	3.07E-2	2.50E-1
Global warming potential (GWP-total)	kg CO_2 eqv.	-1.01E+3	5.29E+0	5.78E+1
Global warming potential - Biogenic (GWP-b)	kg CO_2 eqv.	-1.10E+3	2.44E-3	-9.61E+0
Global warming potential - Fossil (GWP-f)	kg CO_2 eqv.	8.56E+1	5.29E+0	6.72E+1
Global warming potential - Land use and land use change (GWP-luluc)	kg CO_2 eqv.	1.13E+0	1.94E-3	1.59E-1
Ecotoxicity, freshwater (ETP-fw)	CTUe	1.12E+3	7.11E+1	1.45E+3
Particulate Matter (PM)	disease incidence	8.10E-6	4.76E-7	2.87E-6
Eutrophication marine (EP-m)	kg N eqv.	8.17E-2	1.08E-2	6.80E-2
Eutrophication, freshwater (EP-fw)	kg P eqv.	9.68E-3	5.33E-5	1.83E-3
Eutrophication, terrestrial (EP-T)	mol N eqv.	1.59E+0	1.19E-1	8.99E-1
Human toxicity, cancer (HTP-c)	CTUh	6.15E-8	2.31E-9	9.48E-8
Human toxicity, non-cancer (HTP-nc)	CTUh	1.45E-6	7.78E-8	8.20E-7
Ionising radiation, human health (IR)	kBq U235 eqv.	3.46E+0	3.34E-1	2.35E+1
Land use (SQP)	Pt	6.98E+4	6.91E+1	3.87E+3
Ozone depletion (ODP)	kg CFC 11 eqv.	1.73E-5	1.17E-6	1.31E-5
Photochemical ozone formation - human health (POCP)	kg NMVOC eqv.	4.93E-1	3.40E-2	2.20E-1
Resource use, fossils (ADP-f)	MJ	1.93E+3	7.97E+1	2.26E+3
Resource use, minerals and metals (ADP-mm)	kg Sb-eqv.	9.11E-4	1.34E-4	5.56E-4
Water use (WDP)	m^3 world eqv.	1.34E+2	2.85E-1	2.18E+1

Parameter	Unit	A1	A2	A3
Renewable primary energy ex. Raw materials	MJ	1.24E+4	9.98E-1	7.74E+2
Renewable primary energy used as raw materials	MJ	8.57E+3	0.00E+0	2.31E+1
Renewable primary energy total	MJ	1.24E+4	9.98E-1	7.74E+2
Non-renewable primary energy ex. Raw materials	MJ	1.88E+3	8.47E+1	2.34E+3
Non-renewable primary energy used as raw materials	MJ	2.89E+2	0.00E+0	3.69E+1
Non-renewable primary energy total	MJ	2.10E+3	8.47E+1	2.34E+3
Use of secondary material	kg	0.00E+0	0.00E+0	0.00E+0
Use of renewable secondary fuels	MJ	0.00E+0	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	MJ	0.00E+0	0.00E+0	0.00E+0
Use of net fresh water	M^3	3.20E+0	9.71E-3	6.57E-1
Hazardous waste disposed	kg	3.31E-3	2.02E-4	2.18E-3
Non hazardous waste disposed	kg	6.06E+0	5.06E+0	9.97E+0
Radioactive waste disposed	kg	4.69E-3	5.24E-4	2.04E-2
Components for re-use	kg	0.00E+0	0.00E+0	0.00E+0
Materials for recycling	kg	0.00E+0	0.00E+0	1.86E-1
Materials for energy recovery	kg	0.00E+0	0.00E+0	0.00E+0
Exported energy	MJ	0.00E+0	0.00E+0	1.14E+1
Exported energy thermic	MJ	0.00E+0	0.00E+0	7.23E+0
Exported energy electric	MJ	0.00E+0	0.00E+0	4.20E+0

4.3 Construction process stage (A4 - 5)

- A4. transport to the building site
- A5. installation into the building

Impact category	Unit	A4	A5
Depletion of abiotic resources-elements	kg Sb	6.01E-4	8.73E-5
Depletion of abiotic resources-fossil fuels	kg Sb	1.73E-1	5.66E-2
Global warming	kg CO_2 Equiv.	2.35E+1	7.66E+0
Ozone layer depletion	kg CFC-11 Equiv.	4.17E-6	1.31E-6
Photochemical oxidants creation	kg Ethene Equiv.	1.42E-2	7.72E-3
Acidification of soil and water	kg SO2 Equiv.	1.03E-1	2.91E-2
Eutrophication	kg PO43- Equiv.	2.03E-2	6.47E-3
Human toxicity	kg 1.4 DB	9.90E+0	3.10E+0
Ecotoxicity. fresh water	kg 1.4 DB	2.89E-1 1.	38E-1
Ecotoxicity. marine water (MAETP)	kg 1.4 DB	1.04E+3	2.65E+2
Ecotoxicity. terrestric	kg 1.4 DB	3.50E-2	2.18E-2
Acidification (AP)	mol H+ eqv.	1.38E-1	4.00E-2
Global warming potential (GWP-total)	kg CO_2 eqv.	2.37E+1	5.39E+0
Global warming potential - Biogenic (GWP-b)	kg CO_2 eqv.	1.09E-2	-2.33E+0
Global warming potential - Fossil (GWP-f)	kg CO_2 eqv.	2.37E+1	7.68E+0
Global warming potential - Land use and land use change (GWP-luluc)	kg CO_2 eqv.	8.69E-3	3.95E-2
Ecotoxicity, freshwater (ETP-fw)	CTUe	3.19E+2	1.21E+2
Particulate Matter (PM)	disease incidence	2.13E-6	5.29E-7
Eutrophication marine (EP-m)	kg N eqv.	4.85E-2	1.07E-2

Impact category	Unit	A4	A5
Eutrophication, freshwater (EP-fw)	kg P eqv.	2.39E-4	3.74E-4
Eutrophication, terrestrial (EP-T)	mol N eqv.	5.34E-1	1.44E-1
Human toxicity, cancer (HTP-c)	CTUh	1.03E-8	7.42E-8
Human toxicity, non-cancer (HTP-nc)	CTUh	3.49E-7	1.15E-7
Ionising radiation, human health (IR)	kBq U235 eqv.	1.50E+0	9.24E-1
Land use (SQP)	Pt	3.10E+2	2.24E+3
Ozone depletion (ODP)	kg CFC 11 eqv.	5.23E-6	1.34E-6
Photochemical ozone formation - human health (POCP)	kg NMVOC eqv.	1.53E-1	4.04E-2
Resource use, fossils (ADP-f)	MJ	3.58E+2	1.54E+2
Resource use, minerals and metals (ADP-mm)	kg Sb-eqv.	6.01E-4	8.73E-5
Water use (WDP)	m^3 world eqv.	1.28E+0	5.61E+0

Parameter	Unit	A4	A5
Renewable primary energy ex. Raw materials	MJ	4.48E+0	3.98E+2
Renewable primary energy used as raw materials	MJ	0.00E+0	2.58E+2
Renewable primary energy total	MJ	4.48E+0	3.98E+2
Non-renewable primary energy ex. Raw materials	MJ	3.80E+2	1.56E+2
Non-renewable primary energy used as raw materials	MJ	0.00E+0	9.79E+0
Non-renewable primary energy total	MJ	3.80E+2	1.63E+2
Use of secondary material	kg	0.00E+0	0.00E+0
Use of renewable secondary fuels	MJ	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	MJ	0.00E+0	0.00E+0

Parameter	Unit	A4	A5
Use of net fresh water	M^3	4.36E-2	1.29E-1
Hazardous waste disposed	kg	9.06E-4	2.40E-4
Non hazardous waste disposed	kg	2.27E+1	3.31E+0
Radioactive waste disposed	kg	2.35E-3	9.27E-4
Components for re-use	kg	0.00E+0	0.00E+0
Materials for recycling	kg	0.00E+0	2.12E+0
Materials for energy recovery	kg	0.00E+0	0.00E+0
Exported energy	MJ	0.00E+0	0.00E+0
Exported energy thermic	MJ	0.00E+0	0.00E+0
Exported energy electric	MJ	0.00E+0	0.00E+0

A4. transport to the building site

Parameter	Unit / functional unit
Fuel type and consumption of vehicle – or – vehicle type used for transport	not available Lorry (Truck), unspecified (default)
Distance	267 km
Capacity utilisation (including empty returns)	50 % (loaded up and return empty)
Bulk density of transported products	inapplicable
Volume capacity utilisation factor	1

A5. installation of the product in the building

Parameter	Unit / functional unit
Ancillary materials, water use and energy use for installation	
Waste materials on the building site before waste processing generated by the product's installation	- 0.871 kg | Cardboard - 0.2 p | Wooden pallets - 0.541 kg | Plastic strips
Bulk density of transported products	3% of MDF

4.4 Use stage (B1 - 7)

- B1. use or application of the installed product (m.n.d.)
- B2. maintenance (m.n.d.)
- B3. repair (m.n.d.)
- B4. replacement (m.n.d.)
- B5. refurbishment (m.n.d.)
- B6. operational energy use (m.n.d.)
- B7. operational water use (m.n.d.)

Reference Service Life

Parameter	RSL
Product: MDF	50 years
Methanol | Methanol | market for (GLO)	100 years
Urea | Urea, as N | production (EU)	100 years
Melamine | Melamine | production (EU)	100 years
Wood, from logs | Pulpwood, Pine, measured as solid wood under bark (490kg/m^3), SFM (DE)	50 years
Acetic Acid 40%, active matter | Acetic acid, without water, in 98% solution state | market for (GLO)	100 years
Sodium hydroxide 25%, active matter | Sodium hydroxide, without water, in 50% solution state | market for (GLO)	100 years

Parameter	RSL
Wood, from chips | Pulpwood, Pine, measured as solid wood under bark (490kg/m^3), SFM (DE)	50 years
Sodium acetate | NIBE Sodium acetate | market for (GLO)	100 years
Wood, from chips | Pulpwood, Pine, measured as solid wood under bark (490kg/m^3), SFM (DE)	50 years
Sodium acetate | NIBE Sodium acetate | market for (GLO)	100 years
Wax/paraffins | Paraffin | production (EU)	50 years
Water | Water - Tap water	100 years
Methanol | Methanol | market for (GLO)	100 years
Urea | Urea, as N | production (EU)	100 years
Melamine | Melamine | production (EU)	100 years
Acetic Acid 40%, active matter | Acetic acid, without water, in 98% solution state | market for (GLO)	100 years
Sodium hydroxide 25%, active matter | Sodium hydroxide, without water, in 50% solution state | market for (GLO)	100 years
Sodium acetate | NIBE Sodium acetate | market for (GLO)	100 years
Methanol | Methanol | market for (GLO)	100 years
Urea | Urea, as N | production (EU)	100 years
Melamine | Melamine | production (EU)	100 years
Water | Water - Tap water	100 years
Acetic Acid 40%, active matter | Acetic acid, without water, in 98% solution state | market for (GLO)	100 years
Sodium hydroxide 25%, active matter | Sodium hydroxide, without water, in 50% solution state | market for (GLO)	100 years
Sodium acetate | NIBE Sodium acetate | market for (GLO)	100 years
Water | Water - Tap water	100 years

4.5 End of life stage (C1 - 4)

- C1. de-construction. Demolition (m.n.d.)
- C2. transport to waste processing
- C3. waste processing for reuse. recovery and/or recycling
- C4. disposal

Impact category	Unit	C2	C3	C4
Depletion of abiotic resources-elements	kg Sb	3.09E-4	1.31E-5	3.76E-6
Depletion of abiotic resources-fossil fuels	kg Sb	8.88E-2	3.53E-2	4.04E-3
Global warming	kg CO_2 Equiv.	1.21E+1	6.05E+0	2.51E+0
Ozone layer depletion	kg CFC-11 Equiv.	2.14E-6	6.64E-7	8.69E-8
Photochemical oxidants creation	kg Ethene Equiv.	7.29E-3	2.32E-2	7.82E-4
Acidification of soil and water	kg SO2 Equiv.	5.31E-2	1.24E-1	2.31E-3
Eutrophication	kg PO43- Equiv.	1.04E-2	3.18E-2	9.50E-4
Human toxicity	kg 1.4 DB	5.09E+0	1.47E+1	2.16E-1
Ecotoxicity. fresh water	kg 1.4 DB	1.48E-1	6.39E-1	4.26E-3
Ecotoxicity. marine water (MAETP)	kg 1.4 DB	5.34E+2	3.75E+2	1.54E+1
Ecotoxicity. terrestric	kg 1.4 DB	1.80E-2	1.63E-2	7.03E-4
Acidification (AP)	mol H+ eqv.	7.07E-2	1.82E-1	3.05E-3
Global warming potential (GWP-total)	kg CO_2 eqv.	1.22E+1	9.82E+2	3.70E+0
Global warming potential - Biogenic (GWP-b)	kg CO_2 eqv.	5.62E-3	9.75E+2	3.30E+0
Global warming potential - Fossil (GWP-f)	kg CO_2 eqv.	1.22E+1	6.14E+0	3.94E-1
Global warming potential - Land use and land use change (GWP-luluc)	kg CO_2 eqv.	4.46E-3	2.92E-3	1.72E-4
Ecotoxicity, freshwater (ETP-fw)	CTUe	1.64E+2	1.65E+2	8.33E+0
Particulate Matter (PM)	disease incidence	1.10E-6	1.46E-6	5.77E-8
Eutrophication marine (EP-m)	kg N eqv.	2.49E-2	8.27E-2	1.97E-3

Impact category	Unit	C2	C3	C4
Eutrophication, freshwater (EP-fw)	kg P eqv.	1.23E-4	2.61E-4	7.33E-6
Eutrophication, terrestrial (EP-T)	mol N eqv.	2.75E-1	9.52E-1	1.13E-2
Human toxicity, cancer (HTP-c)	CTUh	5.31E-9	2.19E-6	2.31E-10
Human toxicity, non-cancer (HTP-nc)	CTUh	1.79E-7	5.40E-7	8.89E-9
Ionising radiation, human health (IR)	kBq U235 eqv.	7.70E-1	2.07E-1	3.25E-2
Land use (SQP)	Pt	1.59E+2	1.97E+1	1.97E+1
Ozone depletion (ODP)	kg CFC 11 eqv.	2.69E-6	7.23E-7	1.09E-7
Photochemical ozone formation - human health (POCP)	kg NMVOC eqv.	7.84E-2	2.49E-1	4.02E-3
Resource use, fossils (ADP-f)	MJ	1.84E+2	6.65E+1	8.31E+0
Resource use, minerals and metals (ADP-mm)	kg Sb-eqv.	3.09E-4	1.31E-5	3.76E-6
Water use (WDP)	m^3 world eqv.	6.57E-1	2.52E+1	3.56E-1

Parameter	Unit	C1	C2	C3	C4
Renewable primary energy ex. Raw materials	MJ 0.00E+0	2.30E+0	3.57E+0	1.46E-1	7.33E-6
Renewable primary energy used as raw materials	MJ 0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.13E-2
Renewable primary energy total	MJ 0.00E+0	2.30E+0	3.57E+0	1.46E-1	2.31E-10
Non-renewable primary energy ex. Raw materials	MJ 0.00E+0	1.95E+2	7.13E+1	8.83E+0	8.89E-9
Non-renewable primary energy used as raw materials	MJ 0.00E+0	0.00E+0	0.00E+0	0.00E+0	3.25E-2
Non-renewable primary energy total	MJ 0.00E+0	1.95E+2	7.13E+1	8.83E+0	1.97E+1
Use of secondary material	kg 0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.09E-7
Use of renewable secondary fuels	MJ 0.00E+0	0.00E+0	0.00E+0	0.00E+0	4.02E-3
Use of non-renewable secondary fuels	MJ 0.00E+0	0.00E+0	0.00E+0	0.00E+0	8.31E+0
Use of net fresh water	M^3 0.00E+0	2.24E-2	2.70E-1	8.67E-3	3.76E-6

Parameter	Unit	C1	C2	C3	C4
Hazardous waste disposed	kg 0.00E+0	4.66E-4	3.44E-4	1.28E-5	3.56E-1
Non hazardous waste disposed	kg 0.00E+0	1.17E+1	4.45E+0	3.32E+1	
Radioactive waste disposed	kg 0.00E+0	1.21E-3	2.20E-4	4.94E-5	
Components for re-use	kg 0.00E+0	0.00E+0	0.00E+0	0.00E+0	
Materials for recycling	kg 0.00E+0	0.00E+0	6.63E+1	0.00E+0	
Materials for energy recovery	kg 0.00E+0	0.00E+0	0.00E+0	0.00E+0	
Exported energy	MJ 0.00E+0	0.00E+0	0.00E+0	0.00E+0	
Exported energy thermic	MJ 0.00E+0	0.00E+0	0.00E+0	0.00E+0	
Exported energy electric	MJ 0.00E+0	0.00E+0	0.00E+0	0.00E+0	

4.6 Benefits and loads beyond the system boundary (D)

Impact category	Unit	D
Depletion of abiotic resources-elements	kg Sb	-5.53E-4
Depletion of abiotic resources-fossil fuels	kg Sb	-2.24E-1
Global warming	kg CO_2 Equiv.	-3.66E+1
Ozone layer depletion	kg CFC-11 Equiv.	-9.92E-6
Photochemical oxidants creation	kg Ethene Equiv.	-1.09E-1
Acidification of soil and water	kg SO2 Equiv.	-6.94E-1
Eutrophication	kg PO43- Equiv.	-2.27E-1
Human toxicity	kg 1.4 DB	-5.99E+1
Ecotoxicity. fresh water	kg 1.4 DB	-1.27E+0
Ecotoxicity. marine water (MAETP)	kg 1.4 DB	-1.76E+3
Ecotoxicity. terrestric	kg 1.4 DB	-3.86E-1
Acidification (AP)	mol H+ eqv.	-1.08E+0
Global warming potential (GWP-total)	kg CO_2 eqv.	3.23E+0
Global warming potential - Biogenic (GWP-b)	kg CO_2 eqv.	4.08E+1
Global warming potential - Fossil (GWP-f)	kg CO_2 eqv.	-3.71E+1
Global warming potential - Land use and land use change (GWP-luluc)	kg CO_2 eqv.	-3.95E-1
Ecotoxicity, freshwater (ETP-fw)	CTUe	-1.04E+4
Particulate Matter (PM)	disease incidence	-1.52E-5
Eutrophication marine (EP-m)	kg N eqv.	-3.17E-1
Eutrophication, freshwater (EP-fw)	kg P eqv.	-3.62E-3
Eutrophication, terrestrial (EP-T)	mol N eqv.	-5.18E+0
Human toxicity, cancer (HTP-c)	CTUh	-1.21E-7
Human toxicity, non-cancer (HTP-nc)	CTUh	-4.37E-6

Impact category	Unit	D
Ionising radiation, human health (IR)	kBq U235 eqv.	-2.01E+0
Land use (SQP)	Pt	-4.41E+4
Ozone depletion (ODP)	kg CFC 11 eqv.	-1.01E-5
Photochemical ozone formation - human health (POCP)	kg NMVOC eqv.	-9.18E-1
Resource use, fossils (ADP-f)	MJ	-4.69E+2
Resource use, minerals and metals (ADP-mm)	kg Sb-eqv.	-5.53E-4
Water use (WDP)	m^3 world eqv.	-4.32E+0

Parameter	Unit	D
Renewable primary energy ex. Raw materials	MJ	-8.98E+3
Renewable primary energy used as raw materials	MJ	-9.56E+2
Renewable primary energy total	MJ	-8.98E+3
Non-renewable primary energy ex. Raw materials	MJ	-4.99E+2
Non-renewable primary energy used as raw materials	MJ	-7.02E-1
Non-renewable primary energy total	MJ	-4.99E+2
Use of secondary material	kg	0.00E+0
Use of renewable secondary fuels	MJ	0.00E+0
Use of non-renewable secondary fuels	MJ	0.00E+0
Use of net fresh water	M^3	-1.42E-1
Hazardous waste disposed	kg	-1.60E-3
Non hazardous waste disposed	kg	-1.62E+1
Radioactive waste disposed	kg	-2.90E-3
Components for re-use	kg	0.00E+0
Materials for recycling	kg	0.00E+0

Parameter	Unit	D
Materials for energy recovery	kg	0.00E+0
Exported energy	MJ	3.82E+3
Exported Energy Thermic	MJ	2.42E+3
Exported Energy Electric	MJ	1.40E+3

5. References

ISO 14040

ISO 14040:2006-10, Environmental management - Life cycle assessment - Principles and framework; EN ISO 14040:2006

ISO 14044

ISO 14044:2006-10, Environmental management - Life cycle assessment - Requirements and guidelines; EN ISO 14040:2006

ISO 14025

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NMD verification protocol

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NMD Determination method

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Ecoinvent 3.6

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