epd-norway
Global Program Operator

ENVIRONMENTAL PRODUCT DECLARATION

In accordance with ISO 14025, ISO 21930 and EN 15804+A2

A product specific EPD for

Railway sleepers made of pine, u 20%, treated with copper solution and RVP Repellent

Rundvirke Poles

Owner of the declaration:
Rundvirke Poles AB
Hällarnavägen 1
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Program holder and publisher
The Norwegian EPD Foundation

Declaration number:
NEPD-6049-5312-EN

Product category/PCR:
Wood and wood-based products

Issue date: 08.02.2024
Valid to: 08.02.2029

EPD Software:
This EPD is based on IVL EPD Generator for the Sawmill products (NEPDT26) and follows the approved background database verification approach.

The Norwegian
EPD Foundation

ivl

General information

Product:
Railway sleepers made of pine, u 20%, treated with copper solution and RVP Repellent

Program Operator:
The Norwegian EPD Foundation
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Declaration Number:
NEPD-6049-5312-EN

This declaration is based on Product Category Rules:
CEN Standard EN 15804 A2 serves as core PCR and PCR Part B for wood and wood-based products for use in construction (NPCR 015 07.10.2021).

Statement of liability:
The owner of the declaration shall be liable for the underlying information and evidence. EPD Norway shall not be liable with respect to manufacturer, life cycle assessment data and evidences.

Declared unit:
1 m^3 railway sleeper treated with copper solution and RVP Repellent

Declared unit with option:
A1-A5, C1-C4 and D

Functional unit:
—

Verification:
Independent verification of the declaration and data, according to ISO14025:2010.

☐ Internal ☒ External

Third party verifier:

Linda Høibye, Life Cycle Assessment Consulting
Independent verifier approved by EPD Norway

Owner of the declaration and manufacturer:

Rundvirke Poles AB

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Place of production:
Linbanevägen 1, 826 66 Marmaverken
Hällarnavägen 1, 771 31 Ludvika
Sweden

Management system:
ISO 9001, ISO 14001

Organisation no:
556300-2582

Issue date:
08.02.2024

Valid to:
08.02.2029

Year of study:
2022

Comparability:
EPD of construction products may not be comparable if they not comply with EN 15804 and seen in a building context.

The EPD has been prepared by:
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Approved by:

Håkon Hauan
(Managing Director EPD Norway)

Product

Product description:

Railway sleepers are used for infrastructure purposes in public and private railway networks. A moisture content of 20% is used for the calculation. On request, timber with a different moisture content can be delivered. The sleepers are treated with Tanalith E 3463/3475, a water-based copper solution, with a following oil-treatment with RVP Repellent. The poles are treated according to class NTR A. The sapwood content of the product is 32%.

Technical data:

Railway sleepers are delivered according to qualities, sizes and treatment specified by demands from different markets and customers.
The raw dry mass is 420 kg/m^3 for pine as a Swedish average and used here to calculate biogenic carbon content and the delivery density including water according to the current moisture content. The railway sleepers conform to the NTR standard, and specific requirements from customers.

Product specification:

Railway sleepers are produced in different sizes and the declared product is representative for the average sawn timber produced by the sawmill. 100% pine.

Materials, product	kg/m^3	weight-%
Pine	519	96%
Copper preservative solution	7	1%
RVP Repellent	16	3%
Sum	542	100%

Packaging materials	kg/m^3	weight-%
Wood	0,45	85%
Polyethene film	0,00	0%
Plastic strap	0,08	15%
Steel strip	0,00	0%
Cardboard	0,00	0%
Sum	0,53	100%

Market:

Main markets are Sweden and Northern Europe.

Reference service life:

The standard service life is 60 years, however varies depending on customer specifications.

Use QR code for **fact sheet** on Swedish wood products.

LCA: Calculation rules

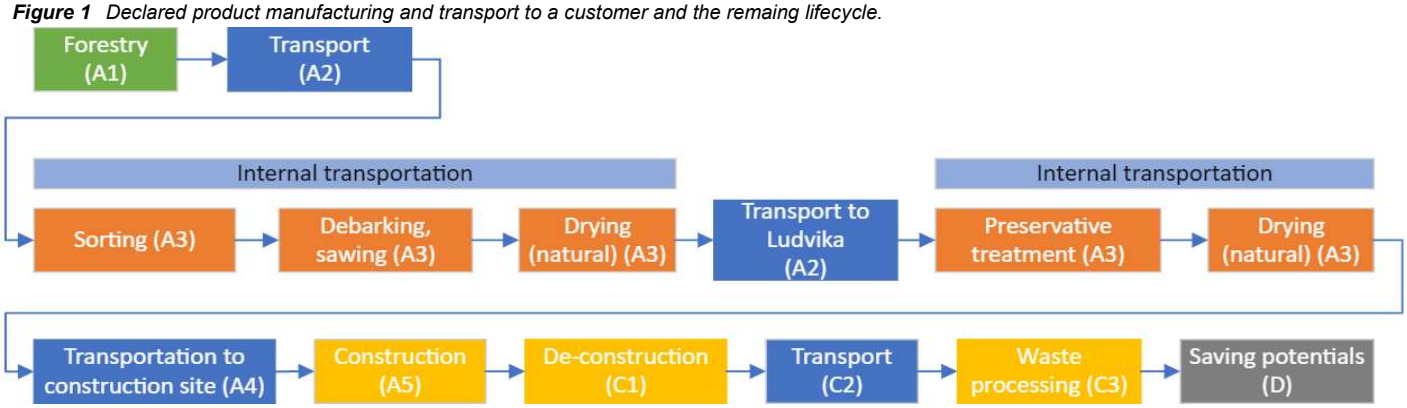
Declared unit:

A1-A5, C1-C4 and D

System boundary:

Flow chart over production (A3 in orange) of the declared product and all other modules is shown below. Module A4 to D is further explained in the scenario section.

Figure 1 *Declared product manufacturing and transport to a customer and the remaing lifecycle.*



Data quality:

For forestry, national representative figures are used. Specific figures are used for transport from forestry to sawmill. Generic upstream data for energy wares, packaging and ancillary materials are mainly from Gabi (age 2017-2022). Data for the wood preservative is based on data from the preservative manufacturer. Data concerning A3 is based on specific data from the manufacturer. The reference year for data collection is 2022.

Cut-off criteria:

All major raw materials and all the essential energy used are included. All production processes are included. The limited cut-off that occur (<<1%) are related to packaging materials that are not substituted in module D. This cut-off rule does not apply for hazardous materials and substances. Inherent biogenic carbon and stored energy in packaging materials are balanced out directly.

Allocation:

The allocation is made in accordance with the provisions of EN15804. All impacts from the sub-processes are allocated to the main product. The shavings are sold and only attributed to its upstream impact from its previously processes. The sawmill and its multiple co-products are allocated based on their different economic values. The economic value of the different parts of the input round timber is attributed using the market value of its final products/co-products.
A conservative approach is used for transport of round timber to the sawmill based on economic allocation factors (module A2).
A conservative economic allocation approach is used for forestry products, where no impact is allocated to the tops and branches (GROT), except forestry operations aimed for GROT (forwarding and shipping). Indicator result on potential soil quality (SQP) is assessed based on national characterisation factors for Swedish forestry (Horn et al 2021).

Calculation of biogenic carbon content:

Sequestration (module A1) and emissions of biogenic carbon are calculated according to EN16485:2014/EN15804+A2, where the net biogenic carbon cycle A to C is zero (i.e. carbon dioxide neutral). In this EPD, the amount of biogenic carbon stored in the product (module A3) is reported additionally (according to EN 15804+A2) as biogenic carbon stored in the product (see table 'Resource use'). For biogenic carbon in all other modules after A3, the carbon in the products is assigned to the module where the emission occurs in order to support the modularity principle in EN15804, so the net result is zero. Biogenic carbon and energy stored in packaging materials (less than 5 weight-%) are directly balanced out and therefore not visible in the environmental indicator result.

LCA: Scenarios and additional technical information

The following information below describe the scenarios in the different modules of the EPD.

Transport from production place to user (A4)

Type	Load factor, % (90+0%)	Type of vehicle	Distance	Fuel consumption	Value
Semi-trailer	45%	TT/AT 28-34 + 34-40t	300	0,027 l/tkm	8,2

A4: The transportation is reported as 300 km as outlined in the PCR and shall be used as factor to estimate the actual distance to the specific object.

Assembly (A5)

	Unit	Value
Material loss	%	0
Crane, electricity consumption	kWh	3,3E-02
Front loader, diesel	kWh	3,1E-01

A5: At the construction site, 4 minutes of work with front loader is assumed (Erlandsson 2015) and an average lift with a crane (Lundström 2016). 5% material loss is assumed att construction site.

Use (B1)

	Unit	Value
MND		

Maintenance (B2)/Repair (B3)

	Unit	Value
MND		

The declared product is not assumed to be exposed for wether and for that reason no mainatance is needed during the service life.

Replacement (B4)/Refurbishment (B5)

	Unit	Value
MND		

Operational energy (B6) and water consumption (B7)

	Unit	Value
MND		

No operational energy used during service life.

End of Life (C1, C3, C4)*

	Unit	Value
C1: Demolition machine (diesel)	kWh	0,60
C3: To material reuse	kg	0
C3: To material recycling	kg	0
C3: To energy recovery	kg	542
C3: Wood chipping (diesel)	kWh	3,3
C4: To landfill	kg	0

Energy need for demolition (C1) and chipping (C3) of the wooden discarded products is found in according to Erlandsson et al (2015). The scenario accounts for 100%* energy recovery and end of waste is reached in C3. No statistics exist in Sweden on recycling of demolition wood but will likely be at least 90%.

Transport to waste processing (C2)*

Type	Load factor, % (90+0%)	Type of vehicle	Distance	Fuel consumption	Value
Large lorry/truck	45%	TT/AT 14-20+20-28t	35	0,037	1,3

*C2: Assumed tranport from demolition site to local waste treatment site, from where it is then sold.

The transport assume empty return.

Benefits and loads beyond the system boundaries (D)*

	Unit	Value
Chipped discarded product that substitute average used fuel in a district heating plant	MJ	-8691

D: The chipped product is assumed to be used as fuel in a district heating and then replaces the average energy mix.

* If less recycling rate than 100% is asked for shall the result from module C and D be multiplied by such factor that takes the actual number into account. 100% is used here to support the modular approach of using these figures on the buildings level.

Additional technical information

No additional information given.

LCA: Results

The LCA results are presented for the declared unit defined on page 2 of the EPD document. EN 15804 exists in two versions and version 2 is the latest.

System boundaries: **X**=included, **MND**= module not declared, **MNR**=module not relevant.

Product stage			Construction		Use stage							End of life stage				Beyond the system
Raw materials	Transport	Manufacturing	Transport	Construction, installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery
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	x	x	x	x	x
SE	SE	SE	SE	SE	—	—	—	—	—	—	—	SE	SE	SE	SE	SE

Core environmental impact, version A2 — mandatory indicators

Parameter	Unit	A1-3	A4	A5	C1	C2	C3	C4	D
GWP-total	kg CO_2 e	-6,93E+02	1,13E+01	7,11E-02	1,36E-01	1,90E+00	7,94E+02	0,00E+00	6,32E+02
GWP-fossil	kg CO_2 e	1,10E+02	1,12E+01	7,04E-02	1,34E-01	1,89E+00	7,49E-01	0,00E+00	-1,91E+02
GWP-biogenic	kg CO_2 e	-8,03E+02	3,49E-02	2,22E-04	4,18E-04	5,87E-03	7,93E+02	0,00E+00	8,22E+02
GWP-LULUC	kg CO_2 e	8,35E-01	6,27E-02	3,90E-04	7,51E-04	1,05E-02	4,18E-03	0,00E+00	-3,73E-03
GWP-IOBC/GHG	kg CO_2 e	1,10E+02	1,13E+01	7,11E-02	1,36E-01	1,90E+00	7,55E-01	0,00E+00	-1,70E+02
ODP	kg CFC11 eq.	1,33E-05	2,53E-07	1,56E-09	3,03E-09	4,26E-08	1,69E-08	0,00E+00	-1,36E-06
AP	mol H^+ eq.	7,48E-01	1,26E-01	7,82E-04	1,51E-03	2,12E-02	8,43E-03	0,00E+00	-4,31E-01
EP-freshwater	kg P eq.	3,70E-03	5,80E-04	3,60E-06	6,95E-06	9,76E-05	3,87E-05	0,00E+00	-4,16E-04
EP-marine	kg N eq.	3,67E-01	6,81E-02	4,21E-04	8,15E-04	1,14E-02	4,54E-03	0,00E+00	-7,04E-03
EP-terrestial	mol N eq.	3,30E+00	6,47E-01	3,99E-03	7,74E-03	1,09E-01	4,31E-02	0,00E+00	7,40E-02
POCP	kg NMVOC eq.	5,75E-01	8,83E-02	5,47E-04	1,06E-03	1,48E-02	5,89E-03	0,00E+00	-4,68E-02
ADP-m&m [2)]	kg Sb eq.	2,20E-04	6,05E-06	3,83E-08	7,24E-08	1,02E-06	4,03E-07	0,00E+00	-1,36E-05
ADP-fossil [2)]	MJ	2,67E+03	1,71E+02	1,18E+00	2,05E+00	2,87E+01	1,14E+01	0,00E+00	-1,99E+03
WDP	m^3	9,73E+02	2,01E+02	1,24E+00	2,41E+00	3,38E+01	1,34E+01	0,00E+00	-3,95E+03

GWP-total: *Global Warming Potential;* ***GWP-fossil:*** *Global Warming Potential fossil fuels;* ***GWP-biogenic:*** *Global Warming Potential biogenic;* ***GWP-LULUC:*** *Global Warming Potential land use and land use change;* ***ODP:*** *Depletion potential of the stratospheric ozone layer;* ***AP:*** *Acidification potential, Accumulated Exceedance;* ***EP-freshwater:*** *Eutrophication potential, fraction of nutrients reaching freshwater end compartment;* ***EP-marine:*** *Eutrophication potential, fraction of nutrients reaching freshwater end compartment;* ***EP-terrestial:*** *Eutrophication potential, Accumulated Exceedance;* ***POCP****: Formation potential of tropospheric ozone;* ***ADP-m&m****: Abiotic depletion potential for non-fossil resources (****minerals and metals****);* ***ADP-fossil:*** *Abiotic depletion potential for fossil resources;* ***WDP:*** *Water deprivation potential, deprivation weighted water counsumption*

Note 1 *– This additional indicator* ***GWP-GHG/IOBC*** *is also referred to as* ***GWP-GHG*** *in the context of Swedish and Finish legislation.*
Disclaimer 2 – The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

Additional environmental impact, version A2 — addition of non-mandatory indicators with poor reliability

Parameter	Unit	A1-3	A4	A5	C1	C2	C3	C4	D
PM [2)]	Disease incidence	4,48E-06	6,78E-07	4,21E-09	8,12E-09	1,14E-07	4,52E-08	0,00E+00	1,90E-02
IRP [1)]	kBq U235 eq	1,08E+01	3,85E-01	7,95E-03	4,61E-03	6,47E-02	2,57E-02	0,00E+00	-3,17E+01
ETP-fw [2)]	CTUe	3,77E+03	2,99E+02	1,91E+00	3,58E+00	5,03E+01	1,99E+01	0,00E+00	-6,98E+02
HTP-c [2)]	CTUh	6,47E-08	5,98E-09	3,94E-11	7,15E-11	1,00E-09	3,99E-10	0,00E+00	-1,39E-08
HTP-nc [2)]	CTUh	2,65E-06	3,65E-07	2,30E-09	4,37E-09	6,13E-08	2,43E-08	0,00E+00	-2,53E-06
SQP [2)]	Dimensionless	5,92E+04	2,19E+02	1,43E+00	2,62E+00	3,68E+01	1,46E+01	0,00E+00	-4,03E+02

PM: *Particulate matter emissions;* ***IRP:*** *Ionising radiation, human health;* ***ETP-fw:*** *Ecotoxicity (freshwater);* ***ETP-c:*** *Human toxicity, cancer effects;* ***HTP-nc:*** *Human toxicity, non-cancer effects;* ***SQP:*** *Land use related impacts / soil quality*

Disclaimer 1 – This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.
Disclaimer 2 – The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

Environmental impact, version A1

Parameter	Unit	A1-3	A4	A5	C1	C2	C3	C4	D
GWP-TOT	kg CO_2 e	-6,91E+02	1,10E+01	6,92E-02	1,32E-01	1,85E+00	7,99E+02	0,00E+00	-1,70E+02
GWP-IOBC*	kg CO_2 e	1,08E+02	1,10E+01	6,92E-02	1,32E-01	1,85E+00	7,36E-01	0,00E+00	-1,70E+02
ODP	kg CFC11 e	1,75E-05	2,28E-07	1,40E-09	2,73E-09	3,83E-08	1,52E-08	0,00E+00	-1,12E-06
POCP**	kg C_2H_4 e	-5,53E-02	-2,27E-02	-1,39E-04	-2,71E-04	-3,81E-03	-1,51E-03	0,00E+00	9,36E-03
AP	kg SO_2 e	5,65E-01	8,13E-02	5,04E-04	9,73E-04	1,37E-02	5,42E-03	0,00E+00	-4,04E-01
EP	kg PO_4^{3-} e	1,96E-01	3,15E-02	1,95E-04	3,77E-04	5,29E-03	2,10E-03	0,00E+00	1,02E-02
ADPM	kg Sb e	3,46E-04	6,06E-06	3,87E-08	7,25E-08	1,02E-06	4,04E-07	0,00E+00	-1,69E-05
ADPE	MJ	2,27E+03	1,66E+02	1,04E+00	1,99E+00	2,79E+01	1,11E+01	0,00E+00	-1,35E+03

GWP Global warming potential; **ODP** Depletion potential of the stratospheric ozone layer; **POCP** Formation potential of tropospheric photochemical oxidants; **AP** Acidification potential of land and water; **EP** Eutrophication potential; **ADPM** Abiotic depletion potential for non fossil resources; **ADPE** Abiotic depletion potential for fossil resources.

Resource use, version A1+2 — mandatory indicators

Parameter	Unit	A1-3	A4	A5	C1	C2	C3	C4	D
RPEE	MJ	4,79E+02	5,87E+01	4,76E-01	7,03E-01	9,87E+00	3,92E+00	0,00E+00	7,31E+03
RPEM	MJ	8,46E+03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-8,46E+03	0,00E+00	0,00E+00
TPE	MJ	8,94E+03	5,87E+01	4,76E-01	7,03E-01	9,87E+00	-8,46E+03	0,00E+00	7,31E+03
NRPE	MJ	2,68E+03	1,71E+02	1,18E+00	2,05E+00	2,88E+01	1,14E+01	0,00E+00	-1,05E+03
NRPM	MJ	4,58E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-4,58E+02	0,00E+00	0,00E+00
TRPE	MJ	3,14E+03	1,71E+02	1,18E+00	2,05E+00	2,88E+01	-4,46E+02	0,00E+00	-1,05E+03
SM	kg	1,15E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-5,58E+03
NRSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-1,51E+03
W	m^3	2,29E+01	4,69E+00	2,91E-02	5,62E-02	7,89E-01	3,13E-01	0,00E+00	0,00E+00

RPEE Renewable primary energy resources used as energy carrier; **RPEM** Renewable primary energy resources used as raw materials; **TPE** Total use of renewable primary energy resources; **NRPE** Non renewable primary energy resources used as energy carrier; **NRPM** Non renewable primary energy resources used as materials; **TRPE** Total use of non renewable primary energy resources; **SM** Use of secondary materials; **RSF** Use of renewable secondary fuels; NRSF Use of non renewable secondary fuels; **W** Use of net fresh water. Energy stored as material in the packaging materials is direct balanced out in the module it arrise and stored in the product is balanced out over the life cycle, exactly the same as stored biogenic carbon is reported in GWP.

End of life — Waste, version A1+2 — mandatory indicators

Parameter	Unit	A1-3	A4	A5	C1	C2	C3	C4	D
HW	kg	5,21E-03	7,21E-10	3,87E-11	8,64E-12	1,21E-10	4,81E-11	0,00E+00	-3,72E-08
NHW	kg	2,28E+00	2,16E-02	1,72E-04	2,58E-04	3,63E-03	1,44E-03	0,00E+00	-7,53E-01
RW	kg	7,97E-02	1,86E-04	4,93E-05	2,22E-06	3,12E-05	1,24E-05	0,00E+00	-2,53E-01

HW Hazardous waste disposed; **NHW** Non hazardous waste disposed; **RW** Radioactive waste disposed

End of life — Output flow, version A1+2 — mandatory indicators

Parameter	Unit	A1-3	A4	A5	C1	C2	C3	C4	D
CR	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MR	kg	1,14E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MER	kg	2,69E+00	0,00E+00	5,25E-01	0,00E+00	0,00E+00	5,42E+02	0,00E+00	0,00E+00
EEE	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
ETE	MJ	2,70E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

CR Components for reuse; **MR** Materials for recycling; **MER** Materials for energy recovery; **EEE** Exported electric energy; **ETE** Exported thermal energy

Information describing the biogenic carbon content at the factory gate

Biogenic carbon content	Amount	Unit
Biogenic carbon content in product	218	kg C
Biogenic carbon content in the accompanying packaging	0,2*	kg C

44/12 is the ratio between the molecular mass of CO2 and C molecules.
* The biogenic carbon and its energy content stored in packaging materials is less tha 5% and therefore according to EN 15804 direct balanced out in the environmental indicator result (i.e. set to zero for GWP and energy used as materials).

LCA: Complementary scenario results

This section includes an alternative end of life scenario and creates an information model that in combination with the main scenario reported above can be used by the end-user to define a specific scenario based on local conditions.

Alternative 100% scenario for the scenario: **Deconstruction losses**

It should be noticed that landfilling of organic waste as wood is not allowed by EC legislation and the worst scenario alternative will then be the fact that the deconstruction/demolition process generate a wood fraction that will not be recycled at all. Such waste flow can be generated in the deconstruction process and where the wood is then wasted on the surface or alternative in the topsoil in the ground at the construction site or elsewhere. The modelled scenario presented below is based on the wood that remains on the site of the building being broken down aerobically, that is, with access to oxygen and completely decomposed within the 100 year time-related cut off that is applied. In such aerobic decomposition the inherent carbon is transformed to carbon dioxide (compared to an anaerobic process that partly also create methene). The demolition process C1 is the same as in the main scenario reported above. There will not be any transport C2 since the waste is lost at the site.

End of life stage				Beyond the system boundary
De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery
C1	C2	C3	C4	D
x	x	x	x	x
SE	SE	SE	SE	SE

Core environmental impact, version A2 — mandatory indicators

Parameter	Unit				C1	C2	C3	C4	D
GWP-total	kg CO_2 e				1,36E-01	0,00E+00	0,00E+00	7,99E+02	0,00E+00
GWP-fossil	kg CO_2 e				1,34E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00
GWP-biogenic	kg CO_2 e				4,18E-04	0,00E+00	0,00E+00	7,99E+02	0,00E+00
GWP-LULUC	kg CO_2 e				7,51E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00
GWP-IOBC/GHG	kg CO_2 e				1,36E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00
ODP	kg CFC11 eq.				3,03E-09	0,00E+00	0,00E+00	0,00E+00	0,00E+00
AP	mol H^+ eq.				1,51E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EP-freshwater	kg P eq.				6,95E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EP-marine	kg N eq.				8,15E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EP-terrestial	mol N eq.				7,74E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00
POCP	kg NMVOC eq.				1,06E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00
ADP-m&m [2)]	kg Sb eq.				7,24E-08	0,00E+00	0,00E+00	0,00E+00	0,00E+00
ADP-fossil [2)]	MJ				2,05E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
WDP	m^3				2,41E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

GWP-total: *Global Warming Potential;* ***GWP-fossil:*** *Global Warming Potential fossil fuels;* ***GWP-biogenic:*** *Global Warming Potential biogenic;* ***GWP-LULUC:*** *Global Warming Potential land use and land use change;* ***ODP:*** *Depletion potential of the stratospheric ozone layer;* ***AP:*** *Acidification potential, Accumulated Exceedance;* ***EP-freshwater:*** *Eutrophication potential, fraction of nutrients reaching freshwater end compartment;* ***EP-marine:*** *Eutrophication potential, fraction of nutrients reaching freshwater end compartment;* ***EP-terrestial:*** *Eutrophication potential, Accumulated Exceedance;* ***POCP****: Formation potential of tropospheric ozone;* ***ADP-m&m****: Abiotic depletion potential for non-fossil resources (****minerals and metals****);* ***ADP-fossil:*** *Abiotic depletion potential for fossil resources;* ***WDP:*** *Water deprivation potential, deprivation weighted water counsumption*

Note 1 *– This additional indicator* ***GWP-GHG/IOBC*** *is also referred to as* ***GWP-GHG*** *in the context of Swedish and Finnish legislation.*
Disclaimer 2 – The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

Additional environmental impact, version A2 — addition of non-mandatory indicators with poor reliability

Parameter	Unit				C1	C2	C3	C4	D
PM [2)]	Disease incidence				8,12E-09	0,00E+00	0,00E+00	0,00E+00	0,00E+00
IRP [1)]	kBq U235 eq				4,61E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00
ETP-fw [2)]	CTUe				3,58E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
HTP-c [2)]	CTUh				7,15E-11	0,00E+00	0,00E+00	0,00E+00	0,00E+00
HTP-nc [2)]	CTUh				4,37E-09	0,00E+00	0,00E+00	0,00E+00	0,00E+00
SQP [2)]	Dimensionless				2,62E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

PM: *Particulate matter emissions;* ***IRP:*** *Ionising radiation, human health;* ***ETP-fw:*** *Ecotoxicity (freshwater);* ***ETP-c:*** *Human toxicity, cancer effects;* ***HTP-nc:*** *Human toxicity, non-cancer effects;* ***SQP:*** *Land use related impacts / soil quality*

Disclaimer 1 – This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.
Disclaimer 2 – The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

Environmental impact, version A1

Parameter	Unit				C1	C2	C3	C4	D
GWP-TOT	kg CO_2 e				1,32E-01	0,00E+00	0,00E+00	7,99E+02	0,00E+00
GWP-IOBC*	kg CO_2 e				1,32E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00
ODP	kg CFC11 e				2,73E-09	0,00E+00	0,00E+00	0,00E+00	0,00E+00
POCP**	kg C_2H_4 e				-2,71E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00
AP	kg SO_2 e				9,73E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EP	kg PO_4^{3-} e				3,77E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00
ADPM	kg Sb e				7,25E-08	0,00E+00	0,00E+00	0,00E+00	0,00E+00
ADPE	MJ				1,99E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

GWP Global warming potential; **ODP** Depletion potential of the stratospheric ozone layer; **POCP** Formation potential of tropospheric photochemical oxidants; **AP** Acidification potential of land and water; **EP** Eutrophication potential; **ADPM** Abiotic depletion potential for non fossil resources; **ADPE** Abiotic depletion potential for fossil resources.
***** Also referred to as **GWP-GHG** in context of e.g. Swedish and Finish legislation.
** Negative impact occur due to negative characterization factors. LCI origin from GaBi database separates NOx into NO and NO2, in combination with the applied characterization model with a marginal approach for POCP based on highly polluted ambient air than can result in a negative characterization factor for nitric oxide.

Resource use, version A1+2 — mandatory indicators

Parameter	Unit				C1	C2	C3	C4	D
RPEE	MJ				7,03E-01	0,00E+00	0,00E+00	8,46E+03	0,00E+00
RPEM	MJ				0,00E+00	0,00E+00	0,00E+00	-8,46E+03	0,00E+00
TPE	MJ				7,03E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRPE	MJ				2,05E+00	0,00E+00	0,00E+00	4,46E+02	0,00E+00
NRPM	MJ				0,00E+00	0,00E+00	0,00E+00	-4,58E+02	0,00E+00
TRPE	MJ				2,05E+00	0,00E+00	0,00E+00	-1,14E+01	0,00E+00
SM	kg				0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RSF	MJ				0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF	MJ				0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
W	m^3				5,62E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00

RPEE Renewable primary energy resources used as energy carrier; **RPEM** Renewable primary energy resources used as raw materials; **TPE** Total use of renewable primary energy resources; **NRPE** Non renewable primary energy resources used as energy carrier; **NRPM** Non renewable primary energy resources used as materials; **TRPE** Total use of non renewable primary energy resources; **SM** Use of secondary materials; **RSF** Use of renewable secondary fuels; NRSF Use of non renewable secondary fuels; **W** Use of net fresh water. Energy stored as material in the packaging materials is direct balanced out in the module it arrise and stored in the product is balanced out over the life cycle, exactly the same as stored biogenic carbon is reported in GWP.

End of life — Waste, version A1+2 — mandatory indicators

Parameter	Unit				C1	C2	C3	C4	D
HW	kg				8,64E-12	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NHW	kg				2,58E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RW	kg				2,22E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00

HW Hazardous waste disposed; **NHW** Non hazardous waste disposed; **RW** Radioactive waste disposed

End of life — Output flow, version A1+2 — mandatory indicators

Parameter	Unit				C1	C2	C3	C4	D
CR	kg				0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MR	kg				0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MER	kg				0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EEE	MJ				0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
ETE	MJ				0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

CR Components for reuse; **MR** Materials for recycling; **MER** Materials for energy recovery; **EEE** Exported electric energy; **ETE** Exported thermal energy

Additional requirements

Greenhous gas emission from the use of electricity in the manufacturing phase

Swedish national production mix from import, low voltage (production of transmission lines, in addition to direct emissions and losses in grid) of applied electricity for the manufacturing process (A3).

Data source	Amount	Unit
Energywares Gabi and end energymix ENSTO-E 2016	0,042	kg CO_2e/kWh

Dangerous substances

☐ The product contains no substances given by the REACH Candidate list or the Norwegian priority list.

☑ The product contains substances given by the REACH Candidate list or the Norwegian priority list that are less than 0,1 % by weight.

☐ The product contain dangerous substances, more then 0,1% by weight, given by the REACH Candidate List or the Norwegian Priority list, see table.

☐ The product contains no substances given by the REACH Candidate list or the Norwegian priority list. The product is classified as hazardous waste (Avfallsforskiften, Annex III), see table below.

Name	CAS no.	Amount
—	—	—

Indoor environment

Not relevant

Carbon footprint

Carbon footprint according to ISO 14067 has not been worked out for the product.

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