Environmental Product Declaration

In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC:2021 for:

EKOLUTION® - Hemp Fibre Insulation IB30

From:
Ekolution AB

The EPD document for producing EKOLUTION HEMP FIBER MATS
EPD of multiple products, based on a representative product

EKOLUTION

Programme:	The International EPD System, www.environdec.com
Programme operator:	EPD International AB
Type of EPD:	Product recently on the market and EPD of multiple products – Results of this EPD shall be used with care as the LCI data is not yet based on 1 year of production which may result in increased uncertainty
EPD registration number:	EPD-IES-0024945
Version date:	2025-09-05
Validity date:	2026-09-04

An EPD may be updated or depublished if conditions change. To find the latest version of the EPD and to confirm its validity, see www.environdec.com

General information

Programme information

Programme:	The International EPD System
Address:	EPD International AB Box 210 60 SE-100 31 Stockholm Sweden
Website:	www.environdec.com
E-mail:	support@environdec.com

PCR and verification

Product Category Rules (PCR)
CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
Product Category Rules (PCR): PCR 2019:14 Construction products v.2.0.1 and C-PRC-005 for Thermal insulation products
PCR review was conducted by: PCR review was conducted by the Technical Committee of the International EPD® System. See https://environdec.com/about-us/the-international-epd-system-about-the-system for a list of members. Review chair: Rob Rouwette. The review panel may be contacted via the Secretariat www.environdec.com/contact.
Life Cycle Assessment (LCA)
LCA accountability: *Fanni Végvári, CarbonZero AB*
Verification
Independent third-party verification of the declaration and data, according to ISO 14025:2006, via: ☒ **Individual EPD verification without a pre-verified LCA/EPD tool** Third-party verifier: *Stephen Forson, ViridisPride* Approved by: The International EPD System
Procedure for follow-up of data during EPD validity involves third party verifier: ☐ Yes ☒ No

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

EPDs within the same product category but published in different EPD programmes, may not be comparable. For two EPDs to be comparable, they shall be based on the same PCR (including the same first-digit version number) or be based on fully aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have identical scope in terms of included life-cycle stages (unless the excluded life-cycle stage is demonstrated to be insignificant); apply identical impact assessment methods (including the same version of characterisation factors); and be valid at the time of comparison.

For further information about comparability, see EN 15804 and ISO 14025.

Information about EPD owner

Owner of the EPD
Ekolution AB

Address:
Västanvägen
245 42 Staffanstorp
Sweden

Contact:
Naib Woldemariam, naib.woldemariam@ekolution.se

Description of the organisation:
Ekolution is a forward-thinking company that designs, manufactures, and distributes innovative hemp-based materials and technologies for multiple industries.

With a deep commitment to environmental responsibility and material innovation, Ekolution works closely with stakeholders across various sectors to develop high-quality, low-carbon solutions tailored to the evolving demands of modern society.

At the heart of Ekolution's product development is **industrial hemp,** a highly renewable, fast-growing crop whose components offer exceptional versatility. Both hemp fibers and hemp shives are used as the foundation for a broad and expanding product portfolio, processed using environmentally conscious, low-emission methods.

Figure 1 *One of Ekolutions hemp fields being harvested*

Ekolution produces high-performance nonwoven materials, insulation, composites, and packaging solutions primarily from hemp fibers and hemp shives. These raw materials are selected for their exceptional technical and ecological properties, including:

- **Carbon sequestration** during growth
- High **tensile strength** and durability
- Excellent **thermal** and **acoustic** performance
- Natural **moisture regulation** and vapor openness
- **Biodegradability** and recyclability

Thanks to this combination of performance and sustainability, Ekolution's materials are suited for a diverse range of applications, including but not limited to:

- **Nonwoven** products for insulation, acoustic panels, and filtration
- Interior **automotive** components
- **Textile** applications within apparel and home textiles
- **Construction** materials, such as thermal insulation and boards
- **Biocomposite** innovations that are emerging
-

Figure 2 *Hemp products layered on top of each other showing the wide spectra of hemp-based building products.*

A Vision for Carbon-Negative Innovation

Ekolution's mission is to lead the transition toward climate-positive industries. By utilizing hemp, a carbon-sequestering crop, and maintaining a low-emission manufacturing process, Ekolution delivers materials that are not only high-performing but also carbon-negative across their lifecycle.

This positions the company as a pioneer in environmental stewardship, enabling industries to reduce their ecological footprint, embrace regenerative materials, and meet ambitious climate targets through smart material choices.

Through continuous innovation, partnerships, and cross-sector collaboration, Ekolution aims to redefine how sustainable materials are integrated across construction, manufacturing, and design, offering hemp-based solutions that support a cleaner, healthier future.

Product information

Product name(s):
Ekolution Hemp Fiber Insulation IB30 - Representative Product
Ekolution Hemp Fiber Insulation IB50
Ekolution Hemp Fiber Insulation IB70
Ekolution Hemp Fiber Insulation IB100
Ekolution Hemp Fiber Insulation IB120

UN CPC code:
54650 - Insulating materials and articles, n.e.c

Product description:
This EPD covers the production of **Non Woven - Ekolution® Hemp Fiber** that are produced through airlay technology creating building and acoustic insulation. Engineered from **locally sourced hemp fibers** grown and processed in **Skåne, Sweden**, these mats represent a new standard in sustainable building materials.

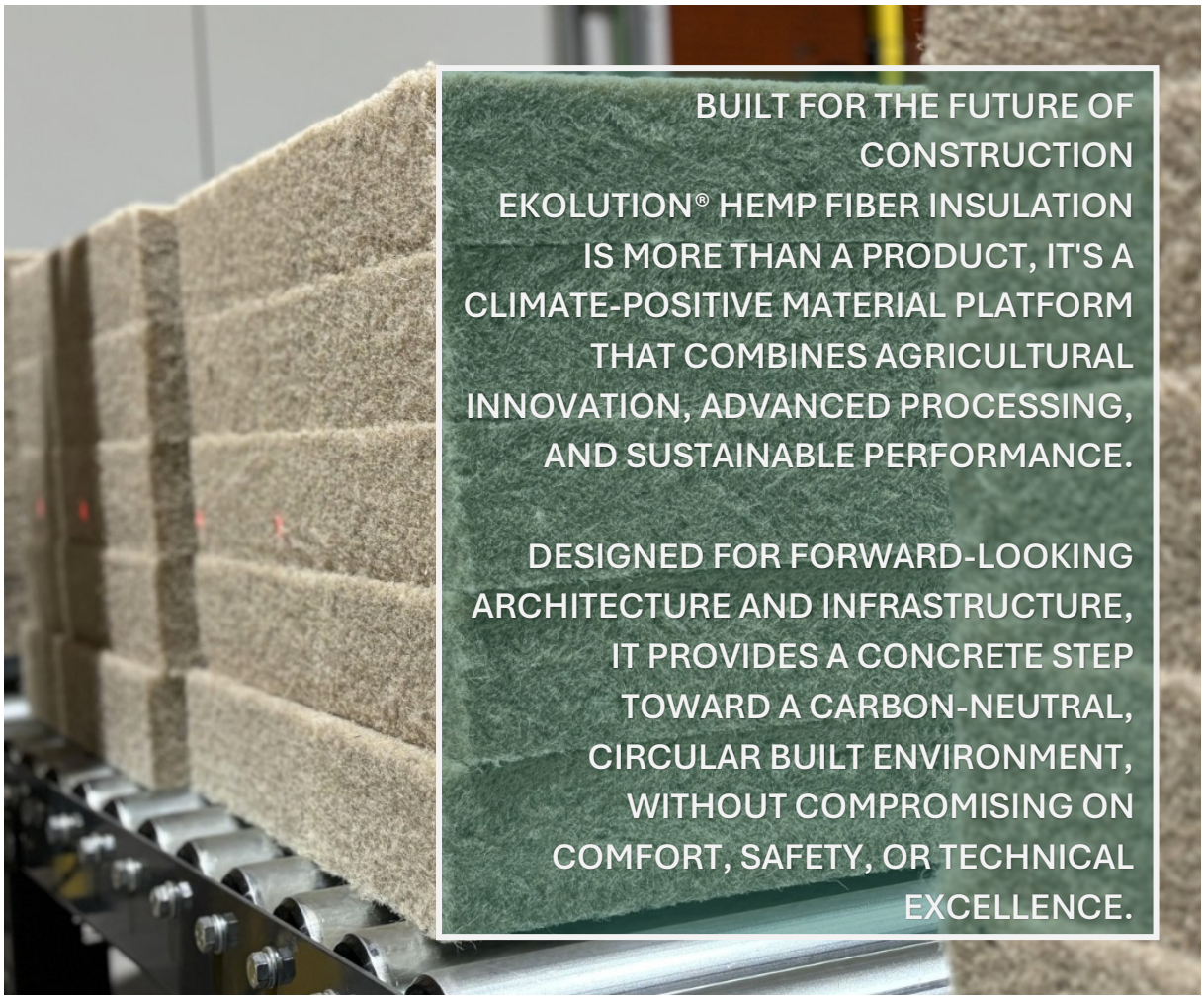


Figure 3 *Hemp Fiber Insulation on the production line*

Ekolution® Hemp Fiber Insulation - *Setting a new standard for regenerative construction materials*
Ekolution® Hemp Fiber Insulation represents a paradigm shift in the development of high-performance, carbon-storing materials for the construction sector. Engineered and produced in southern Sweden through a fully vertically integrated value chain, this non-woven insulation is manufactured using advanced airlay technology, combining locally cultivated industrial hemp, recycled-content binders, and a natural flame retardant based on food-grade mineral salts.

The result is a **next-generation insulation** solution that supports the green transition while meeting the highest technical, environmental, and health standards.

Local, Circular, and Traceable
From hemp seed to final product, Ekolution controls the entire value chain within a close geographic radius-minimizing emissions, eliminating unnecessary transport, and enabling full material traceability. The production process includes:

- Local cultivation partnerships using regenerative practices
- In-house mechanical decortication and fiber refinement
- Non-toxic, mineral-based fire protection
- Closed-loop handling of production residues for **zero waste**

Performance Category	Specification
Thermal conductivity	*0.038 - 0.041 W/m·K (EN 12667)*
Specific heat capacity	*2300 J/kg·K (EN ISO 10456)*
Acoustic absorption	*Class A (EN ISO 11654)*
Density range	*30–120 kg/m^3*
Resistance to Fire	*R30-R60, EI30-EI120*

Areas of Use

Hemp fiber insulation is well-suited for a wide range of above-ground structural applications, including exterior and interior walls, roofs, and intermediate floors. In addition to its thermal performance, hemp fiber insulation also provides effective acoustic insulation, making it ideal for both interior and exterior noise reduction

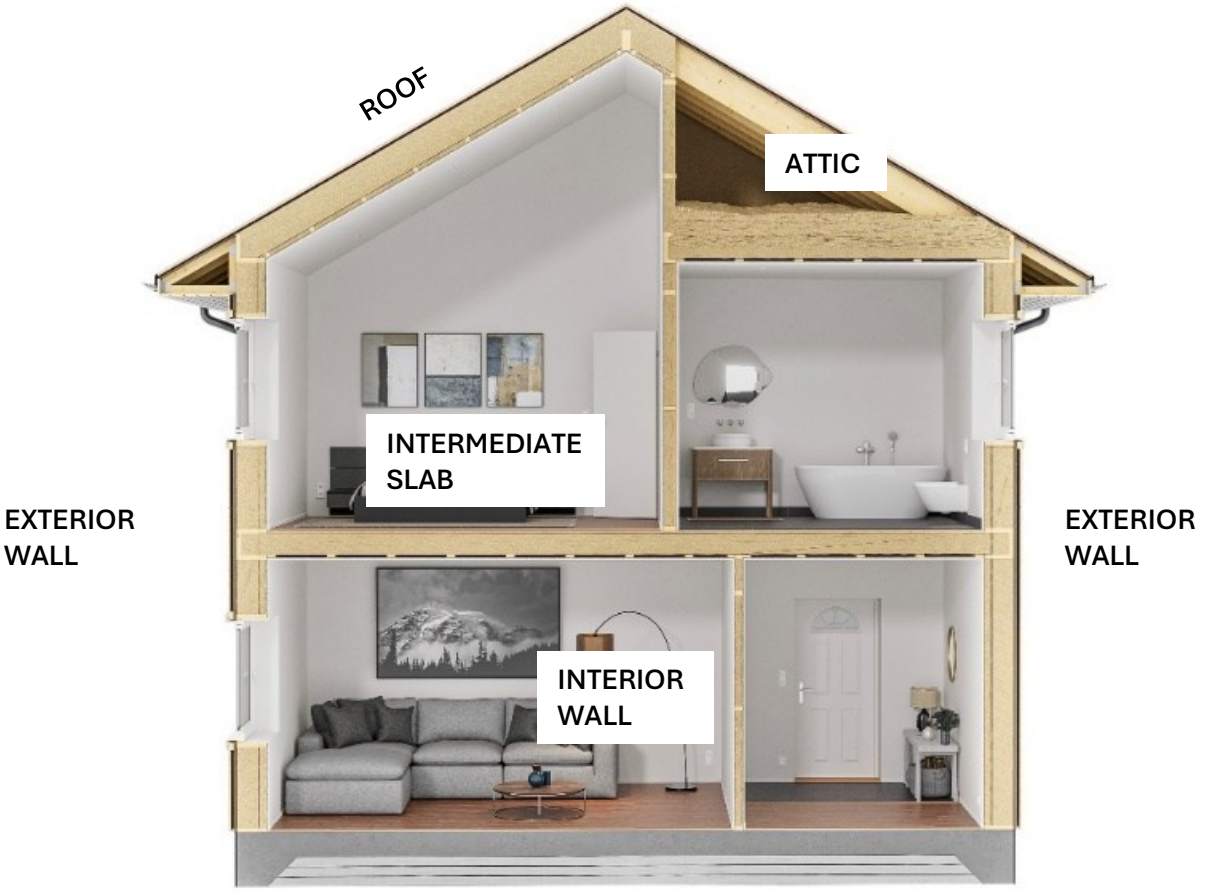


Figure 4 *Cross-Section of a residential house showing application of hemp fiber insulation in walls, roof and intermediate slab*

1 | Declaration Basis

This Environmental Product Declaration (EPD) covers Ekolution® Hemp Fiber Insulation manufactured on continuous non-woven airlay lines. The declared products are delivered as factory-made insulating boards for building envelopes, interior applications and acoustic insulation.

2 | Constituent Materials (mass-% at plant gate)

Component	Function	Range %
Industrial Hemp Fibers	Core Insulation Matrix	92
Binders with Post Consumer content	Thermo Bonding network	5
Mineral Salt Fire retardant	Resistance to fire	3

3 | Product Identification

Parameter	Value / Reference
Trade name	Ekolution® Hemp Fiber Insulation
UN CPC	54650 - Insulating materials and articles, n.e.c
Harmonised standard	EN 13171:2012 +A1
Geographical scope of validity	Europe (EU / EFTA, excl. CH)
Declaration type	Cradle-to-gate with options (A1-A3, C1-C3, D)

4 |Standard Dimensions

Stud Type	Width x Lenght (mm)	Thickness T (mm)
Wood Stud	415 x 1170	45 · 70 · 95 · 120 · 145 · 170 · 195 · 220
	565 x 1170	45 · 70 · 95 · 120 · 145 · 170 · 195 · 220
Steel Stud	460 x 1170	45 · 70 · 95 · 120 · 145 · 170 · 195 · 220
	610 x 1170	45 · 70 · 95 · 120 · 145 · 170 · 195 · 220

*Custom densities (30 – 120 kg/m^3) and lengths up to 2400 mm supplied on request. Full product matrix available at www.ekolution.se.

5 | Manufacturing Process

Ekolution® Hemp Fiber Insulation is manufactured in a highly automated, vertically integrated facility designed for energy efficiency, traceability, and minimal material loss. The production process incorporates closed-loop resource handling, real-time quality monitoring, and digital process control to ensure consistent product properties across all density ranges and formats.

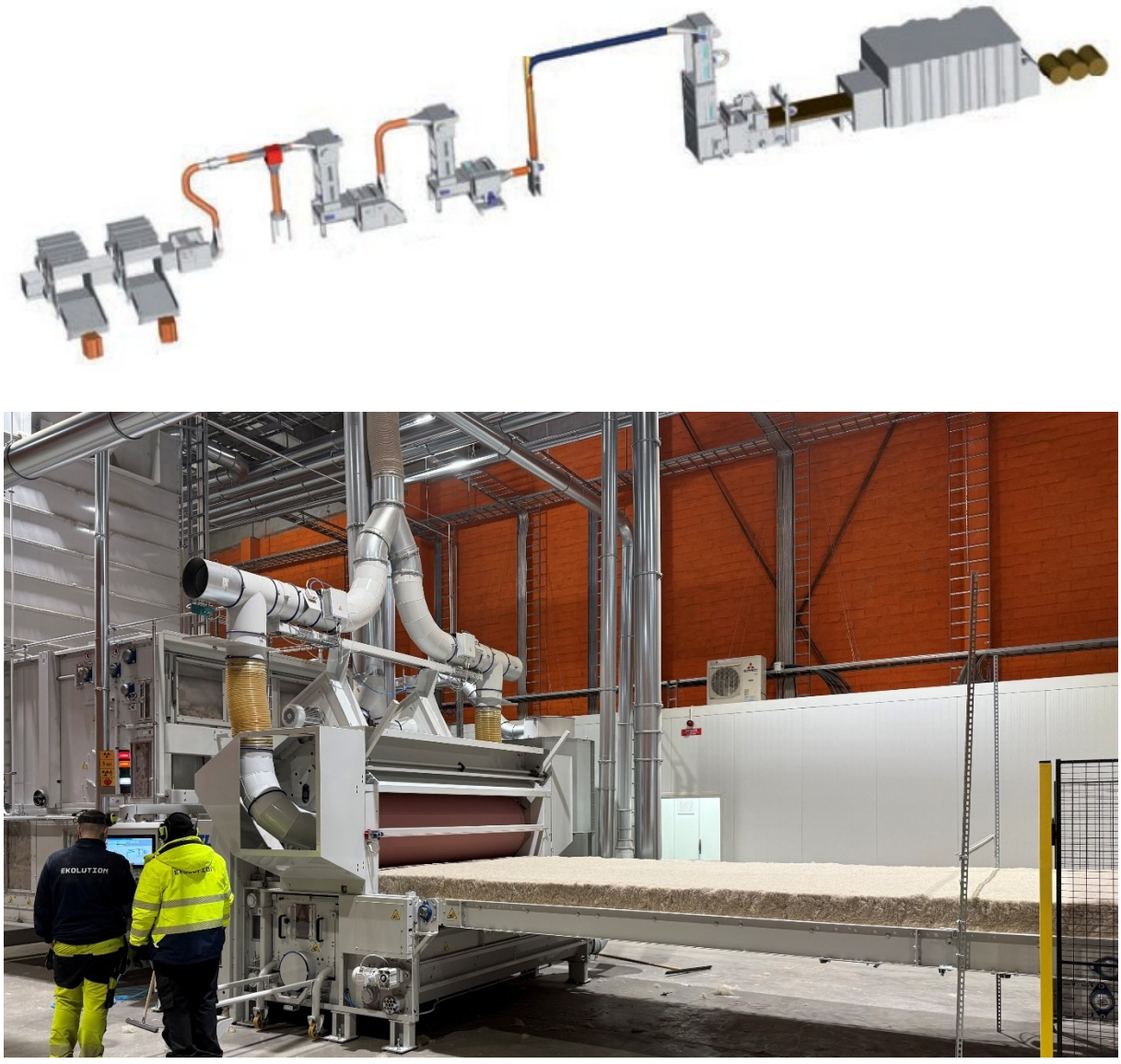


Figure 5 *Production of insulation at Ekolution factory*

The manufacturing process includes the following controlled stages (illustrated in *Figure*

1. **Preparation of raw materials** from locally grown industrial hemp
2. **Integration of functional additives**, including recycled binders
3. **Forming and thermal stabilization** of the insulation matrix
4. **Final shaping, dimensioning, and packaging** in accordance with building industry standards and custom requirements.

6 | Product Installation

Ekolution® Hemp Fiber Insulation can be cut and installed using standard construction tools, including wave-blade insulation knives for on site cutting and circular saws or band saws for industrial applications.

Figure 6 *Ekolution Insulation Cutting Table*

The product is clean to handle, with no skin or respiratory irritation. No dust extraction is necessary during cutting under normal site conditions. The material does not off-gas VOCs or release microplastics, and installation does not contribute to site-level environmental pollution.

Name and location of production site(s):
Ekolution AB, Staffanstorp, Sweden

Content declaration

Material content:
Hemp fibre insulation is primarily composed of natural components. The average composition, as declared in the Environmental Product Declaration (EPD) across various products, is as follows:

- Hemp fibres: 92%
- Binder fibers (PE/PP): 5%
- Fire Retardant (Mineral salt): 3%

The binder fibres consist of polypropylene (PP) and recycled post-consumer polyethylene (PE), contributing to the insulation's structural integrity. The mineral salt - *ammonium phosphate* used as a flame retardant is a food-grade mineral salt, ensuring safe application and handling. The density of the average hemp fibre insulation product is 30 kg/m^3. Please note that these proportions reflect an average product; actual ratios may vary depending on specific product dimensions and manufacturing variations.

During the cultivation and production process, approximately 2,64 kg of CO_2 is sequestered per product unit, contributing to the material's positive environmental footprint. Importantly, no substances listed in the REACH Candidate List of Substances of Very High Concern (SVHC) are present in or used during the manufacturing of this product, in compliance with the EPD.

Packaging:
Ekolution® Hemp Fibre Insulation is packaged using polyethylene foil, a material that is recyclable when unmixed. Alternatively, it can be recovered for energy use. The final packaged products are transported on wooden pallets to installation sites, ensuring durability during handling and logistics.

Use of Recycled Material:
The bi-component fibres used in production are 25-50% derived from post-consumer recycled material, reinforcing the product's sustainable profile and commitment to circular material use. Therefore, an average of the recycled materials has been used to model a representative scenario.

Content declaration

Product contents	Mass, kg	Post-consumer recycled material, weight-% of product	Biogenic material, mass-% of product	Biogenic material, weight-% and kg C/kg[1]
Hemp Fiber	1,104	0	92	60 and 0,60
Binder	0,06	37,5	0	0 and 0
Flame Retardant	0,036	0	0	0 and 0
TOTAL	**1,2**	**1,9**	**92**	**60 and 0,60**

[1] 1 kg biogenic carbon in the product/packaging is equivalent to the uptake of 44/12 kg of CO2.

Packaging materials	Mass, kg	Post-consumer recycled material, weight-% of packaging	Weight-% (versus the product)	Biogenic material[1], weight-% and kg C/kg
Plastic film	1,17E-02	30	1,4	0 and 0
Pallet	6,25E-01	100	52	47,2 and 0,472
TOTAL	6,42E-01	98	53,4	47,2 and 0,472

Hazardous substances from the candidate list of SVHC	EC No.	CAS No.	Mass-% per declared unit
-	-	-	-

In this study, no hazardous or toxic materials or substances are included in the product that are in the candidate list of Substances of Very High Concern (SVHCs) which exceeds the limits for registration with the European Chemicals Agency (i.e., if the substance constitutes more than 0.1% of the weight of the product or any component of the product, if applicable).

Figure 7 Insulation on production line in Ekolutions factory

LCA information

Functional unit:
The declared unit in this LCA study is 1 m^2 of hemp fiber insulation with a thickness of 40 mm (R=1 $m^2 \cdot K / W$ and weight of 1.2 kg).

Reference Service Life (RSL):
The Reference Service Life (RSL) is assumed to be 60 years.

Technical lifespan:
The technical lifespan of hemp fiber insulation is up to 100 years, depending on how it's being handled.

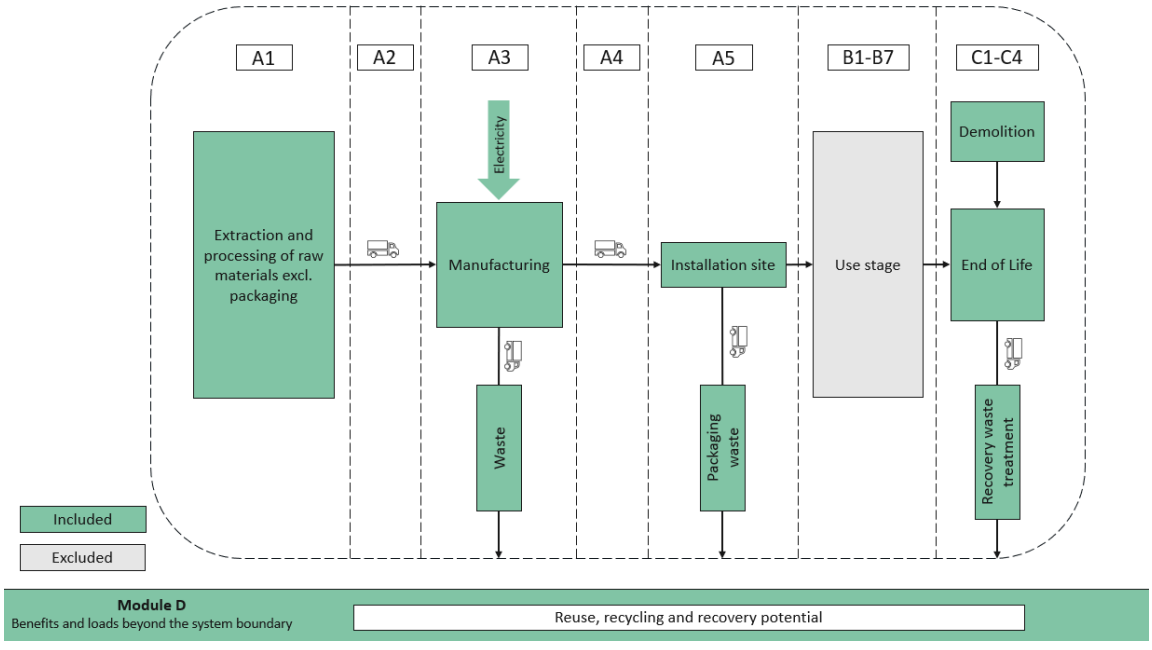
Time representativeness:
The data used to model product manufacturing correspond to 2025. The manufacturing data has been collected for a couple of months as the product is new on the market. When a full year of manufacturing data is collected, the EPD will be updated. The data from generic databases are from 2021 – 2023. No data used is older than 5 years.

Geographical scope:
The geographical scope is Sweden for all the modules included A1-A3, A4-A5, C1-C4 and D.

Database(s) and LCA software used:
Calculation completed in LCA for Experts v.10.9 with an integrated ecoinvent database 3.11. The characterization factors used in this study refer to PCR 2019:14 version 2.0.1 and EN 15804+A2 (based on EF 3.1).

Description of system boundaries:
Cradle to gate with modules C1–C4 and module D (A1–A3 + C + D).

Process flow diagram:



Allocation:
Allocation criteria are based on mass (kg). The energy used during manufacturing has been calculated based on mass allocations as the data has been collected based on the machine's intensity and collected data per kg of hemp run in the machine. The recycled content of the packaging materials are modelled to have impacts from the transportation and waste management of the materials.

Electricity used in manufacturing:
The GWP-GHG values for the manufacturing stage impacts are 0,011 kg CO_2-eq./kWh.

The following dataset has been used to model the electricity used in this study. Only wind power has been used to produce the industrial hemp.

Electricity source	Dataset	Source	Reference year
Wind power	Electricity from wind power	Sphera	2021

Cut-off criteria
The following procedures were followed for the exclusion of inputs and output.

- All input and output flows in a unit process were considered i.e., taking into account the value of all flows in the unit process and the corresponding LCI where data was available
- Generic national data was used for modules C1-C4 and D as no specific data was able to be collected
- The use of cut-off criterion on mass inputs and primary energy at the unit process level (1%) and at the information module level (5%) was not applied as all inputs were included

In this study, no hazardous or toxic materials or substances are included in the product.

Scenario descriptions for upstream and core stages

A1, Raw material supply
This stage includes acquisition and transformation of raw materials. The hemp in the hemp fiber insulation is processed at Ekolution's factory and acts as primary data into the hemp fiber insulation product. The hemp fiber insulation also contains a binder and fire retardant.

A2, Transport to manufacturer
This stage includes the transportation from the suppliers to the manufacturing site. Specific data based on suppliers' location was taken into account.

A3, Manufacturing
This stage includes resources used during the manufacturing process of the first production line as well as the second production line to create the hemp fiber insulation. Ekolution uses wind power exclusively in their factory bought from the grid mix. Manufacturing of the packaging material is included at this stage. Packaging materials consists of polyethylene (30% PCR) and pallet (100% PCR)

Scenario descriptions for downstream stages

Transport to the building site (A4)

The transportation distance out to the installation site is determined as an average distance of 300km as most products are being sold within Sweden.

Scenario information	Unit (expressed per functional unit or per declared unit)
Fuel type and consumption of vehicle or vehicle type used for transport e.g. long-distance truck, boat, etc.	Diesel, 0,019 l/tkm for average truck with a 27 ton payload
Distance	300 km
Capacity utilisation (including empty returns)	61 %
Volume capacity utilisation factor (factor: =1 or <1 or ≥ 1 for compressed or nested packaged products)	Not applicable

A5, Construction installation

The installation of the product has been assumed to be done by hand and therefore the impact is considered negligible. This stage also includes the waste management of the packaging that arises on the installation site. The PE film is being recycled and incinerated, and the pallet is being incinerated based on Swedish Statistics (SCB, 2020). See **Fel! Hittar inte referenskälla.** table below for the waste rates of the packaging materials.

Material	Recycling rate	Incineration rate	Landfill rate
Polyethylene	26%	74%	0%
Wood	0%	100%	0%

End-of-Life (C1, C3, C4)

Ekolution has a take-back system of their hemp fiber insulations, where the product is being collected separately from other construction waste.

Process	Unit (expressed per functional unit or per declared unit of components products or materials and by type of material)
C1: Collection process specified by type	1,2 kg collected separately
	0 kg collected with mixed construction waste
C3: Recovery system specified by type	0 kg for re-use
	1,2 kg for recycling
	0 kg for energy recovery
C4: Disposal specified by type	0 kg product or material for final deposition

Transport to the building site (C2)

The transportation distance reflects the average transportation distance out to the installation site in module A5 of 300 km.

Scenario information	Unit (expressed per functional unit or per declared unit)
Fuel type and consumption of vehicle or vehicle type used for transport e.g. long-distance truck, boat, etc.	Diesel, 0,019 l/tkm for average truck with a 27 ton payload
Distance	300 km
Capacity utilisation (including empty returns)	61%
Volume capacity utilisation factor (factor: =1 or <1 or ≥ 1 for compressed or nested packaged products)	Not applicable

Default values applied for End of Life (C1-C4)

Module	Processes	Energy carrier	Quantity [kWh/tonne]	Weight considered [kg]
C1	Demolition/deconstruction of concrete/reinforced concrete	Diesel	10	0
	Demolition/deconstruction of masonry, tiles and paver blocks	Diesel	5	0
	Demolition/deconstruction of steel, wood and other materials	Diesel	1.1	1,2
Module	**Processes**	**Energy carrier**	**Quantity [kWh/tonne]**	**Weight considered [kg]**
C3	Loading and unloading at sorting facility	Diesel	1.8	1,2
	Mechanical sorting	Electricity	2.2	1,2
	Crushing of concrete	Diesel	2.0	0
	Crushing of masonry, tiles and paver blocks	Diesel	1.5	0
	Fragging of steel	Diesel	7.4	0
	Chipping of wood	Diesel	6.0	0
	Treatment of other materials	Diesel	0.8	1,2
C4	Compacting of inert construction waste for landfills (including backfilling)	Diesel	1.6	0

100% scenarios

In addition to the most probable end-of-life stage scenario, 100% scenarios have been modelled to give other perspectives. The 100% scenarios have been modelled in accordance with the default values given in table 4 of PCR2019:14 Version 2.0, to complement other processes in the end-of-life stage. Values for the end-of-life stage for the 100% scenarios are described in the table below.

Module	Processes	Energy carrier	Quantity [kWh/tonne]	Weight considered [kg]
C1	Demolition/deconstruction of concrete/reinforced concrete	Diesel	10	0
	Demolition/deconstruction of masonry, tiles and paver blocks	Diesel	5	0
	Demolition/deconstruction of steel, wood and other materials	Diesel	1.1	1,2
Module	**Processes**	**Distance [km]**	**Weight considered [kg]**	
C2	Transports (for materials not to be incinerated)	80	1,2 (for recycling and landfill scenario)	
	Transports (for materials to be incinerated)	130	1,2 (for incineration scenario)	
Module	**Processes**	**Energy carrier**	**Quantity [kWh/tonne]**	**Weight considered [kg]**
C3	Loading and unloading at sorting facility	Diesel	1.8	1,2 (for recycling and incineration scenario)
	Mechanical sorting	Electricity	2.2	1,2 (for recycling and incineration scenario)
	Crushing of concrete	Diesel	2.0	0
	Crushing of masonry, tiles and paver blocks	Diesel	1.5	0
	Fragging of steel	Diesel	7.4	0
	Chipping of wood	Diesel	6.0	0
	Treatment of other materials	Diesel	0.8	1,2 (for recycling and incineration scenario)
C4	Compacting of inert construction waste for landfills (including backfilling)	Diesel	1.6	1,2 (for landfill scenario)

For module C1, the amount of diesel has been used to model. For module C2, the scenarios where the materials go to recycling or landfill 80km has been used for the transportation distance to the waste facility. For the materials going to incineration, a 130km distance has been used. For module C3, materials go through loading and unloading at sorting facility, mechanical sorting and treatment of the material for the materials that are being recycled and incinerated, in addition to the processed for recycling and incineration. For module C4, the default scenario has been used in addition to the process for landfilling of the material. Please see Figure 11 for the modelling of the 100% end-of-life scenarios.

Modules declared, geographical scope, share of specific data (in GWP-GHG results) and data variation (in GWP-GHG results):

	Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction/ demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
Module	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Modules declared	X	X	X	X	X	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
Geography	SE	SE	SE	SE	SE	-	-	-	-	-	-	-	SE	SE	SE	SE	SE
Specific data used	9,5%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	400%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	0%			-	-	-	-	-	-	-	-	-	-	-	-	-	-

ND: Not Declared

Declaration of data sources, reference years, and share of primary data:

Process	Source type	Source	Reference year	Data category	Share of primary data, of GWP-GHG results for A1-A3
Production of hemp	Database/collected data	ecoinvent 3.11/EPD owner	2022-2025	Primary data, secondary data	8,6%, 0%
Production of binder	Database	Sphera	2024	Secondary data	0%
Production of fire retardant	Database	Fertilizer Europe	2023	Secondary data	0%
Transportation of hemp	Collected data	Sphera and ecoinvent 3.11	2023	Primary data	0%
Transportation of binder	Collected data	Sphera and ecoinvent 3.11	2023	Primary data	0,3%
Transportation of fire retardant	Collected data	Sphera and ecoinvent 3.11	2023	Primary data	0,6%
Manufacturing of product	Collected data	Sphera	2020	Primary data	2%
Manufacturing of packaging	Database	Sphera, Worldsteel and ecoinvent 3.11	2021-2024	Representative data	0%
Total share of primary data, of GWP-GHG results for A1-A3	**9,5%**				

Summary of data quality:

The data quality detailed above is considered being fair as most of the data is specific to Ekolution and collected directly from their suppliers. Data has been collected during 2025, where the processing of the hemp has been collected for a couple of months during Q2 as the machines have been running to estimate an average energy consumption to be able to model with most accuracy. This EPD will be updated once a full year production has been collected.

Process	Source	Reference year	Geographical representativeness	Technical representativeness	Time representativeness	Data quality level - total
Production of hemp	EPD owner	2024-2025 (sampling Sep 2024-Jun 2025)	Good	Fair	Very good	Fair
Production of binder	Database	2024	Fair	Fair	Very good	Fair
Production of fire retardant	Database	2023	Fair	Fair	Very good	Fair
Transportation of materials	EPD owner	2024-2025	Fair	Good	Very good	Fair
Manufacturing (electricity)	EPD owner	2024-2025	Very good	Very good	Very good	Very good
Packaging materials	EPD owner	2021-2025	Fair	Fair	Very good	Fair

Environmental performance

The environmental performance results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. The results of the end-of-life stage (module C) should be considered when using the results of the production stage (modules A1-A3).

The estimated impact results are only relative statements, which do not indicate the endpoints of the impact categories, exceeding threshold values, safety margins and/or risks.

The results of the impact categories abiotic depletion of minerals and metals, land use, human toxicity (cancer), human toxicity, non-cancer and ecotoxicity (freshwater) may be highly uncertain in LCAs that include capital goods/infrastructure in generic datasets, in case infrastructure/capital goods contribute greatly to the total results. This is because the LCI data of infrastructure/capital goods used to quantify these indicators in currently available generic datasets sometimes lack temporal, technological and geographical representativeness. Caution should be exercised when using the results of these indicators for decision-making purposes.

LCA results of the product(s) - main environmental performance results

Mandatory impact category indicators according to EN 15804

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq.	-2,09E+00	2,84E-02	1,05E-01	4,35E-04	8,69E-03	2,32E+00	0,00E+00	-3,26E-01
GWP-fossil	kg CO_2 eq.	1,23E-01	2,80E-02	9,98E-02	4,35E-04	8,58E-03	7,75E-02	0,00E+00	-2,56E-01
GWP-biogenic	kg CO_2 eq.	-2,23E+00	6,70E-05	4,78E-03	4,83E-08	2,05E-05	2,24E+00	0,00E+00	-4,07E-02
GWP-LULUC	kg CO_2 eq.	2,44E-02	2,87E-04	7,57E-05	4,45E-08	8,79E-05	2,65E-05	0,00E+00	-2,96E-02
ODP	kg CFC11 eq.	4,73E-10	4,63E-15	6,00E-10	6,45E-12	1,42E-15	9,67E-10	0,00E+00	-2,28E-09
AP	mol H^+ eq.	1,03E-03	6,00E-05	3,78E-04	3,89E-06	1,90E-05	3,58E-04	0,00E+00	-1,42E-03
EP-freshwater	kg P eq.	2,89E-04	7,52E-08	1,13E-05	1,40E-08	2,30E-08	9,31E-06	0,00E+00	-3,23E-04
EP-marine	kg N eq.	1,57E-03	2,67E-05	1,51E-04	1,81E-06	8,49E-06	1,55E-04	0,00E+00	-1,89E-03
EP-terrestial	mol N eq.	4,34E-03	2,85E-04	1,41E-03	1,98E-05	9,05E-05	1,45E-03	0,00E+00	-5,66E-03
POCP	kg NMVOC eq.	4,65E-04	5,47E-05	3,88E-04	5,93E-06	1,73E-05	5,45E-04	0,00E+00	-6,51E-04
ADP-M&M[2]	kg Sb eq.	1,07E-07	1,86E-09	2,91E-07	1,55E-10	5,68E-10	3,08E-07	0,00E+00	-7,24E-07
ADP-fossil[2]	MJ	3,59E+00	3,58E-01	9,30E-01	5,61E-03	1,09E-01	8,46E-01	0,00E+00	-5,15E+00
WDP[2]	m^3	1,84E+00	1,28E-04	1,26E-01	1,72E-05	3,91E-05	8,83E-03	0,00E+00	-2,14E+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; See "additional Norwegian requirements" for indicator given as PO4 eq. **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*

Resource use

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
RERE	MJ	1,49E+01	2,70E-02	1,03E-01	3,57E-05	8,25E-03	4,13E-02	0,00E+00	-1,56E+01
PERM	MJ	2,73E+01	0,00E+00	-1,25E+01	0,00E+00	0,00E+00	-1,48E+01	0,00E+00	0,00E+00
PERT	MJ	2,98E+01	2,70E-02	1,03E-01	3,57E-05	8,25E-03	4,13E-02	0,00E+00	-1,56E+01
PERNE	MJ	3,59E+00	3,58E-01	9,30E-01	5,61E-03	1,09E-01	8,46E-01	0,00E+00	-5,15E+00
PENRM	MJ	3,57E+00	0,00E+00	-7,87E-01	0,00E+00	0,00E+00	-2,78E+00	0,00E+00	0,00E+00
PENRT	MJ	4,71E+00	3,58E-01	9,30E-01	5,61E-03	1,09E-01	8,46E-01	0,00E+00	-5,15E+00
SM	kg	6,37E-01	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	0,00E+00
NRSF	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
W	m^3	4,28E-02	1,33E-05	2,97E-03	4,00E-07	4,08E-06	2,10E-04	0,00E+00	-5,21E-02

***RERE**: Renewable primary energy resources used as energy carrier; **PERM**: Renewable primary energy resources used as raw materials; **PERT**: Total use of renewable primary energy resources; **PENRE:** Non-renewable primary energy resources used as energy carrier; **PENRM:** Non-renewable primary energy resources used as materials; **PENRT:** 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*

End of life - Waste

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
HW	kg	1,00E-04	1,43E-11	3,86E-03	5,01E-06	4,39E-12	1,01E-05	0,00E+00	-3,45E-09
NHW	kg	1,41E-03	4,99E-05	1,17E-01	3,72E-05	1,53E-05	8,83E-05	0,00E+00	-3,13E-03
RW	kg	6,63E-05	6,75E-07	1,38E-05	0,00E+00	2,07E-07	2,68E-06	0,00E+00	-5,11E-04

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

End of life – output flow

Parameter	Unit	A1-A3	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	0,00E+00	0,00E+00	6,25E-01	0,00E+00	0,00E+00	1,20E+00	0,00E+00	0,00E+00
MER	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
EEE	MJ	0,00E+00	0,00E+00	1,47E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
ETE	MJ	0,00E+00	0,00E+00	2,65E+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*

Additional mandatory and voluntary impact category indicators

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP-GHG[2]	kg CO_2 eq.	1,23E-01	2,84E-02	1,04E-01	4,35E-04	8,68E-03	8,79E-02	0,00E+00	-3,23E-01
PM	Disease incidence	4,94E-09	4,77E-10	1,08E-08	1,10E-10	1,48E-10	7,25E-09	0,00E+00	-7,42E-08
IRP[2]	kBq U235 eq.	7,93E-03	9,69E-05	3,71E-03	2,41E-06	2,97E-05	3,56E-03	0,00E+00	-6,15E-02
ETP-fw[1]	CTUe	7,09E+01	4,65E-01	4,78E-01	3,00E-04	1,42E-01	4,40E-01	0,00E+00	-7,59E+01
HTP-c[2]	CTUh	1,78E-10	6,27E-12	1,09E-10	4,69E-14	1,92E-12	7,19E-11	0,00E+00	-6,17E-10
HTP-nc[2]	CTUh	-2,04E-08	3,51E-10	1,34E-09	7,14E-13	1,07E-10	5,67E-10	0,00E+00	2,00E-08
SQP[2]	Dimensionless	3,69E+01	1,58E-01	6,40E-01	3,72E-04	4,84E-02	2,14E-01	0,00E+00	-4,19E+01

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*

[2] This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such, the indicator is identical to GWP-total except that the CF for biogenic CO_2 is set to zero.

Information describing the biogenic carbon content at the factory gate

Biogenic carbon content	Unit (expressed per declared unit)
Biogenic carbon content in product	6,62E-01 kg CO_2
Biogenic carbon content in the accompanying packaging	2,95E-01 kg CO_2
Note:	1 kg biogenic carbon in the product/packaging is equivalent to the uptake of 44/12 kg of CO2.

Additional LCA results

In addition to the most probable scenario, results from the corresponding 100% scenarios are added in this section.

Mandatory impact category indicators according to EN 15804

Indicator	Unit	C1 100%	C2 100% RC	C2 100% INC	C2 100% LF	C3 100% RC	C3 100% INC	C3 100% LD	C4 100% RC	C4 100% INC	C4 100% LF	D 100% RC	D 100% INC	D 100% LF
GWP-total	kg CO_2 eq.	4,35E-04	1,56E-02	1,56E-02	1,56E-02	8,90E-02	3,60E-02	0,00E+00	0,00E+00	0,00E+00	1,86E+00	-1,28E-01	-3,64E-01	0,00E+00
GWP-fossil	kg CO_2 eq.	4,35E-04	1,54E-02	1,54E-02	1,54E-02	7,75E-02	3,58E-02	0,00E+00	0,00E+00	0,00E+00	8,71E-02	-6,47E-02	-3,51E-01	0,00E+00
GWP-biogenic	kg CO_2 eq.	4,83E-08	3,69E-05	3,69E-05	3,69E-05	1,15E-02	1,51E-04	0,00E+00	0,00E+00	0,00E+00	1,77E+00	-3,68E-02	-7,15E-03	0,00E+00
GWP-LULUC	kg CO_2 eq.	4,45E-08	1,58E-04	1,58E-04	1,58E-04	2,65E-05	4,93E-05	0,00E+00	0,00E+00	0,00E+00	1,07E-04	-2,65E-02	-5,78E-03	0,00E+00
ODP	kg CFC11 eq.	6,45E-12	2,55E-15	2,55E-15	2,55E-15	9,67E-10	1,33E-11	0,00E+00	0,00E+00	0,00E+00	3,04E-12	-2,28E-09	-1,11E-12	0,00E+00
AP	mol H^+ eq.	3,89E-06	1,01E-04	1,01E-04	1,01E-04	3,58E-04	3,37E-04	0,00E+00	0,00E+00	0,00E+00	5,21E-04	-1,26E-03	-2,80E-04	0,00E+00
EP-freshwater	kg P eq.	1,40E-08	4,14E-08	4,14E-08	4,14E-08	9,31E-06	6,62E-08	0,00E+00	0,00E+00	0,00E+00	3,83E-06	-3,23E-04	-3,18E-07	0,00E+00
EP-marine	kg N eq.	1,81E-06	5,04E-05	5,04E-05	5,04E-05	1,55E-04	9,96E-05	0,00E+00	0,00E+00	0,00E+00	2,23E-04	-1,83E-03	-1,04E-04	0,00E+00
EP-terrestial	mol N eq.	1,98E-05	5,49E-04	5,49E-04	5,49E-04	1,45E-03	1,41E-03	0,00E+00	0,00E+00	0,00E+00	2,04E-03	-5,02E-03	-1,18E-03	0,00E+00
POCP	kg NMVOC eq.	5,93E-06	9,66E-05	9,66E-05	9,66E-05	5,45E-04	2,75E-04	0,00E+00	0,00E+00	0,00E+00	1,29E-03	-5,06E-04	-2,64E-04	0,00E+00
ADP-M&M[2]	kg Sb eq.	1,55E-10	1,02E-09	1,02E-09	1,02E-09	3,08E-07	3,08E-09	0,00E+00	0,00E+00	0,00E+00	3,69E-09	-7,11E-07	-2,36E-08	0,00E+00
ADP-fossil[2]	MJ	5,61E-03	1,97E-01	1,97E-01	1,97E-01	8,46E-01	5,12E-01	0,00E+00	0,00E+00	0,00E+00	1,24E+00	-6,72E-01	-8,23E+00	0,00E+00
WDP[2]	m^3	1,72E-05	7,02E-05	7,02E-05	7,02E-05	8,83E-03	2,15E-01	0,00E+00	0,00E+00	0,00E+00	9,81E-03	-2,13E+00	-2,51E-02	0,00E+00

100% RC: 100% recycling, 100% INC: 100% incineration with energy recovery, 100% LF: 100% landfill

***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; See "additional Norwegian requirements" for indicator given as PO4 eq. **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*

Additional mandatory and voluntary impact category indicators

Indicator	Unit	C1 100%	C2 100% RC	C2 100% INC	C2 100% LF	C3 100% RC	C3 100% INC	C3 100% LD	C4 100% RC	C4 100% INC	C4 100% LF	D 100% RC	D 100% INC	D 100% LF
GWP-GHG[2]	kg CO_2 eq.	4,35E-04	1,56E-02	1,56E-02	1,56E-02	8,79E-02	3,60E-02	0,00E+00	0,00E+00	0,00E+00	1,69E+00	-1,25E-01	-3,64E-01	0,00E+00
PM	Disease incidence	1,10E-10	4,27E-10	4,27E-10	4,27E-10	7,25E-09	2,43E-09	0,00E+00	0,00E+00	0,00E+00	5,03E-09	-7,24E-08	-3,41E-09	0,00E+00
IRP[1]	kBq U235 eq.	2,41E-06	5,33E-05	5,33E-05	5,33E-05	3,56E-03	4,58E-03	0,00E+00	0,00E+00	0,00E+00	2,28E-03	-2,21E-03	-1,09E-01	0,00E+00
ETP-fw[2]	CTUe	3,00E-04	2,56E-01	2,56E-01	2,56E-01	4,40E-01	1,95E-01	0,00E+00	0,00E+00	0,00E+00	6,42E-01	-7,58E+01	-1,84E-01	0,00E+00
HTP-c[2]	CTUh	4,69E-14	3,46E-12	3,46E-12	3,46E-12	7,19E-11	2,03E-11	0,00E+00	0,00E+00	0,00E+00	2,08E-11	-5,57E-10	-1,12E-10	0,00E+00
HTP-nc[2]	CTUh	7,14E-13	1,93E-10	1,93E-10	1,93E-10	5,67E-10	1,04E-09	0,00E+00	0,00E+00	0,00E+00	3,14E-09	2,05E-08	-9,28E-10	0,00E+00
SQP	Dimensionless	3,72E-04	8,70E-02	8,70E-02	8,70E-02	2,14E-01	1,54E-01	0,00E+00	0,00E+00	0,00E+00	1,10E-01	-4,07E+01	-2,07E+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*

Resource use

Parameter	Unit	C1 100%	C2 100% RC	C2 100% INC	C2 100% LF	C3 100% RC	C3 100% INC	C3 100% LD	C4 100% RC	C4 100% INC	C4 100% LF	D 100% RC	D 100% INC	D 100% LF
RERE	MJ	3,57E-05	1,48E-02	1,48E-02	1,48E-02	4,13E-02	1,41E-01	0,00E+00	0,00E+00	0,00E+00	1,35E-01	-1,36E+01	-3,63E+00	0,00E+00
PERM	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-1,48E+01	-1,48E+01	-1,48E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	MJ	3,57E-05	1,48E-02	1,48E-02	1,48E-02	4,13E-02	1,41E-01	0,00E+00	0,00E+00	0,00E+00	1,35E-01	-1,36E+01	-3,63E+00	0,00E+00
PERNE	MJ	5,61E-03	1,97E-01	1,97E-01	1,97E-01	8,46E-01	5,12E-01	0,00E+00	0,00E+00	0,00E+00	1,24E+00	-6,72E-01	-8,23E+00	0,00E+00
PENRM	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-2,78E+00	-2,78E+00	-2,78E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PENRT	MJ	5,61E-03	1,97E-01	1,97E-01	1,97E-01	8,46E-01	5,12E-01	0,00E+00	0,00E+00	0,00E+00	1,24E+00	-6,72E-01	-8,23E+00	0,00E+00
SM	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	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	0,00E+00	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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
W	m^3	4,00E-07	7,33E-06	7,33E-06	7,33E-06	2,10E-04	5,06E-03	0,00E+00	0,00E+00	0,00E+00	2,66E-04	-4,95E-02	-4,69E-03	0,00E+00

***RERE**: Renewable primary energy resources used as energy carrier; **PERM**: Renewable primary energy resources used as raw materials; **PERT**: Total use of renewable primary energy resources; **PENRE:** Non-renewable primary energy resources used as energy carrier; **PENRM:** Non-renewable primary energy resources used as materials; **PENRT:** 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*

End of life - Waste

Parameter	Unit	C1 100%	C2 100% RC	C2 100% INC	C2 100% LF	C3 100% RC	C3 100% INC	C3 100% LD	C4 100% RC	C4 100% INC	C4 100% LF	D 100% RC	D 100% INC	D 100% LF
HW	kg	5,01E-06	7,90E-12	7,90E-12	7,90E-12	1,01E-05	1,01E-05	0,00E+00	0,00E+00	0,00E+00	2,23E-06	0,00E+00	-5,54E-09	0,00E+00
NHW	kg	3,72E-05	2,75E-05	2,75E-05	2,75E-05	8,83E-05	3,85E-02	0,00E+00	0,00E+00	0,00E+00	7,28E-01	0,00E+00	-5,05E-03	0,00E+00
RW	kg	0,00E+00	3,71E-07	3,71E-07	3,71E-07	2,68E-06	2,88E-05	0,00E+00	0,00E+00	0,00E+00	1,54E-05	0,00E+00	-9,37E-04	0,00E+00

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

End of life – output flow

Parameter	Unit	C1 100%	C2 100% RC	C2 100% INC	C2 100% LF	C3 100% RC	C3 100% INC	C3 100% LD	C4 100% RC	C4 100% INC	C4 100% LF	D 100% RC	D 100% INC	D 100% LF
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	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	1,20E+00	0,00E+00	0,00E+00	0,00E+00	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	0,00E+00	0,00E+00	0,00E+00	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	2,72E+00	0,00E+00	0,00E+00	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	4,89E+00	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*

Additional Environmental Information

Conversion factor for product variants:
The different products which are covered in this EPD are mentioned in the below table with product descriptions and conversion factors to multiply the results by to receive the correct values for the respective products.

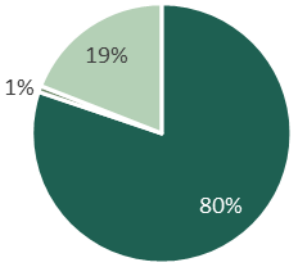
Please note that the different products have the same declared content and the ratio is also the same. Hence, the environmental impact remains the same for each product but scaled to represent each product as stated below.

Product	Density	Thickness T (mm)	Conversion factor	Variation (%) GWP-GHG
Ekolution Hemp Fiber Insulation IB50	50	30 – 100	1.67	+67
Ekolution Hemp Fiber Insulation IB70	70	30 – 100	2.34	+234
Ekolution Hemp Fiber Insulation IB100	100	30 – 100	3.33	+333
Ekolution Hemp Fiber Insulation IB120	120	30 – 100	4	+400

*Custom densities (30 – 120 kg/m^3) and lengths up to 2400 mm supplied on request.
Full product matrix available at **www.ekolution.se**.

LCA: Interpretation

The different life cycle stages have different impact on the total environmental impact from the production of hemp fibre insulation. The result of the GWP fossil during the product stage (A1-A3) is from the production of raw material (A1) that contributes to 80% of the total impact. Meanwhile, the A2 stage accounts for 1% and the A3 stage for 19%.



The raw material stage is declared including the CO_2 sequestered in the product. The results of the LCA study show that the biogenic carbon dioxide sequestered during plant growth exceeds the emissions from the manufacturing of the product (A1-A3). A closer look on the data reveals that the bi-component fibre used as a binding agent stands for 44% of the total climate impact (GWP fossil), while the hemp fibre production and fire retardant only stand for 22% and 16% respectively.

Environmental & Health Advantages

- **CO_2 sequestration**: Industrial hemp absorbs large volumes of atmospheric CO_2 during rapid growth cycles
- **Minimal embodied energy**: Significantly lower other insulations materials
- **Thermal inertia**: High specific heat moderates temperature fluctuations indoors
- **Moisture buffering**: Naturally regulates indoor humidity, improving occupant comfort
- **Non-toxic and hypoallergenic**: Free from VOCs, microplastics, and skin irritants
- **100% renewable and recyclable**: Supports circular material flows in future-proof buildings

Biogenic carbon uptake:

Hemp is a crop that binds up to 24 tonnes of carbon dioxide per hectare (depends on the yield of harvest usually between 10-12 tons per hectare). Studies have obtained results concerning the amount of carbon dioxide that is sequestered per kilogram of products, but an average 2.023 kg CO_2 per kilogram of hemp fibre has been estimated.

Hemp can be grown anywhere in the world, and it is possible to obtain a full harvest in about 100 days. This means a much more time efficient growth rate if compared with other crops and biomass sources, e.g. boreal forests can take around 70 years for one full harvest. This property can make a significant difference in climate change mitigation, as climate impact depends heavily on the timing of the emissions and uptakes.

Other properties:

Almost all varieties of hemp are naturally resistant to insect pests and predators. Not only does this mean that harmful chemical pesticides – which can leach into the soil and waterways – need not be used. Hemp is an important plant for crop rotation for several reasons. Firstly, despite it being an annual crop, hemp's roots reach deep down into the soil. This both helps to hold the soil together, reducing erosion, and to loosen the soil, allowing more delicate plants to grow afterwards. Secondly, hemp produces high quantities of biomass (a matter which returns to the soil and decomposes,

feeding nutrients back into the ground). For this reason, hemp is often grown in rotation with winter cereals, which require high-quality soil.

Moreover, no processing is necessary to extract natural bonding agents from naturally produced hemp fibres, making hemp a superior crop with potential applications in a broad range of products. The significant strength of the hemp fibres and its vapour permeability makes it a remarkable material to develop a wide range of construction products.

Climate effects of biogenic carbon storage:
The GWP indicator presented in this EPD does not capture the difference made by the timing of the carbon dioxide uptake during growth. However, other methods exist to do this, one of them being Dynamic LCA where simplified estimations can be used to illustrate the benefits of hemp. Dynamic LCA is a method where the climate impact of greenhouse gas emissions and uptakes are assessed based on the time when they occur, with reference to a specific time horizon. Assuming that hemp sequesters 2.023 kg CO_2 in year 1. One stand of boreal forest sequesters 1.65 kg CO_2 per kilogram of wood harvested. And that this is equally distributed throughout the 70 years of harvesting period, the following dynamic LCA results are obtained with a time horizon of 100 years for the climate impact of the biogenic carbon uptake per kg of product harvested:

Biomass source	Cumulative radiative forcing ($W.m^2$)	Relative impact (kg CO_2 eq)
Industrial Hemp Plant	-1,47E-13	-1,5
Wood from boreal forests	-1,03E-13	-1,2

The results in the table above show the cumulative radiative forcing, the phenomenon that causes climate change, avoided by the uptake of biogenic carbon by hemp fibres and wood during the first one hundred years after the harvesting. The hemp may absorb a lower amount of carbon dioxide per kilogram of fibres produced, but since the hemp does this in only one year, the cumulative effect in terms of radiative forcing avoided is higher (-1,43 W.m2) if compared with that of the wood from boreal forests (-1,03 W.m2).

The wood from boreal forests absorbs the carbon dioxide much slower (through 70 years of harvesting periods), and therefore the cumulative radiative forcing is lower. These effects of the timing of emissions are not captured by the GWP indicators used in EPDs, since these indicators are calculated assuming that all the uptakes and emissions of carbon dioxide occur in the first year, which does not represent reality.

Disclaimers

ILCD classification	Indicator	Disclaimer
ILCD Type 1	Global warming potential (GWP)	None
	Depletion potential of the stratospheric ozone layer (ODP)	None
	Potential incidence of disease due to PM emissions (PM)	None
ILCD Type 2	Acidification potential, Accumulated Exceedance (AP)	None
	Eutrophication potential, Fraction of nutrients reaching freshwater end compartment (EP-freshwater)	None
	Eutrophication potential, Fraction of nutrients reaching marine end compartment (EP-marine)	None
	Eutrophication potential, Accumulated Exceedance (EP-terrestrial)	None
	Formation potential of tropospheric ozone (POCP)	None
	Potential Human exposure efficiency relative to U235 (IRP)	1
ILCD Type 3	Abiotic depletion potential for non-fossil resources (ADP-minerals & metals)	2
	Abiotic depletion potential for fossil resources (ADP-fossil)	2
	Water (user) deprivation potential, deprivation-weighted water consumption (WDP)	2
	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	2
	Potential Comparative Toxic Unit for humans (HTP-c)	2
	Potential Comparative Toxic Unit for humans (HTP-nc)	2
	Potential Soil quality index (SQP)	2
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.		

Abbreviations

Abbreviation	Definition
General Abbreviations	
EN	European Norm (Standard)
EPD	Environmental Product Delcaration
GPI	General Programme Instructions
ISO	International Organization for Standardization
CEN	European Committee for Standardization
CPC	Central product classification
LCA	Life Cycle Assessment
SVHC	Substances of Very High Concern
ND	Not Declared
SE	Sweden
ILCD	International Reference Life Cycle Data System
VOC	Volatile Organic Compounds

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