ECO EPD 00001349

Environmental Product Declaration

In accordance with ISO 14025 and EN 15804: 2012+A1:2013 for:

EKOLUTION® HEMP FIBRE INSULATION

From:
Ekolution AB

The EPD document from seed to finished insulation

Programme:	The International EPD® System, www.environdec.com
Programme operator:	EPD International AB
EPD registration number:	S-P-01961
Publication date:	2020-10-09
Valid until:	2025-09-24

Programme information

Programme:	The International EPD® System EPD International AB Box 210 60 SE-100 31 Stockholm Sweden www.environdec.com info@environdec.com

Product category rules (PCR): PCR 2012:01. Construction products and construction services. Version 2.3. of 2018-11-15
PCR review was conducted by: The Technical Committee of the International EPD® System. Chair: Massimo Marino. Contact via info@environdec.com
Independent third-party verification of the declaration and data according to ISO 14025:2006: ☐ EPD process certification ☒ EPD verification
Third party verifier: Mats Zackrisson, RISE Research Institutes of Sweden AB 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 from different programmes may not be comparable. If EPDs of construction products do not comply with EN 15804, they may not be comparable.

Company information

Owner of the EPD:
Ekolution AB

Description of the company:
Ekolution is a company that design, manufacture and distribute new innovative building materials and technologies for the construction industry. All raw materials, parts and products Ekolution manufactures are developed in close collaboration with the market. The resulting sustainable material and solutions are of the highest quality and with the lowest carbon footprint possible.

Ekolution develops and produces building insulation materials mainly from industrial hemp shives and hemp fibres for the construction industry. All our products are made from renewable, recycled and environmentally friendly materials. Ekolution's building materials are not only carbon-dioxide neutral, but actually carbon-negative (CO_2-negative; there is more CO_2 sequestered in the industrial hemp than emitted in the production of the final products), which differentiates Ekolution and its products from other conventional building and insulation products.

This is achievable thanks to the exceptional properties of the industrial hemp plant and therefore is the core of many our building products. Ekolution strives to become a leader in sustainable construction, through continuous improvement and innovation.

Product information

This EPD covers the production of insulation from bast fibres derived from the industrial hemp plant. The bast hemp fibres are a soft, woody fibre obtained from the hemp stems and have a very high tensile strength. The hemp fibres are often used as a reinforcement in bio-composites and has very good thermal and acoustic insulating capacity.

Ekolution® Hemp fibre Insulation is thus a bio-composite material that is very suitable for the construction sector. Ekolution® Hemp fibre insulation has several technical and environmental advantages:

- The industrial hemp binds large amounts of CO_2 in a plant during its growth, faster than most other sources of biomass raw materials.
- Low-embodied energy
- High sorption capacity (moisture buffering) and effectively adjusting humidity levels
- High specific heat inertia, means that hemp fibre takes longer to heat and cool, resulting in less temperature variations in the material
- Reducing heat consumption and energy costs
- Breathable with diffusion-open designs and building techniques.
- Very good sound attenuating properties.
- Natural, healthy and anti-bacterial
- Ecological, zero harmful and non-toxic emissions.
- Simplified production process, as the fibre is organic and comfortable against the skin and respiratory tract.
- 100% recyclable and renewable product.

Declaration

This Declaration describes a production volume/weighted average of the Hemp Fibre Insulation materials, which are produced with nonwoven machinery. The Hemp Fibre Insulation materials specified in the Declaration are used as insulating boards and as insulating materials for buildings.

The main raw materials for the manufacturing process of the insulation are hemp fibre, recycled bi-component fibre from the textile industry and caustic soda. The most relevant technical information about the product:

Product name:
Ekolution® Hemp Fibre Insulation

UN CPC code:
31449 Fibreboard of wood or other ligneous materials, Other fibreboard

Geographical scope:
Europe

Delivery status:
The following dimensions refer to standardised Ekolution® Hemp Fibre Insulation product:

Steel studs:

- Width 450 x Length 1200. T= 45, 70, 95, 120, 145, 170, 195 and 220 mm
- Width 600 x Length 1200. T= 45, 70, 95, 120, 145, 170, 195 and 220 mm

Wood studs:

- Width 405 x Length 1200. T= 45, 70, 95, 120, 145, 170, 195 and 220 mm
- Width 555 x Length 1200. T= 45, 70, 95, 120, 145, 170, 195 and 220 mm

Information about additional products specified within the scope of this EPD can be viewed at www.ekolution.se .

Application
Ekolution® Hemp Fibre Insulation is highly versatile and can be used for thermal insulation for wall, roof and floor constructions. It can also be used as an acoustic board, insulation against step sound (sub floor insulation), airborne sound and as an insulation element that can be directly used in all construction parts.

Placing on the market / Application rules
Directive (EU) No.305/2011 applies for placing the product on the market in the EU/EFTA (except Switzerland). Ekolution® Hemp Fibre Insulation materials require a Declaration of Performance taking into consideration the harmonised product standard EN 13171:2012 thermal insulation materials for buildings - Factory-made hemp fibre (WF) products - Specification. The relevant national provisions apply for the use of the products, the Centre of

building engineering, Joint Stock Company for hemp fibre insulation materials in acc. with EDA 040005-00-1201.

Manufacturing of the product

The manufacturing process of the product consists of the following steps. An infographic of the process can be found in Figure 1.

- Processing of the raw hemp stalk from bale to lose fibre
- Dust separation
- Mixing hemp fibre with binder
- Formation of the board through heating process
- Cutting the board
- Stacking, packaging

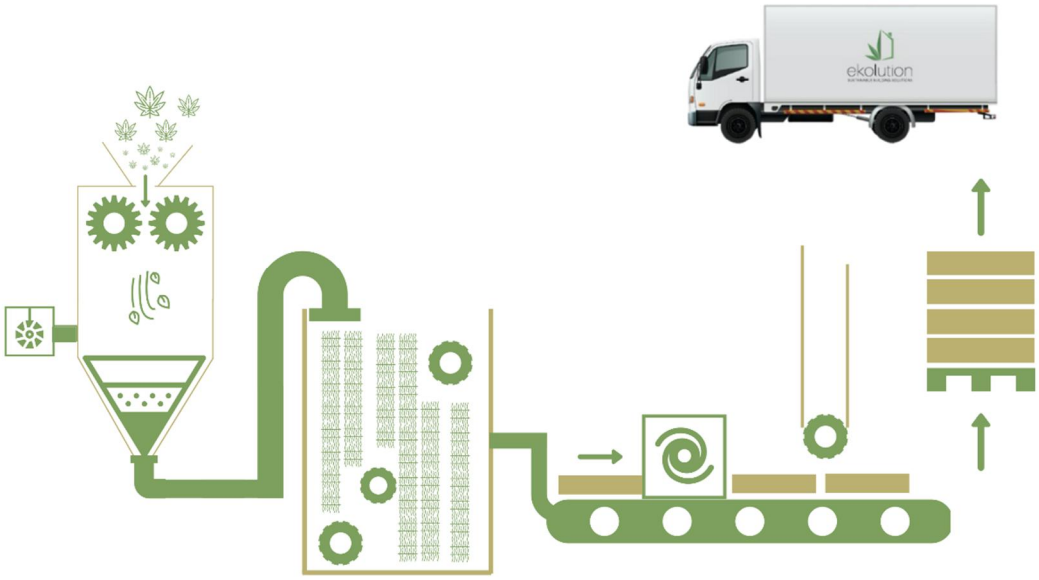


Figure 1 Infographic of the manufacturing process

Environment and health during manufacturing

No other health protection measures are required beyond normal workwear and gloves.

Product installation

Depending on the board thickness and density, Ekolution® Hemp Fibre Insulation materials can be adjusted to desirable fit using an insulation knife with wave cutting blade, alligator saw (recommended), circular saw, band saw or similar tools. Neither the processing nor the installation of Ekolution® Hemp Fibre Insulation materials leads to environmental pollution. As far as environmental protection is concerned, no additional measures are required.

Packaging

For the packaging of Ekolution® Hemp Fibre Insulation materials, foils made of polyethylene, stickers and wood are used. All packing materials are recyclable if unmixed, and/or can be recovered as energy.

Technical Data

The following information refers to the Ekolution's product range. Information about further products specified within the scope of this EPD can be viewed at www.ekolution.se:

- Gross density (in acc. with DIN EN 1602) is 35 kg/m3.
- Thermal conductivity $\lambda = 0.04$ W/(m^{2}K)., declared value (in acc. to DIN EN 12667, EN ISO 10456)
- Water vapour diffusion resistance factor (in acc. with DIN EN 12086) is 2.3 m.
- Reaction to fire class (in acc. with /DIN EN 13501-1+A1) is E.

Technical properties:

<table>
<tr><td colspan="4">Basic Works Requirement 2: Safety in case of fire (BWR 2)</td></tr>
<tr><td>1</td><td>Reaction to fire
(EN 13501-1+A1)</td><td>Class D-s1, d0</td><td>Classification Report
No. PK-16-002</td></tr>
<tr><td colspan="4">Basic Works Requirement 3: Hygiene, health and the environment (BWR 3)*</td></tr>
<tr><td>10</td><td>Water vapour diffusion resistance μ
(EN 12086)</td><td>2.294</td><td>Test Report
Č. 15/1164/T064-A</td></tr>
<tr><td>11</td><td>Water absorption
(EN 1609, method A)</td><td>1.51 kg/m^2</td><td>Test Report
Č. 15/1164/T064-A</td></tr>
<tr><td colspan="4">Basic Works Requirement 3: Hygiene, health and the environment (BWR 3)</td></tr>
<tr><td>2</td><td>Biological resistance (Growth of mould fungus)
(ÖNORM B 6010; EAD 040005-00-1201, Annex B);
EN ISO 846, method A, B, B')</td><td>There is no intensity of fungal growth</td><td>Report No. 124009/2016</td></tr>
<tr><td rowspan="2">8</td><td>Sound absorption
(EN ISO 354, EN ISO 11654)
- Sound absorption coefficient α_s
- Practical sound absorption coefficient α_p</td><td>Product thickness 100 mm
Frequency [Hz] | α_s | α_p
125 | 0,40 | 0,35
250 | 0,65 | 0,60
500 | 0,82 | 0,80
1000 | 0,81 | 0,85
2000 | 0,89 | 0,90
4000 | 1,03 | 1,00</td><td rowspan="2">Test Report
Č. 15/086/A036</td></tr>
<tr><td>- Weighted sound absorption coefficient α_w
- Class sound absorption B</td><td>Thickness [mm] | α_w [-]
100 | 0,85 (H)</td></tr>
<tr><td>18</td><td>Tensile strength parallel**
(EN 1608)
- Thickness 50 mm
- Thickness 200 mm
-</td><td>

10,1 kPa
10,2 kPa</td><td>Test Report
Č. 16/105/C005 A</td></tr>
</table>

* Hemp Fibre Insulation materials have no soluble ingredients that are hazardous to water. Hemp fibre insulation materials are not permanently resistant to standing water. Depending on the damage symptoms, damaged areas must be replaced, either partially or extensively.

** The product is mechanically resistant (pressure, tensile load) depending on the insulation material used. Hemp Fibre Insulation materials have no soluble ingredients that are hazardous to water.

Condition of use

The contents of the products apply for the average product under review. The proportions of the ingredients vary depending on the product range. During growth, approx. 4.4 kg CO_2 per declared unit is bound in the product as biogenic carbon content.

Environment and health during use

When Ekolution® Hemp Fibre Insulation materials are used, there is no hazard potential for water, air or soil. When Ekolution® Hemp Fibre Insulation materials are installed correctly, no health risks or impairments are to be expected. It is possible that small quantities of product substances as hemp dust may be released in the air.

Reference to service life

Due to the many different possible applications for Ekolution® Hemp Fibre Insulation, service life of the product can be expected to be 50-75 years, based on the estimations from the product's form stability.

Reuse & Recycled phase

When disassembled without damage, Ekolution® Hemp Fibre Insulation materials may be re-used for the same application at the end of life or may be reused in the same application spectrum in an alternative location. Insofar as the Ekolution® Hemp Fibre Insulation materials are not contaminated, the raw material can easily be materially recycled and recovered (e.g. re-admission to the production process).

Disposal

Ekolution® Hemp Fibre Insulation materials can be used as renewable energy sources for e.g. in district heating plants. Process energy as well as electricity can be generated.

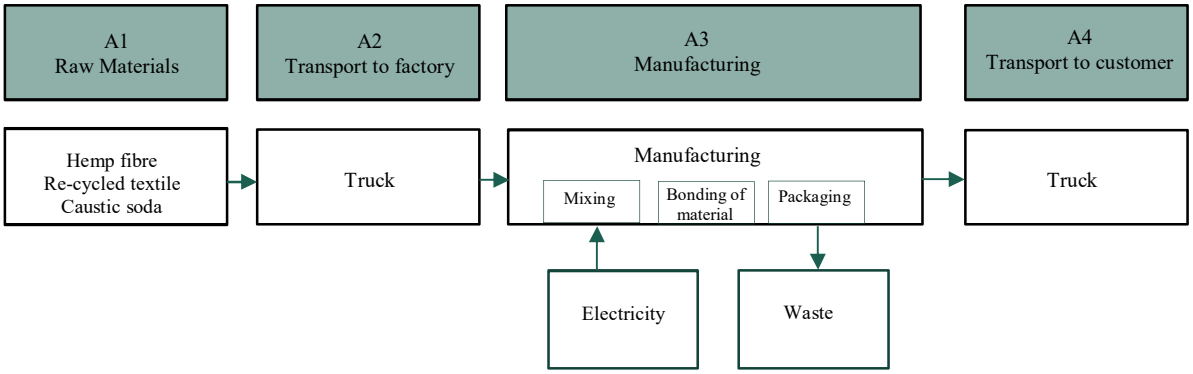
LCA information

Declared unit:
1 m^2 of Hemp Fibre Insulation with a thickness of 100 mm and a weight of 3,5 kg/m^2.

Time representativeness:
The data used to model product manufacturing correspond to 2019. The data from generic databases are from 2011 – 2018. No data used is older than 10 years.

Database(s) and LCA software used:
Databases used are mainly from Thinkstep´s own database from 2019. The LCA software used is GaBi.

System diagram:



Description of system boundaries:
Cradle-to-gate.

Excluded lifecycle stages:
The life cycle stages included are A1-A4.
The life cycle stages excluded are A5, B1-B7, C1-C4 and D.

Allocation:
No by-products are produced besides Ekolution® Hemp Fibre Insulation and no allocation procedure is necessary.

Scenarios:
The analysis is carried out using factory-specific data for use of energy and utilities and waste generation as well as product-specific data for use of raw materials. Therefore, the results represent the product system and no other scenarios are applied.

Data used:
Site-specific production data have been retrieved from the production site for 2019. The upstream and downstream processes have been modelled based on data from generic databases, mostly Thinkstep's database.

Cut-off:
The study applies a cut-off criterion of maximum 1% of the material and energy inputs of the system.

Transportation:
The transport of the raw materials to the production site is carried out by EURO6 trucks, and empty return trips have been assumed.

Energy utilities:
Only electricity is used at the final product manufacturing site in Central Europe. The electricity is obtained partly from the grid and from solar panels installed on the site. The electricity from the grid has been modelled using the Czech residual electricity grid mix in the Thinkstep database.

Direct emissions from production site:
No direct emissions are produced at the production site.

Content declaration

Material content:
Apart from hemp fibres, hemp fibre insulation materials consist of binding agents and other additives. The proportions averaged from the various products for the Environmental Product Declaration are:

- Hemp fibers: 85 %
- Bi-component fibres 12 %
- Caustic soda 3 %

The bi-component fibres consist of recycled polyethylene and polypropylene. Caustic soda is used as a flame retardant. The apparent density of the declared average hemp fibre insulation material is 35 kg/m^3.

The ingredients listed apply to the average product declared, and the proportions of the ingredients may vary depending on the product dimensions. During growth, approx. 4.4 kg CO_2 is bound in the product.

No substances that appear in the REACH candidate list of SVHC (Candidate List of Substances of Very High Concern) are present or used in the product concerning this EPD.

Packaging:
For the packaging of Ekolution® Hemp Fibre Insulation materials, foils made of polyethylene, stickers and wood are used. All packing materials are recyclable if unmixed, and/or can be recovered as energy.

Recycled material:
The bi-component fibers used as raw material are 100% obtained from recycled post-consumer textile waste.

Environmental performance

Potential environmental impact per m^2 of Hemp Fibre Insulation with 100 mm thickness

Parameter describing environmental impacts	PRODUCT STAGE				
	Raw material supply (A1)	Transport (A2)	Manufacturing (A3)	Sum of A1-A3	Transport to site (A4)
Global warming potential – fossil (GWP) [kg CO_2 eq.]	1.34E+00	3.85E-01	4.51E-01	2.18E+00	4.05E-03
Global warming potential – biogenic (GWP biogenic) [kg CO_2 eq.]	-4,4E+00	0	0	-4,4E+00	+4,4E+00*
Depletion potential of the stratospheric ozone layer (ODP) [kg CFC-11 eq.]	5.67E-10	5.18E-17	2.88E-10	8.55E-10	5.43E-19
Acidification potential (AP) [kg SO_2 eq.]	3.44E-03	3.24E-04	3.89E-04	4.15E-03	6.22E-06
Eutrophication potential (EP) [kg $(PO_4)^{3-}$ eq.]	3.81E-03	4.68E-05	3.86E-05	3.90E-03	1.20E-06
Formation potential of tropospheric ozone (POCP) [kg C_2H_4 eq.]	1.89E-04	-1.03E-05	3.75E-05	2.16E-04	1.14E-07
Abiotic depletion potential (ADP-elements) for non-fossil resources [kg Sb eq.]	5.57E-06	1.08E-08	4.02E-08	5.62E-06	1.13E-10
Abiotic depletion potential (ADP-fossil fuels) for fossil resources [MJ]	13.4	5.53	2.62	2.16E+01	0.058

* A positive emission of biogenic carbon dioxide is accounted for in A4 as required in the PCR followed by this study, as a characterisation factor of +1 kg CO_2 eq must be applied to all biogenic carbon leaving the system as part of a product. However, this biogenic carbon remains in the product as long as it is not incinerated or landfilled.

Use of resources per m^2 of Hemp Fibre Insulation with 100 mm thickness

Parameter describing environmental impacts	PRODUCT STAGE				
	Raw material supply (A1)	Transport (A2)	Manufacturing (A3)	Sum of A1-A3	Transport to site (A4)
Use of renewable primary energy excluding renewable primary energy resources used as raw materials [MJ]	4.57E+01	1.63E-02	2.33E+00	4.80E+01	1.71E-04
Use of renewable primary energy resources used as raw materials [MJ]	2.21E-02	0	1.94E-06	2.21E-02	0
Total use of renewable primary energy resources, sum of two above (PERT) [MJ]	4.57E+01	1.63E-02	2.33E+00	4.81E+01	1.71E-04
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials [MJ]	1.58E+01	5.55E+00	3.35E+00	2.47E+01	5.82E-02
Use of non-renewable primary energy resources used as raw material [MJ]	2.65E-01	2.78E-06	2.36E-05	2.65E-01	2.91E-08
Total use of non-renewable primary energy resources (PENRT), sum of two above [MJ]	1.61E+01	5.55E+00	3.35E+00	2.50E+01	5.82E-02
Use of secondary material (SM) [kg]	4.20E-01	0	0	4.20E-01	0
Use of renewable secondary fuels (RSF) [MJ]	0	0	0	0	0

Parameter describing environmental impacts	PRODUCT STAGE				
	Raw material supply (A1)	Transport (A2)	Manufacturing (A3)	Sum of A1-A3	Transport to site (A4)
Use of non-renewable secondary fuels (NRSF) [MJ]	0	0	0	0	0
Net use of fresh water (FW) [m^3]	1.37E-02	3.01E-05	1.60E-03	1.53E-02	3.15E-07

Waste production and output flows

Waste production per m^2 of Hemp Fibre Insulation with 100 mm thickness

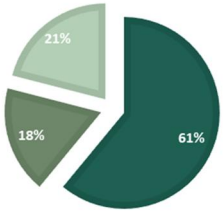
Parameter describing environmental impacts	PRODUCT STAGE				
	Raw material supply (A1)	Transport (A2)	Manufacturing (A3)	Sum of A1-A3	Transport to site (A4)
Hazardous waste disposed (HWD) [kg]	7.25E-08	5.88E-10	8.98E-10	7.40E-08	6.16E-12
Non-hazardous waste disposed (NHWD) [kg]	1.68E-01	3.31E-05	2.06E-03	1.70E-01	3.47E-07
Radioactive waste disposed (RWD) [kg]	8.85E-04	6.38E-06	2.87E-04	1.18E-03	6.69E-08

Output flows per m^2 of Hemp Fibre Insulation with 100 mm thickness

Parameter describing environmental impacts	PRODUCT STAGE				
	Raw material supply (A1)	Transport (A2)	Manufacturing (A3)	Sum of A1-A3	Transport to site (A4)
Components for re-use [kg]	0	0	0	0	0
Materials for recycling [kg]	0	0	0	0	0
Materials for energy recovery [kg]	0	0	0	0	0
Exported electrical energy [MJ]	0	0	0	0	0
Exported thermal energy [MJ]	0	0	0	0	0

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 is from the production of raw material (A1) that contributes to almost 61% of the total impact. Meanwhile, the A2 stage can be accounted with 18% and the A3 stage with about 21%.



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 40% of the total environmental effect while the hemp fibre production only stands for 10%.

Additional information

Recyclability and reusability:
All Ekolution® Hemp Fibre Insulation materials can be returned to the factory where they will be torn down and blended into new products. 100% of all insulation can be recycled to form new products. The insulation that is not reused can go directly to combustion in heating plants.

Biogenic carbon uptake:
Hemp is a crop that binds up to 22 tonnes of carbon dioxide per hectare. Studies have obtained results concerning the amount of carbon dioxide that is sequestered per kilogram of products, but an average 1.5 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 loose 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 (Levasseur et al. 2010).

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 1.7 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

Table 15 cumulative radiative forcing

The results in Table 15 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.

References

EN 15804:2012+A1:2013, Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.

General Programme Instructions of the International EPD® System. Version 3.0 of 11/12/2017.

LCA Methodology Report for 2 EPDs – LCA methodology report for a sector EPD – IKEM expanded polystyrene.

Levasseur, A. et al. (2010) Considering Time in LCA: Dynamic LCA and Its Application to Global Warming Impact Assessments. Environmental Science & Technology 2010 44 (8), 3169-3174 DOI: 10.1021/es9030003

PCR 2012:01 (Construction products and construction services) Version 2.32 of 2020-07-01.

Thinkstep (2017). GaBi Databases. http://www.gabi-software.com/international/databases/gabi-databases/

Contact information

EPD owner:	EKOLUTION AB Adress: Henrik Smithsgatan 1, 211 56 Malmö Website: www.ekolution.se Email: info@ekolution.se Telephone: +46 724 528 242 Contact: Henrik Jacobsson (henrik@ekolution.se)
LCA author:	IVL Swedish Environmental Research Institute Box 210 60 SE-100 31 Stockholm www.ivl.se Contact: Cecilia Johannesson (Cecilia.Johannesson@ivl.se); Diego Peñaloza (Diego.Penaloza@ivl.se)
Programme operator:	EPD International AB info@environdec.com

EPD®

www.environdec.com