LCA Report

IndiNature: IndiTherm

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Year of production analysed	2024
Circulation	At discretion of Industrial Nature UK Ltd
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PCR	PCR 2019:14 Being updated - Construction products (EN 15804+A2) (1.3.4)
Complemetary-PCR	PCR 2019:14-c-PCR-005 Thermal Insulation products (EN 16783) (2024-05-03)

SUMMARY

Renuables Ltd was engaged by Industrial Nature UK Ltd to undertake a life cycle assessment of hemp fibre-based insulation produced at the manufacturing site located at IndiNature Mill, Oxnam Rd, Jedburgh TD8 6NN, Scottish Borders, UK.

The results for the global warming potential (GWP) characterisation factor in units of kg CO_2e are summarised below for a declared unit of 1 m^3, or 1 kg of insulation material.

Life cycle modules	m^3	kg
Whole life carbon (excluding biogenic)	42.55	0.95
A1- A3 cradle to gate carbon (excluding biogenic)	41.59	0.92
A1- A3 cradle to gate carbon (including biogenic)	-36.99	-0.82
A1- A3 cradle to gate carbon (excl. biogenic) insulation only	38.14	0.85
A1- A3 cradle to gate carbon (incl. biogenic) insulation only	-22.46	-0.50
Biogenic carbon in the insulation	60.65	1.35
Biogenic carbon in packaging	17.93	0.40

The GWP results (kgCO_2e) for a functional unit of 1 m^2 of insulation with a thermal resistance (R) of 1 m^2K/W are shown below. Note: Thermal conductivity of insulation material is 0.039 W/mK. A thermal resistance (R) of 1 m^2K/W requires a thickness of 40 mm.

Whole life carbon (excluding biogenic)	1.66
A1- A3 cradle to gate carbon (excluding biogenic) including packaging	1.62
A1- A3 cradle to gate carbon (including biogenic) including packaging	-1.44
A1- A3 cradle to gate carbon (excl. biogenic) insulation only	1.49
A1- A3 cradle to gate carbon (incl. biogenic) insulation only	-0.88
Biogenic carbon in the insulation	2.37
Biogenic carbon in the packaging	0.70

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GOAL AND SCOPE

Renuables Ltd was engaged by Industrial Nature UK Ltd (IndiNature) to perform an attributional LCA for the full life-cycle of:

A declared unit of 1 m^3 of IndiTherm hemp fibre insulation (density 45 kg/m^3) with packaging.

A declared unit of 1 kg of IndiTherm hemp fibre insulation (density 45 kg/m^3) with packaging.

A functional unit of 1 m^2 of IndiTherm hemp fibre insulation (R = 1 m^2K/W) with packaging.

The assumed reference service life is 100 years, but depends upon the lifetime of the building in which the products is installed.

The LCA is to be used by Industrial Nature UK and the parent company for a variety of purposes, including marketing, with an emphasis on business-to-business communication. Renuables Ltd was engaged to conduct an LCA of the production process.

This LCA includes the whole life cycle modules A-D EN 15804+A2.

The inclusion of sequestered carbon in the calculation involves consideration of the whole life cycle.

The atmospheric carbon stored in the biogenic content of the product remains locked up for the lifetime of the product. At the end of life, various options are possible, including incineration with energy recovery (resulting in release of the stored atmospheric carbon as carbon dioxide) or re-use of the product (in which case the atmospheric carbon remains in storage).

The rules of EN 15804:2012+A2:2019/AC:2021 state that the release of atmospheric carbon must be considered without time limit, meaning that the storage of the atmospheric carbon sums to zero over the life cycle (or multiple life cycles), irrespective of the length of storage.

Although there is no agreed LCA methodology for dealing with length of storage of atmospheric carbon, it can be readily shown (using materials flow analysis) that increasing the lifetime of biogenic products does result in higher levels of atmospheric carbon storage in product carbon pools. This involves considering a population of products (buildings in this case) and choosing a suitable decay function to model the release of carbon into the environment.

The report accompanies the LCA Excel spreadsheet model: INDINATURE LCA CALCULATOR V5-2025-01-24.

DESCRIPTION OF COMPANY AND SITE

IndiNature was founded in 2016 to make bio-based, circular construction insulation and materials for a range of markets on an industrial scale, to have positive local and global impact on climate, communities and the environment.

The parent company Industrial Nature Ltd, 12 Clearburn Crescent, Edinburgh, EH16 5ER – leads on investment, scaling, IP and materials innovation including R&D of novel construction products and circular, biobased materials.

The manufacturing subsidiary, Industrial Nature UK Ltd, and first site for the UK is located at: IndiNature Mill, Oxnam Rd, Jedburgh, TD8 6NN, Scottish Borders, UK.

DESCRIPTION OF PROCESS

The hemp fibre is sourced from a local UK company, East Yorkshire Hemp, the soda salts come from a manufacturer in Leeds and the binder is manufactured and transported from Seoul, South Korea.

The IndiTherm® product is distributed in packs of batts, ranging from four to eight batts per pack (depending on dimensions). The packaging used is LDPE film, supplied by Polystar Packaging, in Southampton, UK, with an average of 7.9 linear meters required per cubic meter of product. The dimensions of the film are 1150 mm wide and 40 microns thick. This film is considered to be single use and is removed during the installation stage and subsequently disposed of, assumed to be landfilled.

The IndiTherm® batts are delivered in packs, ranging from four to eight batts per pack depending on the batt thickness. 50 mm thick batts are delivered in packs of eight, 80 mm thick batts are delivered in packs of five, 100 and 140 mm thick batts are delivered in packs of four.

The product is assumed to be delivered by HGV truck (diesel) under average laden conditions, using data from the Department for Energy Security and Net Zero1. The transport distance is assumed to be within a 100 km radius, with a weight of 45.34 kg per declared unit (m^3), including packaging.

DESCRIPTION OF THE INDITHERM PRODUCT

The product is IndiTherm® industrial hemp fibre insulation batt. Vapour breathable flexible insulation batts made with UK industrial hemp, with soda salts as a fire protection agent and low melting polymer as a binder. IndiTherm® can be friction fit between structural framing or against masonry – with excellent rigidity to resist slumping.

Soft to touch for installers. Very large carbon savings – net negative embodied carbon. Building occupants will benefit from the exceptional thermal and moisture buffering properties of this sustainable material. It has the added property of low-density heat storage, which means indoor temperatures stay warm in winter and cool in summer. Soundproofing in internal partition walls and floors better than 40db reduction with 50mm. Durability tested.

Technical data for the declared product.

Thermal Conductivity λ	0.039 W/m.K
Bulk Density ρ	45 kg/m³
Specific Heat Capacity C	2100 J/(kgK)
Vapour Diffusion Resistance μ	1.3
Sound Reduction	Min 40dB (50mm+)
Reaction to Fire	E – BS EN 13501-1:2018 PASS Reaction to Fire Euroclass: E Smoke Class: s1 Flaming Droplets Class: d0

Product dimensions

Dimensions (mm)	Thicknesses (mm)
370 x 1200	50, 80, 100, 140 mm
440 x 1200	50, 80, 100, 140 mm
570 x 1200	50, 80, 100, 140 mm

Reference service life

The service life of the product is the same as the service life as the building in which the product is installed, but a default value of 100 years can be assumed. This is based upon data published by the International Association of Certified Home Inspectors® [https://www.nachi.org/life-expectancy.htm] – accessed 19/09/2024 (100+ years for cellulose insulation).

LCA DATA FOR INDITHERM PRODUCT

The whole product life cycle is considered in this study. All data presented here covers modules A, B, C, D (EN15804).

Modules A1-A3
Agronomy of hemp using primary data supplied by Industrial Nature UK Ltd. Transport of hemp bales from production site in Yorkshire to IndiTherm manufacturing site in Jedburgh. Transport of other components (polymer binder and fire retardant and packaging) to Jedburgh. Use of electricity and gas (LPG) for production for period 06/03/2024 to 04/07/2024. LPG is supplied by tanker from Grangemouth, transport is included in the calculations. Standard UK grid mix is used using 12-month average up to April 2024. Production of pallet used for delivery is included.

Module A4
Transport to installation site 100 km. This is chosen as a default value, impacts for actual delivery distance can be determined by dividing characterisation values (e.g., GWP) by 100 and multiplying by actual delivery distance in km.

Module A5
Manual installation with disposal of packaging to landfill (distance 30 km). Pallet goes to wood recovery facility and exits system. No wastage of insulation product.

Modules B1-B7
No maintenance is required during the service-life of the product.

Module C1
Manual removal is assumed.

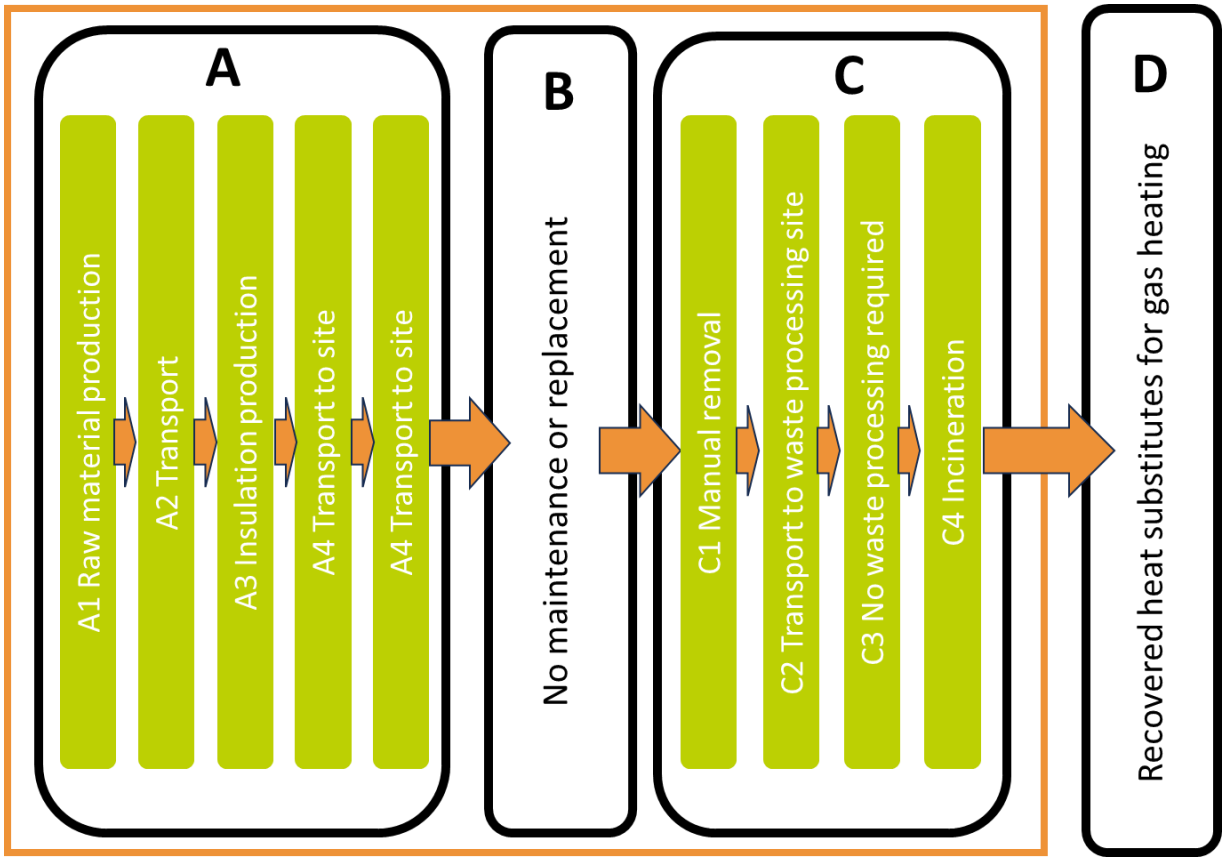
Module C2
Transport to waste incineration facility by HGV, distance 30km.

Module C3
No waste processing is required.

Module C4
Incineration of end-of-life material, with biogenic carbon shown as being released in accordance with EN 15804+A2. Thermal energy exported from system.

Module D
It is assumed that the end-of-life material is incinerated (C4) with recovery of the calorific content for heating, substituting for fossil natural gas as the energy source (80% efficiency). This is one possible scenario. Since the production is recent and a service life of at least 100 years is expected, there is no typical disposal, or recovery scenario. In the future, take-back may be an option, but the environmental merits of this compared with incineration would have to be determined on a case-by-case basis, with transportation being a significant part of the calculation.

Flow diagram of included life cycle stages



Cut-off criteria

Cut off criteria were based upon input flows being less than 1% of the total individually, subject to the sum of all flows being less than 5% of the total, subject to verification that the impacts associated with such flows were not of a magnitude to affect the reported data significantly (less than 5% in total).

Characterization factors

Ecoinvent 3.10 background data was used with Simapro 9.6.

- EF3.1 was used for all impact characterisation factors, except:
- CED for Primary energy resources renewable used as energy carrier and primary energy resources non-renewable used as an energy carrier.
- AWARE for water scarcity potential.

Lower heating value (LHV) was used for primary energy resources renewable/non-renewable used as raw materials. This information was obtained from the Phyllis 2 database.

UK grid mix

UK electricity grid primary energy mix is based upon 2023-24 average.

Primary energy	%
Gas	32
Wind	29.4
Nuclear	14.2
Biomass	5
Coal	1
Solar	4.9
Imports	10.7
Hydro	1.8
Storage	1
TOTAL	**100**

GWP = 0.227 kgCO_2e/kWh

Further environmental information

Calculation of biogenic carbon in the product is based upon the following:

Composition of hemp

Cellulose (%)	Hemicellulose (%)	Lignin (%)	Total (%)
75	19	6	100

Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8911747

Atomic ratios of each component

Component	C	H	O	Ratio
Cellulose	1	2	1	0.75
Hemicellulose	1	2	1	0.19
Lignin	1	1.3	0.4	0.06
Hemp overall	**1.000**	**1.958**	**0.964**	**1.00**

Atomic weight of C = 12, H = 1, O = 16. Therefore, the mass proportion of carbon in hemp is: (1 x 12) / [(1 x 12) + (1.958 x 1) + (0.964 x 16)] = 0.41

The weight of hemp in 1 m^3 of IndiTherm is 40.5 kg, therefore weight of carbon in 1 m^3 of product is 0.41 x 40.5 = 16.5 kg, which is equivalent to 16.5 x (44/12) =

60.6 kg CO_2e / m^3 product

Calorific content of components (lower heating value):

Material	MJ/kg
Hemp	18.0
Polymer binder	21.9
LDPE	40.2

Calculation of weight of LDPE packaging used per m^3 of product:

Length	7.9	m
Width	1.15	m
Thickness	4.00 x 10^{-5}	m
Volume	3.63 x 10^{-4}	m^3
Density of LDPE	930	kg/m^3
Weight	0.338	kg

Weight = 7.9 x 1.15 x 4 x 10^{-5} x 930 = 0.338 kg per m^3 of product

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	X	X	X	X	X	X	X	X	X	X	X	X
Geography	GLO	GLO	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK
Specific data used	55%					-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	0%					-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	0%					-	-	-	-	-	-	-	-	-	-	-	-

Content information

IndiTherm materials per m^3 of product

Product components	**Weight, kg**	**Post-consumer material, weight-%**	**Biogenic material, weight-% and kg C/kg**
Hemp	40.5	0	(41%, 16.5 kgC) 60.7 $kgCO_2e$
Polymer binder	4.05	0	0% 0kgC
Fire retardant	0.45	0	0% 0kgC
TOTAL	**45.0**	**0**	**37%, 16.5 kgC, 60.7 $kgCO_2e$**
Packaging materials	**Weight, kg**	**Weight-% (versus the product)**	**Weight biogenic carbon, kg C**
Low density polyethylene	0.034	1.67	0.00
Pallet	0.978	2.17	1.80
TOTAL	**1.012**	**3.84**	**1.80**

Environmental Information

This EPD contains information about environmental impact, use of resources and waste production in the form of quantitative indicators. The following abbreviations and have been used in the tables which quantify environmental performance:

Indicator	Abbreviation
Global warming potential (Fossil, biogenic, land use and transformation (LUT))	GWP
Depletion potential of the stratospheric ozone layer	ODP
Acidification potential	AP
Eutrophication potential	EP
Formation potential of tropospheric ozone	POCP
Abiotic depletion potential – Elements	ADPE
Abiotic depletion potential – Fossil resources	ADPF
Water scarcity potential	WSP
Primary energy resources – Renewable (use as energy carrier)	PERE
Primary energy resources – Renewable (use raw materials)	PERM
Primary energy resources – Renewable (total)	PERT
Primary energy resources – Non-renewable (use as energy carrier)	PENRE
Primary energy resources – Non-renewable (use raw materials)	PENRM
Primary energy resources – Non-renewable (total)	PENRT
Secondary material	SM
Renewable secondary fuels	RSF
Non-renewable secondary fuels	NRSF
Net use of fresh water	NUFW
Hazardous waste disposed	HWD
Non-hazardous waste disposed	NHWD
Radioactive waste disposed	RWD
Components for re-use	CRU
Material for recycling	MFR
Materials for energy recovery	MFER
Exported energy, electricity	EEE
Exported energy, thermal	EET
Particulate Matter emissions	PM
Ionizing radiation, human health	IRP
Eco-toxicity – freshwater	ETP-fw
Human toxicity, cancer effect	HTP-c
Human toxicity, non-cancer effects	HTP-nc
Land use related impacts/Soil quality	SQP

RESULTS

IndiTherm

Environmental Information for 1m^3 of insulation product

Potential environmental impact– mandatory indicators according to EN 15804

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C2	C4	D
GWP-fossil	kg CO_2 eq.	2.33E+01	2.99E+00	1.52E+01	4.15E+01	5.96E-01	3.40E-02	1.46E-01	1.83E-01	-4.31E+01
GWP-biogenic	kg CO_2 eq.	-7.86E+01	4.65E-04	3.50E-03	-7.86E+01	9.77E-05	1.79E+01	2.39E-05	6.06E+01	-4.82E-03
GWP-luluc	kg CO_2 eq.	2.72E-02	1.17E-03	2.89E-03	3.12E-02	2.03E-04	1.13E-05	4.97E-05	2.64E-05	-3.76E-03
GWP-total	kg CO_2 eq.	-5.52E+01	2.99E+00	1.52E+01	-3.70E+01	5.97E-01	1.80E+01	1.46E-01	6.08E+01	-4.32E+01
ODP	kg CFC 11 eq.	6.13E-05	5.56E-08	7.69E-07	6.21E-05	1.21E-08	6.81E-10	2.96E-09	6.56E-09	-1.97E-06
AP	mol H^+ eq.	1.12E-01	3.66E-02	2.37E-02	1.72E-01	3.32E-03	1.92E-04	8.13E-04	1.19E-02	-3.41E-02
EP-freshwater	kg P eq.	6.02E-03	1.72E-04	6.73E-04	6.86E-03	4.03E-05	2.35E-06	9.87E-06	1.46E-05	-7.80E-04
EP-marine	kg N eq.	2.32E-02	1.11E-02	7.73E-03	4.20E-02	1.39E-03	8.04E-05	3.40E-04	5.69E-03	-1.23E-02
EP-terrestrial	mol N eq.	2.60E-01	1.23E-01	8.81E-02	4.71E-01	1.51E-02	8.78E-04	3.71E-03	6.63E-02	-1.33E-01
POCP	kg NMVOC eq.	1.09E-01	3.69E-02	3.22E-02	1.78E-01	5.12E-03	2.95E-04	1.25E-03	1.75E-02	-8.10E-02
ADP-minerals&metals*	kg Sb eq.	1.92E-04	6.57E-06	1.74E-05	2.16E-04	1.60E-06	8.84E-08	3.91E-07	2.88E-07	-1.50E-05
ADP-fossil*	MJ	4.54E+02	4.16E+01	3.04E+02	8.00E+02	8.69E+00	4.93E-01	2.13E+00	2.86E+00	-6.36E+02
WDP*	m^3	1.00E-02	0.00E+00	5.84E-01	5.94E-01	0.00E+00	3.69E-02	0.00E+00	0.00E+00	-2.20E-01

** Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*
Note: All modules, are declared, but where there are nil entries, they are not included in the EPD to make the data more legible.

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C2	C3	D
GWP-GHG*	kg CO_2 eq.	2.34E+01	2.99E+00	1.52E+01	4.16E+01	5.97E-01	3.40E-02	1.46E-01	1.83E-01	-4.32E+01

**GWP-GHG - 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*

Potential environmental impact – additional mandatory and voluntary indicators (1 m^3)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C2	C3	D
PM	Disease incidence	1.35E-06	2.89E-07	1.61E-07	1.80E-06	7.35E-08	4.29E-09	1.80E-08	9.33E-08	-1.81E-07
IRP	kBq U235 eq.	6.98E+00	4.24E-02	4.55E+00	1.16E+01	1.05E-02	5.89E-04	2.56E-03	3.44E-03	-2.39E-01
ETP-fw	CTUe	1.55E+02	9.10E+00	1.43E+01	1.78E+02	2.04E+00	1.19E-01	4.99E-01	3.23E-01	-2.83E+01
HTP-c	CTUh	5.35E-08	5.35E-08	9.75E-08	2.04E-07	1.35E-08	7.49E-10	3.30E-09	1.42E-09	-1.11E-07
HTP-nc	CTUh	2.30E-07	3.42E-08	6.31E-09	2.71E-07	7.53E-09	4.16E-10	1.84E-09	2.50E-08	-1.23E-08
SQP	dimensionless	1.21E+03	3.19E+01	1.19E+02	1.36E+03	8.63E+00	5.49E-01	2.11E+00	1.32E-01	-1.01E+01

Use of resources (1 m^3)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C2	C4	D
PERE	MJ	2.34E+02	5.68E-01	8.41E+01	3.19E+02	1.37E-01	7.67E-03	3.35E-02	3.62E-02	-2.67E+00
PERM	MJ	6.93E+02	0.00E+00	0.00E+00	6.93E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	9.27E+02	5.68E-01	8.41E+01	1.01E+03	1.37E-01	7.67E-03	3.35E-02	3.62E-02	-2.67E+00
PENRE	MJ	4.86E+02	4.42E+01	3.28E+02	8.58E+02	9.24E+00	5.24E-01	2.26E+00	3.16E+00	-7.05E+02
PENRM	MJ	1.02E+02	0.00E+00	0.00E+00	1.02E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	5.88E+02	4.42E+01	3.28E+02	9.60E+02	9.24E+00	5.24E-01	2.26E+00	3.16E+00	-7.05E+02
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
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
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
FW	m^3	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

Waste production and output flows

Waste production (1 m^3)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C2	C4	D
HWD	kg	4.01E-03	2.59E-04	1.07E-03	5.34E-03	5.71E-05	3.23E-06	1.40E-05	1.37E-05	-2.82E-03
NHWD	kg	2.20E+00	2.65E+00	5.78E-01	5.43E+00	7.32E-01	3.78E-01	1.79E-01	6.56E-03	-9.12E-01
RWD	kg	4.73E-04	1.05E-05	1.08E-03	1.57E-03	2.59E-06	1.46E-07	6.34E-07	9.08E-07	-6.02E-05

Output flows (1 m^3)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C2	C4	D
CRU	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
MFR	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
MFER	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
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	0.00E+00
EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.81E+02	0.00E+00

Environmental Information for 1 kg of insulation product

Potential environmental impact– mandatory indicators according to EN 15804

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C2	C4	D
GWP-fossil	kg CO_2 eq.	5.18E-01	6.64E-02	3.38E-01	9.23E-01	1.33E-02	7.55E-04	3.25E-03	4.07E-03	-9.59E-01
GWP-biogenic	kg CO_2 eq.	-1.75E+00	1.03E-05	7.77E-05	-1.75E+00	2.17E-06	3.98E-01	5.32E-07	1.35E+00	-1.07E-04
GWP-luluc	kg CO_2 eq.	6.04E-04	2.60E-05	6.41E-05	6.94E-04	4.51E-06	2.52E-07	1.10E-06	5.88E-07	-8.35E-05
GWP-total	kg CO_2 eq.	-1.23E+00	6.64E-02	3.38E-01	-8.22E-01	1.33E-02	3.99E-01	3.25E-03	1.35E+00	-9.59E-01
ODP	kg CFC 11 eq.	1.36E-06	1.24E-09	1.71E-08	1.38E-06	2.69E-10	1.51E-11	6.58E-11	1.46E-10	-4.37E-08
AP	mol H^+ eq.	2.49E-03	8.14E-04	5.26E-04	3.83E-03	7.38E-05	4.28E-06	1.81E-05	2.64E-04	-7.59E-04
EP-freshwater	kg P eq.	1.34E-04	3.82E-06	1.50E-05	1.52E-04	8.96E-07	5.22E-08	2.19E-07	3.24E-07	-1.73E-05
EP-marine	kg N eq.	5.15E-04	2.47E-04	1.72E-04	9.34E-04	3.08E-05	1.79E-06	7.55E-06	1.26E-04	-2.73E-04
EP-terrestrial	mol N eq.	5.78E-03	2.73E-03	1.96E-03	1.05E-02	3.37E-04	1.95E-05	8.24E-05	1.47E-03	-2.96E-03
POCP	kg NMVOC eq.	2.43E-03	8.20E-04	7.16E-04	3.96E-03	1.14E-04	6.56E-06	2.78E-05	3.90E-04	-1.80E-03
ADP-minerals&metals*	kg Sb eq.	4.26E-06	1.46E-07	3.88E-07	4.79E-06	3.55E-08	1.96E-09	8.69E-09	6.40E-09	-3.33E-07
ADP-fossil*	MJ	1.01E+01	9.24E-01	6.76E+00	1.78E+01	1.93E-01	1.09E-02	4.73E-02	6.35E-02	-1.41E+01
WDP*	m^3	2.23E-04	0.00E+00	1.30E-02	1.32E-02	0.00E+00	8.19E-04	0.00E+00	0.00E+00	-4.89E-03

** Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*
Note: All modules, are declared, but where there are nil entries, they are not included in the EPD to make the data more legible.

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C2	C3	D
GWP-GHG*	kg CO_2 eq.	5.20E-01	6.64E-02	3.38E-01	9.24E-01	1.33E-02	7.55E-04	3.25E-03	4.07E-03	-9.59E-01

**GWP-GHG - 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*

Potential environmental impact – additional mandatory and voluntary indicators (1 kg)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C2	C3	D
PM	Disease incidence	2.99E-08	6.43E-09	3.58E-09	3.99E-08	1.63E-09	9.54E-11	4.00E-10	2.07E-09	-4.02E-09
IRP	kBq U235 eq.	1.55E-01	9.42E-04	1.01E-01	2.57E-01	2.33E-04	1.31E-05	5.70E-05	7.64E-05	-5.32E-03
ETP-fw	CTUe	3.45E+00	2.02E-01	3.17E-01	3.96E+00	4.53E-02	2.63E-03	1.11E-02	7.18E-03	-6.29E-01
HTP-c	CTUh	1.19E-09	1.19E-09	2.17E-09	4.54E-09	2.99E-10	1.66E-11	7.33E-11	3.16E-11	-2.46E-09
HTP-nc	CTUh	5.12E-09	7.60E-10	1.40E-10	6.02E-09	1.67E-10	9.24E-12	4.10E-11	5.55E-10	-2.73E-10
SQP	dimensionless	2.70E+01	7.08E-01	2.63E+00	3.03E+01	1.92E-01	1.22E-02	4.70E-02	2.93E-03	-2.24E-01

Use of resources (1 kg)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C2	C4	D
PERE	MJ	5.21E+00	1.26E-02	1.87E+00	7.09E+00	3.04E-03	1.70E-04	7.43E-04	8.04E-04	-5.93E-02
PERM	MJ	1.54E+01	0.00E+00	0.00E+00	1.54E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	2.06E+01	1.26E-02	1.87E+00	2.25E+01	3.04E-03	1.70E-04	7.43E-04	8.04E-04	-5.93E-02
PENRE	MJ	1.08E+01	9.83E-01	7.29E+00	1.91E+01	2.05E-01	1.16E-02	5.03E-02	7.02E-02	-1.57E+01
PENRM	MJ	2.27E+00	0.00E+00	0.00E+00	2.27E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	1.31E+01	9.83E-01	7.29E+00	2.13E+01	2.05E-01	1.16E-02	5.03E-02	7.02E-02	-1.57E+01
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
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
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
FW	m^3	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

Waste production and output flows

Waste production (1 kg)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C2	C4	D
HWD	kg	8.92E-05	5.75E-06	2.38E-05	1.19E-04	1.27E-06	7.18E-08	3.11E-07	3.05E-07	-6.26E-05
NHWD	kg	4.89E-02	5.90E-02	1.28E-02	1.21E-01	1.63E-02	8.41E-03	3.99E-03	1.46E-04	-2.03E-02
RWD	kg	1.05E-05	2.33E-07	2.40E-05	3.48E-05	5.75E-08	3.23E-09	1.41E-08	2.02E-08	-1.34E-06

Output flows (1 kg)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C2	C4	D
CRU	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
MFR	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
MFER	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
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	0.00E+00
EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.74E+01	0.00E+00

Environmental Information for 1 m^2 of insulation product (R = 1 m^2K/W)

Potential environmental impact– mandatory indicators according to EN 15804

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C2	C4	D
GWP-fossil	kg CO_2 eq.	9.10E-01	1.17E-01	5.93E-01	1.62E+00	2.33E-02	1.32E-03	5.70E-03	7.15E-03	-1.68E+00
GWP-biogenic	kg CO_2 eq.	-3.06E+00	1.81E-05	1.36E-04	-3.06E+00	3.81E-06	6.99E-01	9.34E-07	2.37E+00	-1.88E-04
GWP-luluc	kg CO_2 eq.	1.06E-03	4.57E-05	1.13E-04	1.22E-03	7.91E-06	4.42E-07	1.94E-06	1.03E-06	-1.46E-04
GWP-total	kg CO_2 eq.	-2.15E+00	1.17E-01	5.94E-01	-1.44E+00	2.33E-02	7.01E-01	5.70E-03	2.37E+00	-1.68E+00
ODP	kg CFC 11 eq.	2.39E-06	2.17E-09	3.00E-08	2.42E-06	4.71E-10	2.66E-11	1.15E-10	2.56E-10	-7.67E-08
AP	mol H^+ eq.	4.38E-03	1.43E-03	9.23E-04	6.73E-03	1.30E-04	7.51E-06	3.17E-05	4.64E-04	-1.33E-03
EP-freshwater	kg P eq.	2.35E-04	6.70E-06	2.63E-05	2.68E-04	1.57E-06	9.16E-08	3.85E-07	5.68E-07	-3.04E-05
EP-marine	kg N eq.	9.04E-04	4.34E-04	3.02E-04	1.64E-03	5.41E-05	3.14E-06	1.33E-05	2.22E-04	-4.80E-04
EP-terrestrial	mol N eq.	1.01E-02	4.78E-03	3.43E-03	1.84E-02	5.91E-04	3.42E-05	1.45E-04	2.58E-03	-5.20E-03
POCP	kg NMVOC eq.	4.26E-03	1.44E-03	1.26E-03	6.95E-03	2.00E-04	1.15E-05	4.89E-05	6.84E-04	-3.16E-03
ADP-minerals&metals*	kg Sb eq.	7.47E-06	2.56E-07	6.81E-07	8.41E-06	6.23E-08	3.45E-09	1.53E-08	1.12E-08	-5.85E-07
ADP-fossil*	MJ	1.77E+01	1.62E+00	1.19E+01	3.12E+01	3.39E-01	1.92E-02	8.30E-02	1.11E-01	-2.48E+01
WDP*	m^3	3.91E-04	0.00E+00	2.28E-02	2.32E-02	0.00E+00	1.44E-03	0.00E+00	0.00E+00	-8.58E-03

** Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*
Note: All modules, are declared, but where there are nil entries, they are not included in the EPD to make the data more legible.

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C2	C3	D
GWP-GHG*	kg CO_2 eq.	9.12E-01	1.17E-01	5.94E-01	1.62E+00	2.33E-02	1.33E-03	5.70E-03	7.15E-03	-1.68E+00

**GWP-GHG - 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*

Potential environmental impact – additional mandatory and voluntary indicators (1 m^2 R = 1)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C2	C3	D
PM	Disease incidence	5.25E-08	1.13E-08	6.28E-09	7.01E-08	2.86E-09	1.67E-10	7.02E-10	3.64E-09	-7.06E-09
IRP	kBq U235 eq.	2.72E-01	1.65E-03	1.78E-01	4.52E-01	4.08E-04	2.30E-05	1.00E-04	1.34E-04	-9.34E-03
ETP-fw	CTUe	6.05E+00	3.55E-01	5.56E-01	6.96E+00	7.95E-02	4.62E-03	1.95E-02	1.26E-02	-1.10E+00
HTP-c	CTUh	2.09E-09	2.09E-09	3.80E-09	7.97E-09	5.25E-10	2.92E-11	1.29E-10	5.54E-11	-4.31E-09
HTP-nc	CTUh	8.99E-09	1.33E-09	2.46E-10	1.06E-08	2.94E-10	1.62E-11	7.19E-11	9.75E-10	-4.79E-10
SQP	dimensionless	4.73E+01	1.24E+00	4.62E+00	5.32E+01	3.36E-01	2.14E-02	8.24E-02	5.14E-03	-3.93E-01

Use of resources (1 m^2 R = 1)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C2	C4	D
PERE	MJ	9.14E+00	2.22E-02	3.28E+00	1.24E+01	5.33E-03	2.99E-04	1.30E-03	1.41E-03	-1.04E-01
PERM	MJ	2.70E+01	0.00E+00	0.00E+00	2.70E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	3.61E+01	2.22E-02	3.28E+00	3.95E+01	5.33E-03	2.99E-04	1.30E-03	1.41E-03	-1.04E-01
PENRE	MJ	1.89E+01	1.72E+00	1.28E+01	3.35E+01	3.61E-01	2.04E-02	8.83E-02	1.23E-01	-2.75E+01
PENRM	MJ	3.99E+00	0.00E+00	0.00E+00	3.99E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	2.29E+01	1.72E+00	1.28E+01	3.75E+01	3.61E-01	2.04E-02	8.83E-02	1.23E-01	-2.75E+01
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
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
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
FW	m^3	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

Waste production and output flows

Waste production (1 m^2 R = 1)

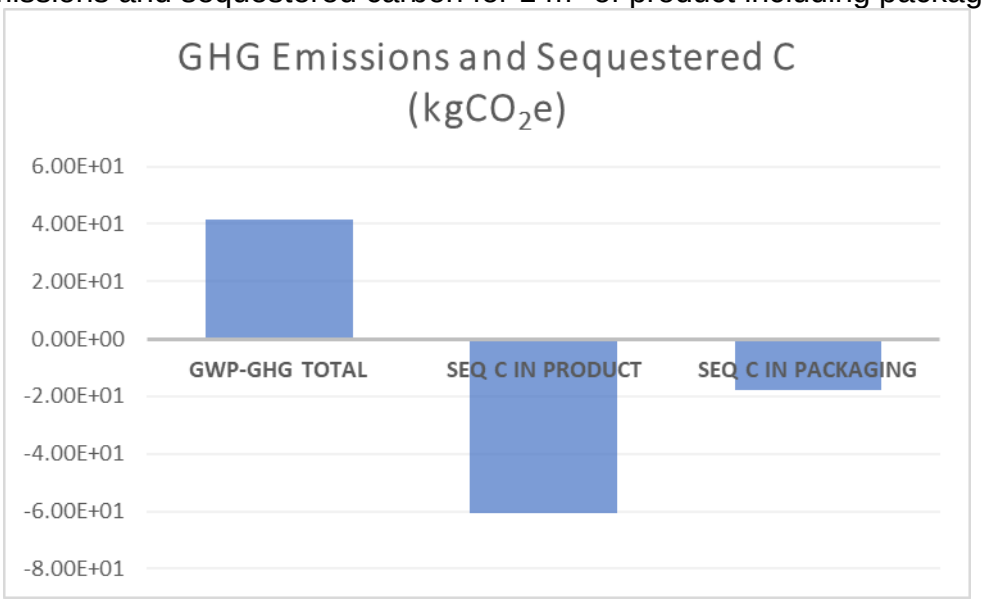
Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C2	C4	D
HWD	kg	1.57E-04	1.01E-05	4.18E-05	2.08E-04	2.23E-06	1.26E-07	5.46E-07	5.35E-07	-1.10E-04
NHWD	kg	8.58E-02	1.04E-01	2.25E-02	2.12E-01	2.86E-02	1.48E-02	6.99E-03	2.56E-04	-3.56E-02
RWD	kg	1.85E-05	4.08E-07	4.22E-05	6.10E-05	1.01E-07	5.68E-09	2.47E-08	3.54E-08	-2.35E-06

Output flows (1 m^2 R = 1)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C2	C4	D
CRU	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
MFR	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
MFER	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
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	0.00E+00
EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.05E+01	0.00E+00

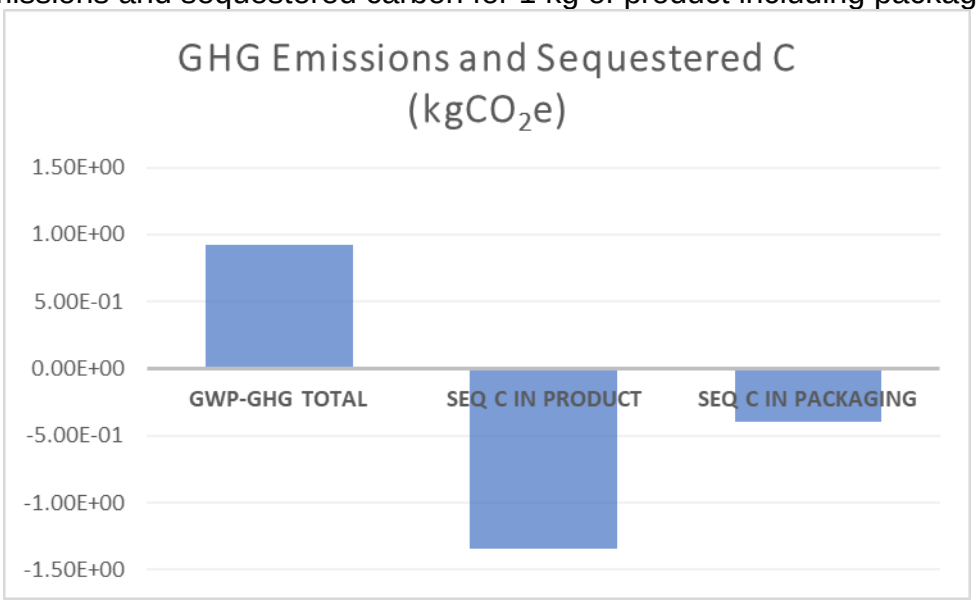
Contribution to GWP indicator (A1-A3) (including sequestered C)

GHG emissions and sequestered carbon for 1 m^3 of product including packaging:



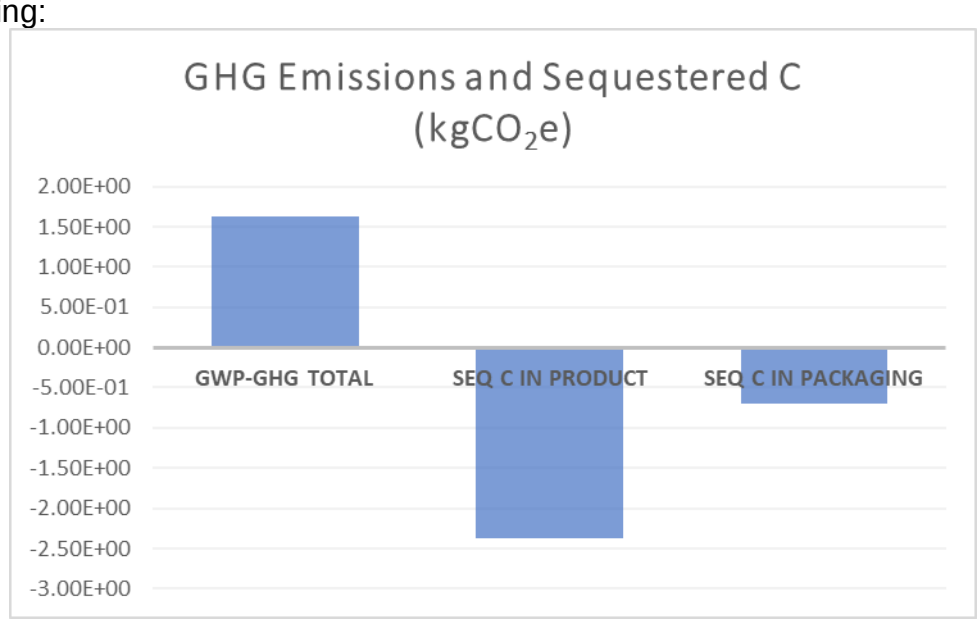
Total GHG emissions of 1 m^3 of product and packaging (including pallet) is 41.59 $kgCO_2e$ with atmospheric carbon stored in the biogenic content in the product of -60.65 $kgCO_2e$ and -17.93 $kgCO_2e$ in the timber pallet.

GHG emissions and sequestered carbon for 1 kg of product including packaging:



Total GHG emissions of 1 m^3 of product and packaging (including pallet) is 0.95 $kgCO_2e$ with atmospheric carbon stored in the biogenic content in the product of -1.35 $kgCO_2e$ and -0.40 $kgCO_2e$ in the timber pallet.

GHG emissions and sequestered carbon for 1 m^2 of product (R=1) including packaging:



Total GHG emissions of 1 m^2 of product and packaging (including pallet) is 1.66 $kgCO_2e$ with atmospheric carbon stored in the biogenic content in the product of -2.37 $kgCO_2e$ and -0.70 $kgCO_2e$ in the timber pallet.

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