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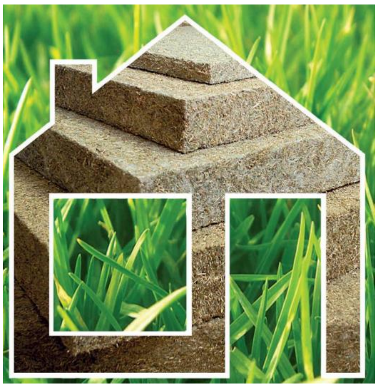
GRAMITHERM

Gramitherm® 100

GRAMITHERM®
Grass Insulating Swiss Technology



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Compliant with EN 15804+A2 standard and B-EPD-PCR version 18.10.2022

DECLARED MODULES

Thermal insulation with area measuring 1 m² for walls, floors, flat or sloped roofs, using Gramitherm® 100 batts (100mm thick), with thermal resistance of 2.47 m².K/W, and a service life of 60 years

A123	A4	A5	B	C	D
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An Environmental Product Declaration (EPD) communicates science-based environmental information about construction products so the environmental performance of buildings can be assessed. An EPD is only recognised after valid registration on www.b-epd.be. SPF Santé Publique is not responsible for the information supplied by the owner of the EPD.

CONTENTS

1 PRODUCT DESCRIPTION

1.1 Gramitherm® 100

Gramitherm® 100 thermo-acoustic insulation batt (100 = thickness in mm)

1.2 Product description and intended use

Gramitherm® 100 is a grass-based insulation batt (waste - waste grass).
Gramitherm® 100 offers protection against the cold and comfort during summer thanks to its thermal insulation properties. Gramitherm® also dampens a wide range of sound frequencies contributing to sound absorption: at 1000Hz αw= 0.99.
Batt dimensions are 0.6 m (width) x 1.2 m (length) x 0.1 m (thickness).

It is a product.

This EPD is specific to a single production site.

Intended uses: construction, renovation

- wall insulation (internal and external)
- insulation of lower floors
- insulation of upper floors, lofts, and the slopes of pitched roofs

1.3 Functional unit

THE CHOSEN FUNCTIONAL UNIT (FU) IS:
"TO THERMALLY INSULATE AND CONTRIBUTE TO SOUND INSULATION OF A SURFACE MEASURING 1M² OF WALL, FLOOR, FLAT OR SLOPED ROOF, USING GRAMITHERM® 100 PANELS, WITH THERMAL RESISTANCE OF 2.47 M².K/W AND A SERVICE LIFE OF 60 YEARS"

The packaging is included.
The weight per reference flow is 4 kg.
The product density is 40 (± 5) kg/m³.

The product is declared "as installed".

1.4 Installation

The EPD covers the batt "as installed".
Gramitherm® 100 batts are manually installed on site according to the manufacturer's instructions (https://gramitherm.eu/applications-pose/).

Installation requires no tools (except for a generic cutter-type tool), and no additional fixing materials are required. Gramitherm® is flexible and compressible, and can easily be placed between rafters. It can be easily cut on site and causes no irritation.
Detailed information on this is available in the "Underlying scenario data" section.

1.5 Composition and content

Components	Composition / content / ingredients	Quantity
Product	– Grass fibre (88% DM) – Recycled jute fibre – Polyethylene terephthalate (PET) (binder) – Total	– 2.88 kg/FU (72%) – 0.80 kg/FU (20%) – 0.32 kg/FU (8%) **– 4.00 kg/FU**
Fixing materials	– None	
Jointing materials	– None	
Treatments	– None	
Packaging	– LDPE film (batt packaging) – Wooden palette – LDPE film (palette) – Total	– 4.167 E-02 kg/FU – 3.038 E-01 kg/FU – 1.403 E-02 kg/FU **– 0.3595 kg/FU**

DM = dry matter; LDPE = low density polyethylene
The product does not contain any material included on the "Candidate list of substances of very high concern for authorisation".

1.6 Reference service life

The reference service life (RSL) is estimated at 60 years.
The RSL is based on the service life of a building before renovation and on the service life of the materials which, when combined, comprise Gramitherm® 100 (as defined by TOTEM).
This RSL is valid under the following conditions: normal use of a correctly installed Gramitherm® 100 batt.
The installation is assumed to have been carried out according to industry standards and the manufacturer's installation instructions. The works are assumed to have been carried out in keeping with industry standards and with current standards.

1.7 Description of geographical representativity

Gramitherm® 100 batts are produced in Belgium.
The end-of-life (C) and benefits (D) are representative of practices in Belgium.
This study is consistent with regard to temporal, geographic, and technological representativity, although it only concerns a single site.
Carried out in Belgium (BE), France (FR), Luxembourg (LX), the Netherlands (NL), and Germany (D).
The EPD is representative for the Belgian market.

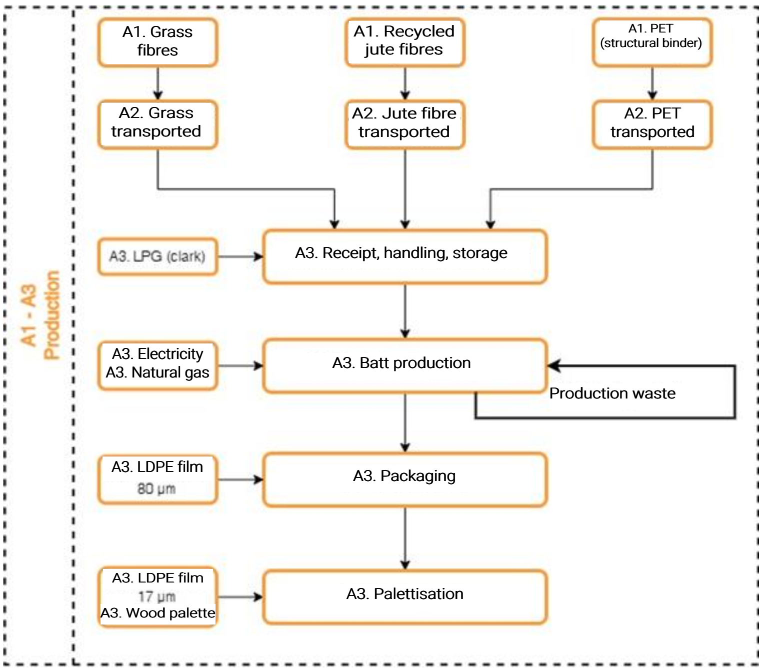
1.8 Description of production process and technology

The Gramitherm® process allows "waste" grass to be fully used as a raw material, without creating any waste. This term is used because the process uses grass biomass which has until now been considered a waste product and not used as animal feed (hay). This grass does not compete with land used for food production, as it consists of natural grass clippings from mowing lawns and verges for safety purposes and comes from the Belgian ANB (Agence pour la Nature et la Forêt), from grass verge clippings from the Flemish Waterways Authority (De Vlaamse Waterweg), and the trunk roads and motorways of the Agency for Roads and Traffic (Agence pour les routes et le trafic). One hectare of grass can produce 200m³ of insulation product.

The process separates two components from the raw material ("waste" grass): the cellulose fibres used in making Gramitherm®, and the digestible components used to produce the biogas used to dry and transform the fibres. The process developed and patented by Gramitherm® is a 3-stage production cycle:

1. Cutting and harvesting of "waste" grass".
2. Cellulose fibres extracted from the grass, which is then dried using the heat produced from the biogas generated by the grass' s fermentable fraction (fermentation carried out by an external partner upstream of production).
3. Production of flexible insulation batts (Air-Lay technology and thermobonding)
   - Primary materials received, handled, and stored.
   - Grass and jute (from recycling decommissioned sacks from the Port of Antwerp) fibres are mixed with bonding fibres (PET, polyethylene terephthalate) using an electronic weigher. Weighing hoppers are used so monitoring can be carried out every 3 batches.
   - Fibres homogenised by combing. Improperly mixed fibres are removed at the output point of this process and reinserted at the input point so they can be combed again (closed loop).
   - Sheet created and product area density determined.
   - Product thermobonded and end product calibrated.
   - Products cut to size and packaged.
   - Products palletised.

Production waste is reintegrated into the cycle upstream of thermobonding, with no loss of material.



2 TECHNICAL DATA / PHYSICAL PROPERTIES

Technical property	Standard	Value	Unit	Comment
Thickness		0.1	m	
Thermal properties R		2.47	m².K/W	
Thermal conductivity λ	EN 12667 EN ISO 10456	0.041	W/(m.K)	
Sound absorption αw		0.99		at 1000 Hz
Water vapour diffusion resistance μ		1		
Water absorption	EN 1609	4.6	kg/m²	
Tensile strength	EN 1608	2x		twice its own weight
Reaction to fire	EN ISO 11925-2 EN 13601-1 EN 13501-1	EURO Class E		
Mildew resistance Assessment of growth intensity	EOTA methodology EN ISO 846	Level 1		no fungal growth – appropriate resistance
Density		40	kg/m³	

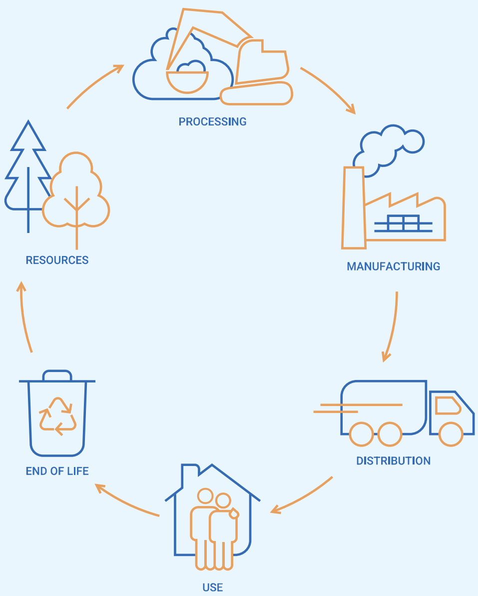
DIBt (Deutsches Institut für Bautechnik) certification:
DIBt grants European technical approval and CE mark accreditation for construction products. It is also a member of EOTA (European Organization for Technical Approvals), UEAtc (European Union for Technical Approval in Construction), and WFTAO (World Federation of Technical Assessment Organisations). Gramitherm® has received ETA (European Technical Approval) under reference: ETA- ETA-21-0260

Batt dimensions: 0.6 m (width) x 1.2 m (length) x 0.1 m (thick)
Area of 1 batt: 0.72 m² (0.72 FU)

3 LIFECYCLE ASSESSMENT (LCA)

3.1 Date of LCA

January 2023



3.2 Software

Simapro 9.4.0.2 was used to calculate the LCA.

3.3 Information on allocation

The allocation principles established by EN 15804+A2 were applied.
The physical allocation (mass) was applied to the solid digestate from the anaerobic fermentation, the biogas production co-product, which corresponds to the grass fibre. The two co-products have a similar economic value.
Selected allocation factors (Peter Jacob Jørgensen, PlanEnergi - Biogas Green Energy):

– Biogas: 0.08752
– Grass fibre: 0.91247

3.4 Information on cut-off value

The following processes are considered to fall beneath the cut-off for the "mineral additives to protect against fire, fungi, and parasites", added in low quantities by the supplier of the grass fibre (no data on the exact quantities or composition), and guaranteed boron and halogen derivative free.

3.5 Information on excluded processes

The following processes were excluded from the inventory:

– lighting, heating, and cleaning of production sites,
– the administrative department,
– employee transport,
– manufacturing of production tools and transport systems (where not directly involved in the lifecycle inventory),
– consumables required for the process (lubricant oil)
– infrastructure
– long-term emissions

3.6 Information on biogenic carbon modelling

The biogenic carbon content of the material is calculated using the following formula: (WM = wet matter, DM = dry matter)
kg C = material mass (kg WM) x DM content x C content of DM (kg C/kg DM)

1. Grass fibre:
Moisture content: 12% (88% DM)
Carbon content: 0.625 (obtained by calculating the carbon content of the various plant species compounds after digestion (Solagro):
Biogenic carbon: 0.88 x 0.625 = 0.55 kg C/kg WM x 2.88 = 1.584 kg C/FU

2. Jute fibre:
Moisture content: 12% (88% DM)
Carbon content: 0.475 (based on dry matter – source documentation Ecoinvent 3.8 for “jute production").
Biogenic carbon: 0.88 x 0.475 = 0.4180kg C/kg WM x 0.32 = 0.3344 kg C/FU

3. Packaging: wooden palette
Carbon content: 0.494 (based on dry matter - source: documentation Ecoinvent 3.8 for “softwood" used for palettes)
Biogenic carbon: 0.88 x 0.494 = 0.4347 kg C/kg WM x 0.3038 = 0.1321 kg C/FU

C/CO_2 conversion obtained by multiplying the result by the molar mass: 3.667 (kg CO_2 /FU)

Biogenic carbon content	(kg C / FU)
Biogenic carbon content of product (at factory gate)	1.918 kg C/FU (7.034 kg CO_2 /FU)
Biogenic carbon content of the packaging (at factory gate)	0.1321 kg C/FU (0.4843 kg CO_2 /FU)
Total (at factory gate)	2.050 kg C/FU (7.518 kg CO_2 /FU)

3.7 Information on biogenic carbon offsetting

Carbon offsetting is not permitted under the EN 15804 standard and is therefore not included in the calculations. Gramitherm® does not participate in carbon offsetting.

3.8 Details of carbonation of cement-based materials

No carbonation of cement-based materials.

3.9 Additional or deviating characterisation factors

For the EN 15804+A2 standard, the EC-JRC characterisation factors were applied.
The characterisation method for the indicators corresponds to the CFs of the EN15804+A2:2019 (v1.03) standard as implemented in SimaPro 9.4.0.2, with adaptations made by Pré Consultants to correspond to the substances used in the SimaPro libraries. For energy resources, the “Cumulative energy demand (LHV)” method was used. It was created by Pré Consultants based on data published by Ecoinvent for raw materials available in the SimaPro database. The method calculates the lower heating values (LHV).
The waste streams were calculated using the EDIP 2003 Hauschild 2003) (a version of the Danish EDIP97 method EDIP97 adapted for SimaPro - http:// www.lcacenter.dk/cms/site.aspx?p=4441).
All characterisation factors comply with the EN 15804: 2012+A2:2019
Compliant with BE-PCR,

- which stipulates that when infrastructure data is available as generic data (e.g. Ecoinvent) used for upstream or downstream processes, it must be included (A17);
- the long-term effects of emissions are excluded (A22).

3.10 Variability

Not applicable – the B-EPD corresponds to production at a single site.

3.11 Specificity

The data used for the LCA are specific to this product which is made by a single manufacturer at a single production site.

3.12 Data collection period

Manufacturer-specific data were collected for **2020**.

3.13 Information on data collection

Data on consumption (materials and energy), origin of materials, and transport (A4) were the primary data directly sent by Gramitherm SA.

3.14 Database used for background data

The database used was Ecoinvent 3.8, except for the grass fibre which was modelled using input from the Environmental Footprint EF2.0 (2019.08) database. In compliance with the EN 15804: 2012+A2: 2019 standard and the BE-PCR complement, the "allocation, cut-off by classification" system model is used when the Ecoinvent v3 generic data is used.
Updated on: Ecoinvent 3.8: November 2021.
Background data are less than ten years old: they are either updated in the database or adjusted according to information directly relating to the Belgian context (such as the electricity mix).
A ten-year time period is used for evaluations.

3.15 Energy mix

Gramitherm SA purchases a specific mix from Luminus.
For the year 2020, it was composed of
- 32.8% natural gas
- 67.2% nuclear

Statbel data for 2020 shows that electricity production from natural gas was split between different sources: direct electricity production (72.75%) and co-generation (27.25 %).

The Ecoinvent 3.8 database includes the energy mix for Belgium in 2018.
The 2020 energy mix for Belgium was modelled based on available data (IEA and Belgian suppliers), and used for consumption in Belgium (other than those at the production site).

2020 mix (IEA): 32.0% fossil fuels, 38.7% nuclear, 1.5% hydropower, 14.5% wind, 5.6% solar, 7.4% biomass, biogas and waste (for a total of 28.9% renewables + waste), and 0.4% other sources.

4 PRODUCTION SITES

The Gramitherm Europe SA production site is a single site, located at Rue des Glaces Nationales, 87 to 5060 Auvelais / Sambreville (Belgium).

5 SYSTEM SCOPE

Product phase			Construction & installation phase		Use phase							End-of-life phase				Beyond the scope of the system
Raw materials	Transport	Manufacturing	Transport	Construction & installation phase	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction-demolition	Transport	Waste processing	Disposal	Reuse-recovery-recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒

X = included in the EPD
☐ = module not declared

6 POTENTIAL ENVIRONMENTAL IMPACTS PER F

	Production			Construction process phase		Use phase						
	A1 Raw materials	A2 Transport	A3 Manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use
GWP total (kg CO2 equiv./FU)	-5.93E+00	4.92E-02	8.69E-01	1.32E-01	6.20E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GWP fossil (kg CO2 eq./FU)	1.10E+00	4.92E-02	1.35E+00	1.32E-01	1.71E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GWP biogenic (kg CO2 eq./FU)	-7.03E+00	0.00E+00	-4.84E-01	0.00E+00	4.49E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GWP-luluc (kg CO2 eq./FU)	9.79E-04	1.97E-05	6.31E-04	4.94E-05	3.83E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ODP (kg CFC 11 eq./FU)	4.86E-06	1.20E-08	1.83E-07	3.28E-08	1.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AP (mol H+ eq./FU)	4.62E-03	1.52E-04	2.42E-03	4.19E-04	2.41E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EP – freshwater (kg PO4 eq./FU)	3.24E-05	3.65E-07	1.39E-05	9.39E-07	1.10E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EP - marine (kg N eq./FU)	8.97E-04	3.24E-05	5.78E-04	9.23E-05	6.76E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EP - terrestrial (mol N eq./FU)	9.38E-03	3.61E-04	6.38E-03	1.03E-03	7.14E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
POCP (kg NMVOC eq./FU)	3.29E-03	1.41E-04	2.37E-03	4.04E-04	2.21E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ADP Elements (kg Sb eq./FU)	1.17E-05	1.46E-07	4.60E-06	3.15E-07	3.76E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ADP fossil fuels (MJ/FU)	2.43E+01	7.84E-01	3.31E+01	2.14E+00	1.37E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
WDP (eq. water deprivation in m³/FU)	4.84E-01	2.67E-03	2.95E-01	7.37E-03	3.06E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

TOTAL GWP = GLOBAL WARMING POTENTIAL (CLIMATE CHANGE); GWP-LULUC = GLOBAL WARMING POTENTIAL (CLIMATE CHANGE) LAND USE AND LAND USE CHANGE; ODP = OZONE DEPLETION POTENTIAL; AP = POTENTIAL; POCP = PHOTOCHEMICAL OZONE CREATION; ADPE = ABIOTIC DEPLETION POTENTIAL - NON-FOSSIL; ADPF = ABIOTIC DEPLETION POTENTIAL - FOSSIL (ADP-FOSSIL FUELS); WDP = WATER USE (WATER (CONSUMPTION)

7 RESOURCE USE

	Production			Construction process phase		Use phase						
	A1 Raw materials	A2 Transport	A3 Manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use
PERE (MJ/FU, net calorific value)	8.11E-01	1.08E-02	6.78E+00	2.73E-02	2.40E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERM (MJ/FU, net calorific value)	5.07E+01	0.00E+00	3.72E+00	0.00E+00	-3.43E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT (MJ/FU, net calorific value)	5.15E+01	1.08E-02	1.05E+01	2.73E-02	-1.03E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRE (MJ/FU, net calorific value)	2.43E+01	7.84E-01	3.32E+01	2.14E+00	2.94E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRM (MJ/FU, net calorific value)	7.34E+00	0.00E+00	2.40E+00	0.00E+00	-2.23E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT (MJ/FU, net calorific value)	3.16E+01	7.84E-01	3.55E+01	2.14E+00	7.06E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM (kg/FU)	3.68E+00	0.00E+00	3.75E-02	0.00E+00	7.44E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF (MJ/FU, net calorific value)	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/FU, net calorific value)	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
FW (m^3 eq. water /FU)	6.26E-03	1.55E-04	3.84E-03	4.43E-04	5.76E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

PERE = USE OF RENEWABLE PRIMARY ENERGY EXCLUDING RENEWABLE PRIMARY ENERGY RESOURCES USED AS RAW MATERIALS; PERM = USE OF RENEWABLE PRIMARY ENERGY RESOURCES PRIMARY ENERGY RESOURCES; PENRE = USE OF NON-RENEWABLE PRIMARY ENERGY EXCLUDING RENEWABLE PRIMARY ENERGY RESOURCES USED AS RAW MATERIALS; PENRM = USE OF NON MATERIALS; PENRT = TOTAL USE OF NON-RENEWABLE PRIMARY ENERGY RESOURCES; SM = USE OF SECONDARY MATERIAL; RSF = USE OF RENEWABLE SECONDARY FUELS; NRSF = NON-RENE

8 WASTE CATEGORIES AND OUTPUT FLOW

	Production			Construction process phase		Use phase						
	A1 Raw materials	A2 Transport	A3 Manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use
Disposal of dangerous waste (kg/FU)	4.03E-05	1.95E-06	2.80E-05	5.19E-06	1.97E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Disposal of non-dangerous waste (kg/FU)	9.13E-02	6.34E-02	5.72E-02	2.00E-01	3.04E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Disposal of radioactive waste (kg/FU)	2.70E-05	5.30E-06	1.33E-04	1.45E-05	4.42E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Components for reuse (kg/FU)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.20E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling (kg/FU)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.44E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for energy recovery (kg/FU)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.15E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Energy supplied externally (MJ/FU)	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

9 POTENTIAL ADDITIONAL ENVIRONMENTAL CONSEQUEN

	Production			Construction process phase		Use phase						
	A1 Raw materials	A2 Transport	A3 Manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use
PM (disease incidence)	4.24E-08	5.08E-09	1.74E-08	1.53E-08	2.66E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+0
IRHH (kg U235 eq./FU)	4.06E-02	3.40E-03	1.55E-01	9.29E-03	4.71E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+0
ETF (CTUe/FU)	1.32E+01	6.19E-01	7.15E+00	1.67E+00	1.08E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+0
HTCE (CTUh/FU)	6.70E-10	1.83E-11	7.48E-10	4.56E-11	6.33E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+0
HTnCE (CTUh/FU)	1.22E-08	6.38E-10	5.91E-09	1.76E-09	1.65E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+0
land use related impacts (dimensionless)	1.54E+01	7.89E-01	3.61E+01	2.45E+00	1.20E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+0

HTCE = HUMAN TOXICITY - CARCINOGENIC EFFECTS; HTNCE = HUMAN TOXICITY - NON-CARCINOGENIC EFFECTS; ETF = ECOTOXICITY - FRESHWATER; (POTENTIAL COMPARATIVE TOXIC UNIT) PM = PARTICLES IN SUSPENSION (POTENTIAL INCIDENCE OF DISEASE DUE TO PARTICLE EMISSIONS);
IRHH = IONIZING RADIATION – HUMAN HEALTH EFFECTS (POTENTIAL HUMAN EXPOSURE EFFICIENCY RELATIVE TO U235);

9.1 Environmental impact categories explained

Global Warming Potential

The global warming potential of a gas refers to its total contribution to global warming resulting from the emission of a single unit of this gas relative to a unit of the reference gas, carbon dioxide, which is assigned a value of 1.

It is split into 4 parts:

- Total global warming potential (GWP-total) which is the sum of GWP-fossil, GWP-biogenic, and GWP-luluc
- Global warming potential fossil fuels (GWP-fossil): Global warming potential related to greenhouse gas emissions (GHG) in any medium resulting in the oxidation and/or reduction of fossil fuels through transformation or degradation (such as combustion, digestion, disposal, etc.).
- Global warming potential biogenic (GWP-biogenic): The global warming potential related to carbon emissions to air (CO2, CO and CH4) originating from the oxidation and/or reduction of aboveground biomass by means of its transformation or degradation (e.g. combustion, digestion, composting, landfilling) and CO2 uptake from the atmosphere through photosynthesis during biomass growth - i.e. corresponding to the carbon content of products, biofuels or above ground plant residues such as litter and dead wood.[1]
- Global Warming Potential land use and land use change (GWP-luluc): The global warming potential related to carbon uptakes and emissions (CO2, CO and CH4) originating from carbon stock changes caused by land use change and land use. This sub-category includes biogenic carbon exchanges from deforestation, road construction or other soil activities (including soil carbon emissions).

Ozone Depletion

Destruction of the stratospheric ozone layer which shields the earth from ultraviolet radiation harmful to life. This destruction of ozone is caused by the breakdown of certain chlorine and/or bromine containing compounds (chlorofluorocarbons or halons), Which break down when they reach the stratosphere and then catalytically destroy ozone molecules.

Acidification potential

Acid depositions have negative impacts on natural ecosystems and the man-made environment incl. buildings. The main sources for emissions of acidifying substances are agriculture and fossil fuel combustion used for electricity production, heating and transport.

Eutrophication potential

The potential to cause over-fertilization of water and soil, which can result in increased growth of biomass and following adverse effects.

It is split into 3:

- The potential to cause over-fertilization of soil and water, which can result in increased growth of biomass and subsequent adverse effects.
- The potential to cause over-fertilization of soil and water, which can result in increased growth of biomass and subsequent adverse effects.
- The potential to cause over-fertilization of soil and water, which can result in increased growth of biomass and subsequent adverse effects.

Photochemical ozone creation

Chemical reactions brought about by the light energy of the sun creating photochemical smog. The reaction of nitrogen oxides with hydrocarbons in the presence of sunlight to form ozone is an example of a photochemical reaction.

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[1] Carbon exchanges in indigenous forests must be modelled according to GWP-luluc (including emissions from soil, derivative products or residues), whilst their CO2 absorption is excluded.

	Abiotic depletion potential for non-fossil resources	Consumption of non-renewable resources, thereby lowering their availability for future generations. Expressed in comparison to Antimonium (Sb). 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
	Abiotic depletion potential for fossil resources	Measure for the depletion of fossil fuels such as oil, natural gas, and coal. The stock of fossil fuels is formed by the total amount of fossil fuels, expressed in Megajoules (MJ). 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
	Ecotoxicity for aquatic environments (freshwater)	The impacts of chemical substance on ecosystems (freshwater). 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
	Human toxicity (carcinogenic effects)	The impacts of chemical substance of human health via three parts of the environment: air, soil, and water. 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
	Human toxicity (non-carcinogenic effects)	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
	Particulate matter	Accounts for the adverse health effects on human health caused by emissions of Particulate Matter (PM) and its precursors (NOx, SOx, NH3).
	Resource depletion (water)	Accounts for water use related to local water scarcity as freshwater is a scarce resource in some regions, while in others it is not. 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
	Ionizing radiation - human health effects	This impact category deals mainly with the possible impact on human health of low-dose ionizing radiation from nuclear fuel. It does consider health effects due to potential nuclear accidents, occupational exposure, or from the disposal of radioactive waste in underground facilities. Potential ionizing radiation from the soil, radon, and from some construction materials is also not measure by this indicator.
	Land use related impacts	This indicator is the "soil quality index" which is the result of aggregating the following four aspects: – Biotic production – Resistance to erosion – Mechanical filtration – Groundwater Aggregation is carried out based on a JRC model. The four aspects are quantified using the LANCA model for ground use. 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

10 DETAILS OF UNDERLYING SCENARIOS USED TO CALCULATE IMPACTS

10.1 A1 – Raw material supply

This module examines the extraction and processing of all raw materials and energy which occur upstream to the studied manufacturing process.

- Grass originating from unused, waste natural grass clippings. The fresh grass undergoes a special "pressing" process which separates the fibre (cellulose, lignocellulosic, fraction) from the other elements comprising the grass. This, the "juice" corresponding to the fermentable fraction, is processed in an anaerobic digester. The resulting biogas allows the process and the drying of the grass to be energy independent. This operation is carried out by a sub-contractor. The grass fibre is supplied in bulk.
- The jute fibre used is collected at the Port of Antwerp from jute sacks used for holding cacao and coffee which are too damaged to be reused or recycled, and which are collected at the port. They are shredded in Waregem. The inventory includes the collection from the port and transfer to the processing site (by truck), and electricity used for the shredding. The jute fibre is supplied in bulk.
- The PET (polyethylene terephthalate) is added as a structural binder (virgin PET). It is supplied in bulk.

10.2 A2 – Transport to the manufacturer

Grass fibre: 110 km, 32 t truck, EURO6
Jute fibre: 125 km, 32 t EURO 6 truck
PET: 190 km, 12t EURO6 truck
(actual values)
Transport by truck was modelled using the corresponding Ecoinvent entries. The default load and use values were kept.

10.3 A3 – Manufacturing

This module examines the manufacturing process. It includes the receipt of primary materials, their assembly, all handling operations, and packaging and palletisation of the finished product.

The manufacturing process for the Gramitherm® 100 insulation batt comprises the following steps:

- Grass and jute (from recycling decommissioned sacks from the Port of Antwerp) fibres are mixed with bonding fibres (PET) using an electronic weigher. Weighing hoppers are used so monitoring can be carried out every 3 batches.
- Fibres are homogenised by combing. Improperly mixed fibres are removed at the output point of this process and reinserted at the input point so they can be combed again (closed loop).
- Sheet created and product area density determined.
- Product thermobonded and end product calibrated.
- Products cut to size and packaged.
- Products palletised.

Energy consumption:

- LPG for handling operations (Clark)
- Electricity (Gramitherm-specific mix) and natural gas for the process

All manufacturing waste (edge millings and other edge trimming losses after emerging from the cutting block) is reinserted into the manufacturing process at the start of the line, without processing, to maintain a closed loop.

As a result, there is no waste associated with the A3 manufacturing step.

Packaging:

- Packaging: LDPE film (80% recycled): 4.167 E-02 kg/ FU transport: 114.5 km

- Palette: wooden, 120 x 120 cm, 10.5 kg: 0.3038 kg/FU
  transport 62 km
- Palette film: LDPE film (30% recycled): 1.403 E-02 kg/FU
  transport 161 km
- Total packaging weight: 0.3595 kg/FU

10.4 A4 – Transport to construction site

FUEL TYPE AND CONSUMPTION OF VEHICLE OR VEHICLE TYPE USED FOR TRANSPORT	Truck, 32 tonnes – EURO6 Diesel Ecoinvent default
DISTANCE	347.2 km
CAPACITY USE (INCLUDING EMPTY RETURNS)	Ecoinvent default
BULK DENSITY OF TRANSPORTED PRODUCTS	Ecoinvent default
VOLUME CAPACITY UTILISATION FACTOR	Ecoinvent default

The product is transported directly to the installation site, with no intermediate steps. The transport distance corresponds to the average actual value calculated in the reference year.
Total weight transported (waste + packaging): 4.3595 kg/FU

- 100% directly to the construction site over a distance of 347.2 km with a 32-tonne EURO6 truck (Ecoinvent: *Transport, freight, lorry >32 metric ton, EURO 6 - Cut-off, U)*

10.5 A5 – Installation in building

The packaging materials are sorted on the site.
2% loss on installation is taken into account. - 25% of loss on installation is re-used on-site (filling of gaps, occasional over-insulation,...)

- 75% is disposed of according to the default BE-PCR scenario for organic insulation waste (95% energy recovery, 5% to landfill).

Gramitherm® 100 batts are manually installed on site according to the manufacturer's instructions[2] . Installation requires no tools or energy consumption, or any other resource. Installation requires no ancillary materials.

Transport by 16-32-tonne EURO5 truck for waste (packaging, 75% loss on installation). Ecoinvent default load value

Installation elements	Quantity	Description
Processes required for product installation	*None*	NOT APPLICABLE
Fixing materials	*None*	NOT APPLICABLE
Jointing materials	*None*	NOT APPLICABLE
Treatments	*None*	NOT APPLICABLE
Material losses	*2%:* *0.08 kg/FU*	QUANTITY OF MATERIAL LOST AFTER CUTTING TO SIZE AND SHAPE
Packaging	*0.3667 kg/FU*	PACKAGING WASTE ON CONSTRUCTION SITE – INCLUDES PACKAGING OF LOSSES
Other	*None*	NOT APPLICABLE

Ancillary materials for installation (specified by material);	Insert information		
Water use	*None*		
Use of other resources	*None*		
Quantitative description of energy type (regional mix) and consumption during the installation process	*None*		
Waste materials on construction site, before waste processing generated by the product's installation	Batt waste	0.08 kg/FU	Loss rate during commissioning : 2%

———————

[2] https://gramitherm.eu/applications-pose/

	Packaging waste	0.3667 kg/FU	LDPE films: 5.681 E-02 kg/FU palette 0.3099 kg/FU
Output materials (specified by type) resulting from waste processing at the construction site, such as collection for recycling, energy recovery, disposal (specified by route)	Batt waste	0.08 kg/FU	25% reused on site: 0.02 kg/FU 75% disposed of: 0.06 kg/FU energy recovery 95%: 0.057 kg/FU landfill 5%: 0.003 kg/FU
	Palette waste	0.3099 kg/FU	reused: 20%: 6.198 E-02 kg/FU recycled (chips): 40%: 0.1240 kg/FU energy recovery: 40%: 0.1240 kg/FU
	LDPE film waste	5.681 E-02 kg/FU	recycled: 35%: 1.988 E-02 kg/FU energy recovery: 60%: 3.409 E-02 kg/FU landfill: 5%: 2.841 E-03 kg/FU
Direct emissions into ambient air, soil and water	*None*		
Distance	Sorting centre Energy recovery Landfill	30 km 100 km 50 km	0.4267 kg/FU 0.2150 kg/FU 5.841 E-03

10.6 B – Use phase (excluding potential savings)

No scenario. Gramitherm® 100 batts are integrated into structural elements and require no maintenance or repair. The B modules are declared but all have a nil value.

10.7 C – End of life

This includes all batts, as well as 25% of the 2% losses which are reused on-site during installation: 4.02 kg/FU.

The disposal method for organic insulation materials as indicated by the BE-PCR is applied: 95% incineration (3.82 kg/FU) and 5% in landfill (0.20 kg/FU).

C1: Batts are deconstructed and removed manually, without tools or energy use.

C2: During deconstruction, the batts follow the default BE-PCR scenario: the demolition waste is transported from the deconstruction/demolition site to a sorting centre. Distance: 30 km.

For disposal, the distance from sorting centre to the incinerator is 100km and distance to the landfill is 50km.

C3: It is considered that all of the affected waste is handled/moved only a single time at the sorting centre (default BE-PCR values).
As the material is dry (both on installation and at end of life), the effectiveness of incineration is considered to be 60% or greater. The fraction incinerated is included in the C3 module in compliance with BE-PCR: 3.82 kg/FU

C4: According to the default scenario for Belgium (BEPCR) for organic insulation materials, 0.2 kg/FU was sent to landfill.
Emissions scenario for landfill: FCBA (2012) - LCA & EPD for wood products and construction materials – Part 2 Accounting for the end of life phase of wood products

- Degradation: 15% after 100 years
- Emissions: 50% CO_2 and 50% CH_4
- CH_4: 30% emissions (70% captured)

Module C2 – Transport to waste processing

Vehicle type (truck/ boat/etc.)	Fuel consumption (litres/km)	distance (km)	Capacity use (%)	Product density (kg/m³)	Estimates
Truck	16-32 t EURO5	30	EI	40 kg/m³	120.6 kg.km
Truck	16-32 t EURO5	100	EI	40 kg/m³	381.9 kg.km
Truck	16-32 t EURO5	50	EI	40 kg/m³	10.05 kg.km

EI: Ecoinvent default value

End of life module - C3 and C4

Parameter	Value (kg)
Waste collected separately	3.82
Waste collected as mixed construction waste	0.20
Waste for reuse	None
Waste for recycling	None
Waste for energy recovery	3.82
Waste disposal	0.20

D – Benefits beyond the scope of the system

Module D is calculated according to the EN 15804: 2012+A2:2019 standard. All reported net benefits and loads declared resulting from net flows leaving the product system which have not been allocated as co-products (there are none in this case) and which have reached the end of cycle waste status in module D (reuse, recycling, direct energy recovery or from the produced biogas).

Gramitherm® 100 batts: LHV of Gramitherm® 100 batts: 14.52 MJ/kg

A5: losses on installation (2%):

- o 25% reused on-site (0.02 kg/FU)
- o 75% disposed of as "organic insulation materials "(0.06 kg/FU)
  - ▪ 95% through energy recovery (0.057 kg/FU)
  - ▪ 5% landfill: 15% broken down into 50% CO_2 and 50% CH_4; 70% of the CH_4 captured and energy recovered (1.369 E-02 MJ/FU)

- – C3: 95% of batts disposed of as "organic insulation materials for energy recovery" (1 FU + 25% of losses reused during installation (3.82 kg/FU);
- – C4: 5% in landfill: 15% broken down into 50% CO_2 and 50% CH_4; 70% of the CH_4 captured and energy recovered (0.9174 MJ/FU)

Palettes (A5): 0.3099 kg/FU; PCI = 12.24 MJ/kg

- – Reuse: 20%: 6.198 E-02 kg/FU; transport 20km[3]
- – Recycled (chips): 40%: 0.1240 kg/FU; transport 20 km + trimmings from the LDPE film palett packaging
- – Energy recovery: 40%: 0.1240 kg/FU

LDPE film (packaging + palette film) (A5): 5.681 E-02 kg/FU; LHV = 43 MJ/kg

- – Energy recovery: 60%: 3.409 E-02 kg/FU
- – No recycling-related benefits noted see net value of negative output flows[4] (packaging: 80% of LDPE recycled and palette film: 30% of LDPE recycled – negative net output flow)

Energy recovery: outputs

- – Batt waste and LDPE films: electrical output 23%, heat output 10%[5]
- – Palette waste: incinerated in a specific co-generation unit, electrical output 22%, heat output 50%[6]
- – Biogas captured in landfill facility: specific co-generation, electrical output 33.6%, heat output 52.6%[7]

QUANTITATIVE DESCRIPTION OF LOADS BEYOND THE SCOPE OF THE SYSTEM	– Transport of reused palettes: 20 km – Transport of recycled palettes: 20 km – Palettes crushed into chips
QUANTITATIVE DESCRIPTION OF THE BENEFITS BEYOND THE SCOPE OF THE SYSTEM	– Batts: installation waste re-used on site instead of new batts: 0.02 kg/FU (A5) – Re-used palettes: 6.198 E-02 kg/FU = new palettes – Recycled palettes: 0.1240 kg/FU = chips – Energy recovery: global values: o Heat: 7.014 MJ/FU (substitutes for heat produced from natural gas) o Electricity: 13.925 MJ/FU (3.868 kWh/FU) (BE mix high voltage without transport network)

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[3] Economically acceptable value – as evidenced by the density of sorting centres in Belgium
[4] BE-PCR: § A26
[5] Personal communication with Intradel / Uvelia for actual outputs of household waste incineration units in Belgium
[6] Https://monprojet.labiomasseenwallonie.be/download/file/fid/2449 (accessed on 01.12.2022)
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11 RELEASE OF DANGEROUS SUBSTANCES DURING USE PHASE

11.1 Indoor air

Gramitherm® 100 batts are not in contact with indoor or outdoor air.

COV emission class: A+ [8]
Tests carried out on a sample of Gramitherm® 240 by CSTC.be under reference DECH-0271 CH-20-191-02.

11.2 Soil and water

Contact with water:
GRAMITHERM® 100 is not in contact with water destined for human consumption.
GRAMITHERM® 100 is used for insulation and does not come into contact with running water.

12 VERIFICATION

PCR documents used for verification: EN ISO 14025:2010, EN 15804/A2:2019, B-EPD Construction product category rules, Complementary to NBN EN 15804+A2, version 18.10.2022 (BE-PCR), B-EPD - Additional mandatory rules complementary to NBN/DTD B 08-001:2017 V.2.01 _ 29.06.2020

Verification by a third party of the declaration and environmental data according to the EN ISO 14025:2010 standard Internal External

Third party verifier:
Naeem Adibi, n.adibi@weloop.org
WeLoop, http://weloop.org
Rue du Bourg 254, 59130 Lambersart – France

[8] France: Labelling of volatile pollutant emissions from construction products. On the label, the level of emissions from the product is shown by a pictogram with a capital letter. This letter indicates the product's level of volatile emissions into the air of a room, from A (very low emissions) to C (high emissions). https://www.ecologie.gouv.fr/etiquetage-des-produits-construction

13 LCA INTERPRETATION

Using biomass waste (grass and jute sack waste) to produce Gramitherm® 100 batts results in a benefit for climate change of up to **-5 kg CO_2 eq/m² of Gramitherm® 100 at the factory gate**. In addition to climate change, the most impacted category is the depletion of fossil resources due to consumption of natural gas and electricity for the batt manufacturing process.

Considering the benefits linked to recycling and energy recovery of the waste, in summary, the impacts for climate change (CC) for 1 m² of thermo-acoustic insulation using Gramitherm® 100 batts is as follows:

- **manufacturing of batts (at factory gate, A1-A3): -5.01 kg CO_2 eq/m²**
- whole life cycle (including the emission of stored carbon at the end of the lifecycle), including module D: 3.28 kg CO_2 eq/m²
- whole life cycle (including the emission of stored carbon at the end of the lifecycle), including module D: 4.95 kg CO_2 eq/m²

These results correspond to the entire life cycle of the product.

14 TECHNICAL INFORMATION FOR SCENARIO DEVELOPMENT

The product is declared "as installed". There are no additional scenarios.

15 APPLICATION UNIT

Gramitherm® is a natural grass-based batt. Gramitherm® offers protection against the cold and also protects against heat in summer thanks to its thermal insulation properties. Gramitherm® also features sound absorption properties.

The board is designed to a certain thickness and the environmental impact is proportional to the thickness (excl. packaging):

The following applications are possible:

- Wood-framed constructions
- Insulating the inside of external walls
- Insulating between rafters
- Insulating above and below rafters
- Ventilated façades
- Thermo-acoustic wall insulation (internal and external)
- Thermo-acoustic insulation of lower floors
- Thermo-acoustic insulation of upper floors, lofts, and the slopes of pitched roofs

- Commercial name: Gramitherm® 100
- Batt dimensions: 0.6 m x 1.2 m x 0.1 m
- No layering required
- Relationship between the application flow and the reference flow in the EPD: 1.

16 ADDITIONAL INFORMATION ON REVERS

Description	Type of fixing	Level of reversibility	Simplicity of disassembly	Speed of disassembly	Ease of handling (size and weight)	Robustne material ial resista disassem
Wall insulation	None	Reversible fixing	Simple - no specific dismantling tools required	Very speedy disassembly	Easy to handle manually, one worker is usually sufficient	The mater well during disassemb of the mat the batts)
Insulation of lower floors	None	Reversible fixing	Simple – no specific dismantling tools required	Very speedy disassembly	Easy to handle manually, one worker is usually sufficient	The materia during disa (recycling c and not the
Insulation of upper floors, lofts, and the slopes of pitched roofs	None	Reversible fixing	Simple - no specific dismantling tools required	Very speedy disassembly	Easy to handle manually, one worker is usually sufficient	The mater well during disassemb of the mat the batts)
...	...	...				

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ACV panneaux Gramitherm 100 - Rapport d'accompagnement de la déclaration environnementale by ULiège https://gramitherm.eu/

General information

Owner of the EDP, Manager of data, LCA and information

Gramitherm Europe SA – Rue des Glaces Nationales 87, 5060 Auvelais/sambreville, Belgium https://gramitherm.eu/? lang=en
+32 71 80 04 46
For further information, please contact Florian Grosjean - f.grosjean@gramitherm.eu info@gamitherm.eu

Author(s) of the LCA and EDP

Prof. Dr Ir Angélique Léonard – a.leonard@uliege.be
Dr Ir Sylvie Groslambert – s.groslambert@uliege.be
Université de Liège– B6a - Allée du 6 Août, 13
4000 Liège

Project report name: ACV panneaux Gramitherm 100 - Rapport d'accompagnement de la déclaration environnementale-v4c

Verification

Naeem Adibi - WeLoop
Verification date: 01.03.2023
Independent external verification of the declaration and data according to the EN ISO 14025 standard and relevant PCR documents

EDPs cannot be compared unless they comply with the same LCA and take the building context into account. The programme operator cannot be held responsible for the information supplied by the owner of the EPD or by the LCA practitioner.

B-EPD programme operator **Federal Public Service (FPS) of Health, Food Chain Safety and Environment**

Av. Galilée 5/2, 1210 Brussels

www.b-epd.be
epd@health.fgov.be

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Email us

info@ecologicalbuildingsystems.com

Find us

Great Britain Ecological Building Systems UK Ltd., Cardewlees, Carlisle, Cumbria, CA5 6LF, United Kingdom

Ireland Ecological Building Systems Ltd., Main Street, Athboy. Co. Meath, C15 Y678, Republic of Ireland