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Institut Bauen und Umwelt e.V.

ECO PLATFORM EPD VERIFIED

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Programme operator:	Institut Bauen und Umwelt e.V. (IBU)
Publisher:	EPD Danmark
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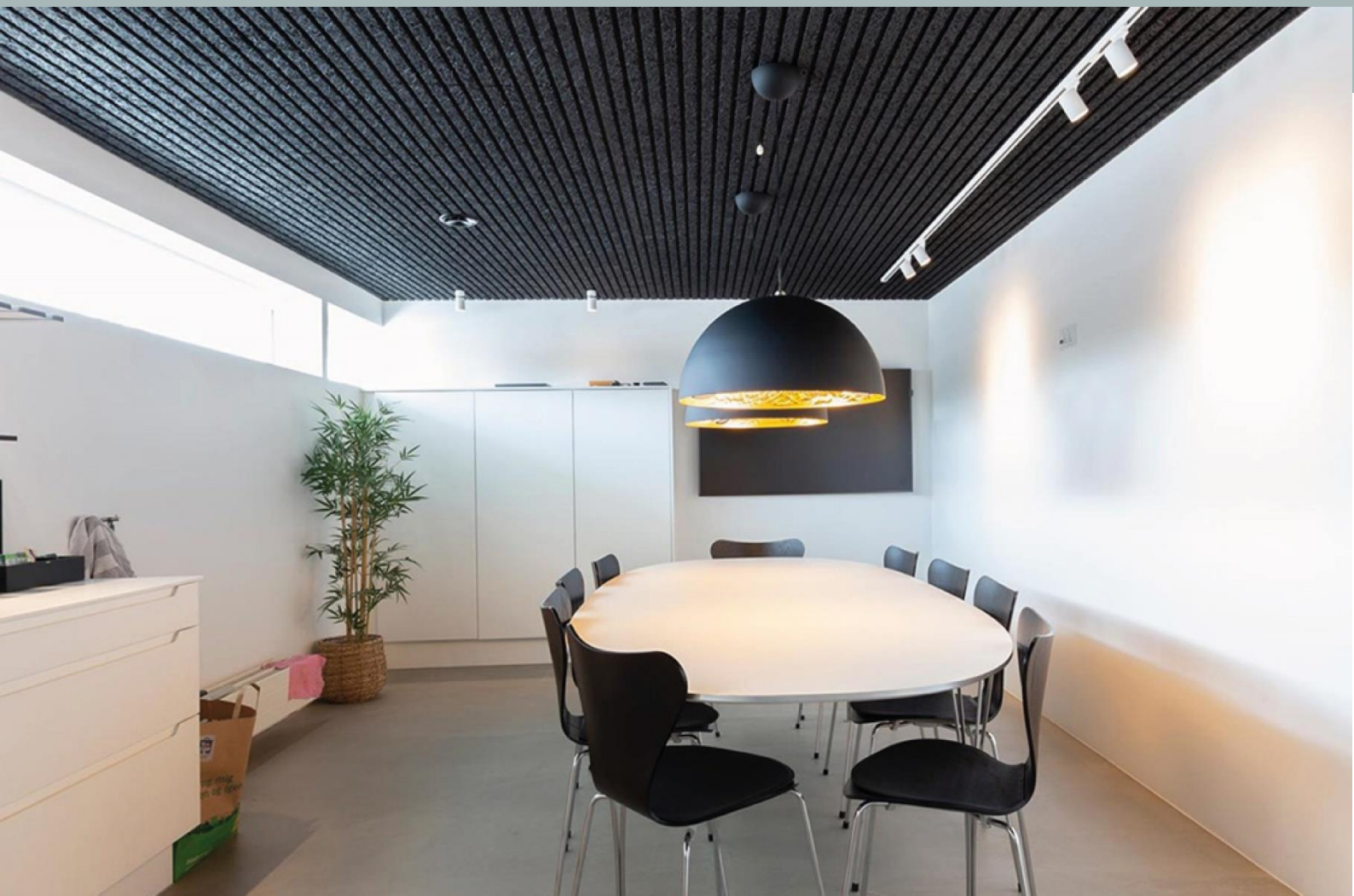
Danish market	All modules valid for the Danish market

3rd PARTY **VERIFIED**

EPD

VERIFIED ENVIRONMENTAL PRODUCT DECLARATION | **ISO 14025** & **EN 15804**



Troldtekt®
Natural acoustic solutions

1. General Information

Troldtekt A/S

Programme holder
IBU – Institut Bauen und Umwelt e.V.
Panoramastr. 1
10178 Berlin
Germany

Declaration number
EPD-TRO-20220047-ICA1-EN

This declaration is based on the product category rules:
Wood cement - Mineral-bonded wooden composites, 01.2019
(PCR checked and approved by the SVR)

Issue date
07-04-2022

Valid to
06-04-2027

Dipl. Ing. Hans Peters
(chairman of Institut Bauen und Umwelt e.V.)

Dr. Alexander Röder
(Managing Director Institut Bauen und Umwelt e.V.))

Troldtekt 35 mm Natural Grey based on FUTURECEM - painted

Owner of the declaration
Troldtekt A/S
Sletvej 2 A
8310 Tranbjerg
Denmark

Declared product / declared unit
Acoustic panel "Natural Grey FUTURECEM" - 1 m^2, 35 mm thickness - painted finish

Scope:
This declaration represents the production, supply, mounting, use, dismantling and disposal of 1 m^2 (35 mm thickness) of grey composite cement-bonded wood wool acoustic panel "Natural Grey FUTURECEM" with a painted finish, produced by Troldtekt A/S, with a reference service life of 50 years. The production facility is located in Jutland, Denmark. Three scenarios represent its use in indoor conditions in Denmark, Sweden and Germany.

The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

The EPD was created according to the specifications of *EN 15804+A1*. In the following, the standard will be simplified as *EN 15804*.

Verification

The standard *EN 15804* serves as the core PCR
Independent verification of the declaration and data according to *ISO 14025:2010*
☐ internally ☒ externally

Ms Jane Anderson
(Independent verifier)

2. Product

2.1 Product description/Product definition

Troldtekt Natural Grey FUTURECEM acoustic panels are some of the leading and preferred solutions for creating a good indoor sound environment. They are sold in various thicknesses (20-35 mm) and dimensions (width: 600 mm, lengths: 600/1200/2400 mm or width: 625 mm, lengths: 625/1250/2500 mm). The panels can be unpainted or painted in a wide variety of colours.

For the placing on the market of the product in the European Union/European Free Trade Association (EU/EFTA) (with the exception of Switzerland) *Regulation (EU) No. 305/2011* applies. The product needs a declaration of performance taking into consideration *EN 13964:2014, Suspended ceilings. Requirements and test methods,* and the CE-marking.

For the application and use, the respective national provisions apply.

2.2 Application

The panels are installed on the ceilings and walls in offices, businesses, schools, institutions, cultural sites, sports centres, swimming pools and private homes.

2.3 Technical Data

The table below indicates the technical specifications of the panels in accordance with *EN 13168*, the standard for cement-bonded wood wool and double-layer panels with cement-bonded wood wool, and *EN 13964*, the standard for suspended ceilings.

Technical specifications of the product covered in this EPD

Name	Value	Unit
Gross density	402	kg/m^3
Grammage	14.07	kg/m^2
Thermal conductivity acc. to EN 13168:2012+A1:2015	0.076	W/(mK)
Water vapour diffusion resistance factor acc. to DIN 4108-4	-	-
Sound absorption coefficient (only with reference to the corresponding component design)	-	%
Light reflection (measured by DELTA Light and Optics	26.3 - 70.8	%
Reaction to fire	B/S1/d0	

Performance data of the product in accordance with the declaration of performance with respect to its essential characteristics according to *EN 13168:2012+A1:2015, Thermal insulation products for buildings. Factory made wood wool (WW) products. Specification,* and *EN 13964:2014, Suspended ceilings. Requirements and test methods*.

2.4 Delivery status

The panel is usually distributed in length of 600, 1200 or 2400 mm by 600 mm width or in length of 625, 1250 or 2500 mm by 625 mm width. It comes in three thicknesses: 20, 25 and 35 mm. Additionally, several density ranges are available: Coarse, Fine and Ultra-Fine causing different densities (388-428 kg/m^3). The panels are normally delivered in packs of 56 units on pallets.

2.5 Base materials/Ancillary materials

The composition of the finished product is a mix of wood wool (29.1 %), Portland composite cement (66.7 %), water (1.8 %), as well as water glass (<1 %) and accelerator (<1 %). Additionally, a painted finish is provided with a water-based paint (1.0 %). The composition is at dry basis at the factory gate, as most of the water has evaporated during drying, but water remains bound to the wood fibre and cement paste (hydrated cement).

This product/article/at least one partial article contains substances listed in the candidate list (date: 17.01.2022) exceeding 0.1 percentage by mass: No

This product/article/at least one partial article contains other CMR substances in categories 1A or 1B which are not on the candidate list, exceeding 0.1 percentage by mass: No

Biocide products were added to this construction product or it has been treated with biocide products (this then concerns a treated product as defined by the (EU) Ordinance on Biocide Products No. 528/2012): No

2.6 Manufacture

Norway spruce logs from local forests (with a moisture content of about 65-70 %) are received and the bark is removed. The wood is stored for approximately six months until the moisture content in the wood drops to 29 %. The wood is then shredded to produce wool. The wood wool is mixed together with Portland composite cement, water, and additives. The mixture is cast and cured using a heat press and dried with a biomass-fired oven. The cast panel is milled to remove any material in excess and cut edges. After approximately 4 weeks of curing, the panel can be painted before being stored on a pallet and packaged to be transported to central distribution warehouses.

2.7 Environment and health during manufacturing

Troldtekt is following its working environment closely. Both the physical working environment and sickness absence are closely monitored. It is an ongoing process involving both leaders and factory workers.

2.8 Product processing/Installation

Installation instructions are available here: https://www.troldtekt.com/Installation

2.9 Packaging

The product is packaged with polyethylene plastic film and cardboard. The packaging material can be easily sorted and treated in dedicated waste recycling channels. The packaged product is delivered on a returnable wood pallet.

2.10 Condition of use

Conditions of use are detailed here: https://www.troldtekt.com/Installation/Use_and_maintenance

2.11 Environment and health during use

Environmental and ecotoxicity risks from exposure to Troldtekt panel products during use have been assessed and found eligible to the following certification schemes:

- Finnish M1 classification
- Danish Indoor Climate
- Cradle to Cradle

These certificates can be accessed here: https://www.troldtekt.com/Web-tools/Downloads/Certificates-and-tests

2.12 Reference service life

The technical service life of the panel is superior to 50 years. This EPD refers to the service lifetime indicated by the *BBSR* table for the material 353.311 of type “Holzbekleidungen: Holz, Holzwerkstoff und Mehrschichtleichtbauplatten”.

Because the panel is used in a building, in this EPD its reference service life is limited by the expected service life of the building, which is commonly accepted as 50 years, at least as LCA timeframe.

There is no influence of the ageing of the material on its technical performance.

2.13 Extraordinary effects

Fire

Information on the fire performance according to *EN 13168*.

Fire protection

Name	Value

Building material class	B
Burning droplets	d0
Smoke gas development	S1

Water
No information on the product performance under the unforeseeable influence of water is available.

Mechanical destruction
No information on the product performance under unforeseeable mechanical destruction is available.

2.14 Re-use phase
Currently, Troldtekt panels undergo thermal treatment with energy recovery. Composting is also possible.

Additional information on recycling options: https://www.troldtekt.com/~/media/Files/Info%20sheets/English/Troldtekt_Recycling%20instructions%20pdf.pdf

2.15 Disposal
The product may be composted, thermally treated with energy recovery, or landfilled.

European Waste Code: 10 13 11 (wastes from cement-based composite materials)

Painted panels must be incinerated at end-of-life.

Additional information on disposal options: https://www.troldtekt.com/environment-and-csr/product-life-cycle/recycling/

2.16 Further information
For additional information on technical specifications, you may consult the Declaration Of Performance: https://www.troldtekt.com/Web-tools/Downloads/DoPs 111121

3. LCA: Calculation rules

3.1 Declared Unit
The functional unit is 1 m^2 of acoustic panel, in 35 mm thickness, corresponding to 14.07 kg of material with a painted finish, mounted on the ceiling, with a reference service life of 50 years.

Declared unit

Name	Value	Unit
Declared unit	1	m^2
Gross density	402	kg/m^3
Grammage	14.07	kg/m^2
conversion factor [Mass/Declared Unit]	14.07	-
Layer thickness	0.035	m

3.2 System boundary
Cradle to grave

3.3 Estimates and assumptions
Assumptions are described occasionally throughout the section "LCA: Calculation rules".

3.4 Cut-off criteria
The cut-off criterion is applied according to *EN 15804* Section 6.3.5 and *PCR part A* Section 5.6.
All inputs and outputs for which data are available are included in the LCA model. Data gaps are filled with conservative assumptions from average data (when available) or with generic data and are documented accordingly.
The following product flows have been omitted according to the 1 % cut-off rule:

- Wooden pallet to transport the product
- Capital infrastructure (factory)
- Energy utilization of incinerated paint
- Allocation of burden from wood logging to residual wood fractions

3.5 Background data
Two types of data source are used as secondary data:

- Product-specific EPDs for the manufacture and supply of Portland composite cement and water-based paint
- Database *ecoinvent v.3.6 cut-off*

3.6 Data quality
Statistical representativeness
The statistical representativeness of the product system is very good. The input and output data samples used to build inventories are based on the entirety of the annual production of panels in 2020 and is verified by a third party. Such representativeness is also valid for the production of Portland composite cement (FUTURECEM), whose EPD was published in 2019 and audited in 2021. The EPD for the paint used was published in 2018.

Temporal, geographical and technological representativeness
All data strictly related to the cement production is technologically, temporally, and geographically representative. The cement production data is less than 5 years old. The data used to model the foreground inventory of acoustic panels dates from the production year of 2020. As for secondary data, some of the ecoinvent datasets are less than 3 years old.

3.7 Period under review
The primary data concerned with the manufacture (A1-A3) relates to the production year 2020 and the data are based on the volumes produced on an annual basis.

3.8 Allocation
Allocation of production data to the multiple produced types of panels (with the same functional unit) is performed based on the rules provided in *EN 15804*. Sub-processes associated to painting have especially been allocated to the painted panels. Data such as waste generation and packaging have been allocated to the entire production volume of panels in Troldtekt. The only case of co-produced outputs is associated to wood logging. However, the environmental load is evenly distributed over all its co-products, such as logs, energy wood, and bark.

3.9 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to *EN 15804* and the building context, respectively the product-specific characteristics of performance, are taken into account.

The used background database is *ecoinvent v.3.6 cut-off*

4. LCA: Scenarios and additional technical information

Manufacture (A1-A3)

Data
Primary data is third-party verified and based on the production year 2020, within the facilities of Troldtekt A/S in Jutland (Denmark).

End-of-waste state and use of by-products
For all processes supplying a residual material/waste that originates the end-of-life phase of a product to the product system to be used as input, the polluter-pay principle “100:0” is used. Some wooden by-products generated during manufacture in Troldtekt end up as soil improvers externally (reaching end-of-waste state), and thus their biogenic carbon leaves Troldtekt's system boundary.

Wind-certified electricity
All the electricity used to produce the panels in Module A3 originates from Danish wind power, for which a certificate ensures the origin. It originates from a 1-3 MW offshore wind turbine, with transformation, transmission and distribution losses and is modelled correspondingly.

Carbon balance
Biogenic: Absorption of biogenic CO_2 by the purchased wood has been considered in A1. Some of it is released again during production in A3, some ends up sequestered in soil, while the majority of the remaining biogenic CO_2, 7.87 kg, is retained in the finished product and emitted during end-of-life incineration in C4.
Fossil: Absorption of some fossil CO_2, originating from the calcination of limestone during cement production, happens when the cement is mixed with water in A3. A majority is absorbed during the use phase B1, and all the absorbed fossil CO_2 is finally emitted during end-of-life incineration in C4.

Distribution to site (A4) and mounting (A5)
To consider the main geographical variants of the life cycle of Troldtekt Natural Grey FUTURECEM panels, three scenarios are developed, where the product is supplied, mounted, used and discarded in Aarhus (Denmark), Hamburg (Germany) and Malmö (Sweden). An additional 50 km from the local warehouse to construction site is assumed.

Transport to the building site (A4)

Name	Value	Unit
Litres of fuel	26.8	l/100km
Transport distance to Denmark	160	km
Transport distance to Germany	370	km
Transport distance to Sweden	394	km
Transport distance from warehouse to local construction sites in Denmark/Germany/Sweden	50	km
Capacity utilisation (including empty runs)	85	%
Gross density of products transported	402	kg/m^3
Capacity utilisation volume factor	1	-

Installation into the building (A5)

Name	Value	Unit
Electricity consumption	0.060	kWh
Material loss (plastic film)	0.009	kg
Material loss (cardboard)	0.039	kg

Use phase (B1)
Before distribution and during the use phase (B1), the carbonation of the cement contained in the panel, during use, is accounted for. Based on laboratory measurement, the panel will absorb up to 140 grams of carbon dioxide per kilogram of cement. Normalized to the reference flow, this corresponds to an uptake of approximately 0.9 kilograms of carbon dioxide by the end of the service lifetime, including the uptake in A3.

Maintenance (B2)
As the panel does not require any maintenance except for the occasional dusting, no maintenance module (B2) is considered.

Maintenance (B2)
As the panel does not require any maintenance except for the occasional dusting, no maintenance module (B2) is considered.

Name	Value	Unit

Repair, replacement, refurbishment (B3, B4, B5)
As the technical service life of the panel is superior to the assumed service life of the building (50 years), no repair (B3), replacement (B4) or refurbishment (B5) steps are considered.

Name	Value	Unit

Replacement (B4) / Refurbishment (B5)

Name	Value	Unit

Information about reference service life is detailed in 2.12.

Reference service life

Name	Value	Unit
Reference service life (according to ISO 15686-1, -2, -7 and -8)	50	a
Life Span (according to BBSR)	50	a
Life Span according to the manufacturer	75	a

Operational energy use (B6) and Operational water use (B7)

Name	Value	Unit
Water consumption	-	m^3
Electricity consumption	-	kWh
Other energy carriers	-	MJ
Equipment output	-	kW

End of life (C1-C4)

Name	Value	Unit
Electricity use (for un-mounting)	0.060	kWh
Transport (to material sorting facility)	50	km
Collected as mixed construction waste	14.07	kg
Energy recovery	3.98	kg
Energy recovery efficiency	10	%
Energy recovered	8.12	MJ

The panel is un-mounted at the end of its reference service life and driven to the regional waste incineration plant. Energy is recovered from the wood part of the panel at 10 % efficiency.

Reuse, recovery and/or recycling potentials (D), relevant scenario information

Name	Value	Unit
Electricity	1.93	MJ
Heat	6.19	MJ

The energy substituted from incineration of the panel's wood component in C4 is considered to be a split of the Danish electricity grid mix (for electricity) and natural gas (for heat).

Details on possible disposal routes
Aalborg Portland cement factory utilizes dust and offcuts from the Troldtekt factory as a raw material in new cement, i.e. in the technical circle. During incineration in the cement kiln, the wood content in the cement-bonded wood wool panels replaces fossil fuels, while the cement ends up as a raw material in new cement, replacing virgin raw materials and heavy fossil fuels, thereby avoiding a significant amount of CO_2 emissions. This scheme of wood wool waste as a raw material can be scaled for construction site and demolition waste. It will be gradually rolled out to all of Denmark in the period 2021-2023. Once Denmark has documented economic and environmental benefits to be gained by including wood wool waste in the production of new cement rather than going to waste incineration or landfill, dialogue with municipalities and local cement producers in the primary markets of Troldtekt is initiated to facilitate similar schemes regionally or nationally.

5. LCA: Results

Note: Global Warming Potential (GWP) indicator includes CO_2 of both biogenic and fossil origin.
Also, GWP results for Troldtekt Natural Grey FUTURECEM (painted) for other delivery scenarios in respectively Germany and Sweden, are 2.72E-1 kg CO_2 and 2.88E-1 kg CO_2.

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED; MNR = MODULE NOT RELEVANT)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	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	X	X	X	X	X	MND	MNR	MNR	MNR	MND	MND	X	X	MND	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A1: 1 m2 Natural Grey FUTURECEM, 35 mm, painted finish, delivered and used in Denmark

Parameter	Unit	A1-A3	A4	A5	B1	C1	C2	C4	D
GWP	[kg CO_2-Eq.]	-1.96E-1	1.36E-1	2.77E-1	-6.86E-1	6.50E-4	1.15E-1	8.79E+0	-1.06E+0
ODP	[kg CFC11-Eq.]	2.70E-7	2.48E-8	1.14E-8	0.00E+0	2.81E-10	2.09E-8	7.13E-9	-5.87E-8
AP	[kg SO_2-Eq.]	1.97E-2	2.75E-4	7.26E-4	0.00E+0	1.59E-6	2.32E-4	5.89E-4	-2.20E-3
EP	[kg $(PO_4)^{3-}$-Eq.]	7.18E-3	5.65E-5	4.02E-4	0.00E+0	8.86E-7	4.76E-5	2.56E-4	-1.63E-3
POCP	[kg ethene-Eq.]	1.12E-3	1.81E-5	4.26E-5	0.00E+0	8.88E-8	1.52E-5	4.61E-5	-1.27E-4
ADPE	[kg Sb-Eq.]	7.83E-5	3.71E-6	4.93E-6	0.00E+0	1.82E-8	3.12E-6	7.77E-7	-2.85E-6
ADPF	[MJ]	4.90E+1	2.07E+0	2.23E+0	0.00E+0	4.20E-2	1.74E+0	7.12E-1	-1.49E+1

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

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A1: 1 m2 Natural Grey FUTURECEM, 35 mm, painted finish, delivered and used in Denmark

Parameter	Unit	A1-A3	A4	A5	B1	C1	C2	C4	D
PERE	[MJ]	8.09E+1	2.92E-2	4.50E-1	0.00E+0	3.91E-2	2.46E-2	9.39E+0	-6.95E+0
PERM	[MJ]	8.21E+1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PERT	[MJ]	1.63E+2	2.92E-2	4.50E-1	0.00E+0	3.91E-2	2.46E-2	9.39E+0	-6.95E+0
PENRE	[MJ]	5.02E+1	2.07E+0	2.23E+0	0.00E+0	4.20E-2	1.74E+0	7.12E-1	-1.49E+1
PENRM	[MJ]	1.51E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PENRT	[MJ]	5.03E+1	2.07E+0	2.23E+0	0.00E+0	4.20E-2	1.74E+0	7.12E-1	-1.49E+1
SM	[kg]	1.75E+0	0.00E+0	2.73E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
RSF	[MJ]	1.02E+1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
NRSF	[MJ]	1.08E+1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
FW	[m^3]	5.39E-1	3.54E-4	2.20E-3	0.00E+0	1.19E-5	2.98E-4	3.13E-4	-2.04E-3

Caption	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A1: 1 m2 Natural Grey FUTURECEM, 35 mm, painted finish, delivered and used in Denmark

Parameter	Unit	A1-A3	A4	A5	B1	C1	C2	C4	D
HWD	[kg]	5.68E-2	2.10E-3	7.11E-2	0.00E+0	5.40E-5	1.77E-3	1.64E-3	-6.49E-2
NHWD	[kg]	1.90E+0	1.44E-1	4.26E-1	0.00E+0	1.12E-3	1.21E-1	6.90E-2	-2.21E+0
RWD	[kg]	1.16E-4	1.42E-5	8.29E-6	0.00E+0	5.78E-7	1.19E-5	5.54E-6	-2.69E-5
CRU	[kg]	6.83E-6	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kg]	1.20E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MER	[kg]	1.78E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EEE	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.93E+0	0.00E+0
EET	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	6.19E+0	0.00E+0

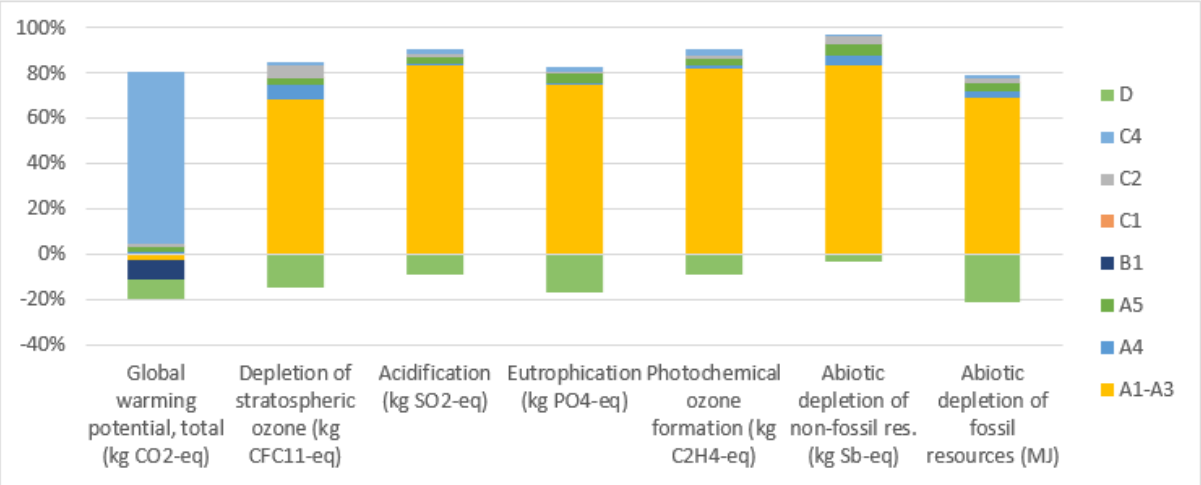
Caption	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy

6. LCA: Interpretation

The estimated impact results are only relative statements that do not indicate the end points of the impact categories, exceeding threshold values, safety margins or risks.

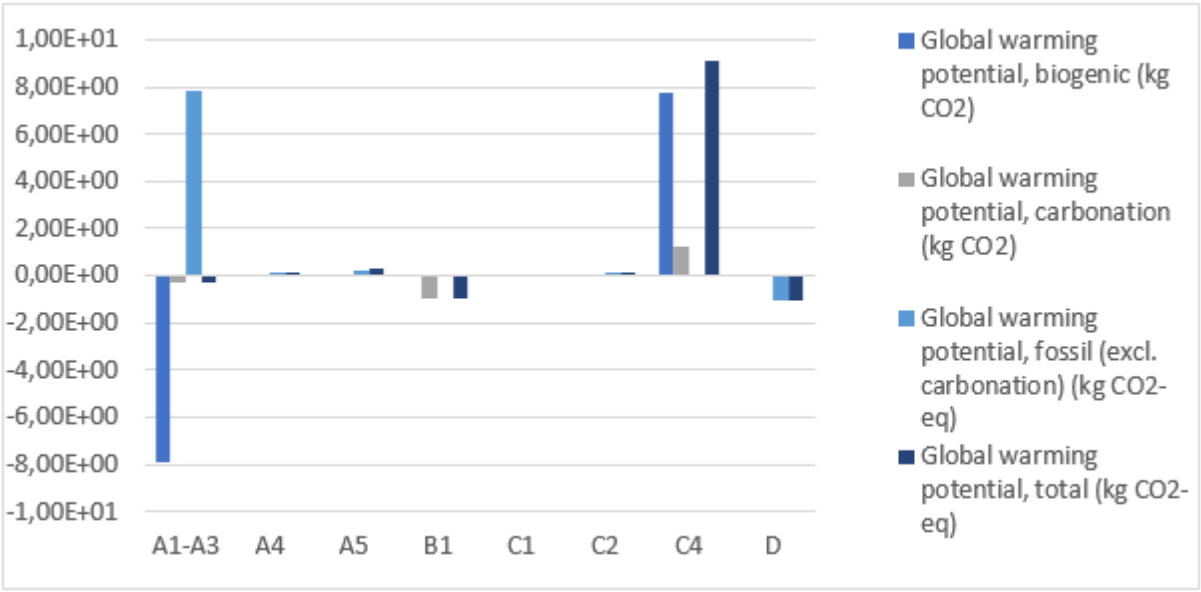
Two charts are presented: (1) with the standard lifecycle impact categories displaying the share of impacts across all lifecycle stages, and (2) displaying the total carbon balance of the Troldtekt product's lifecycle system.

Impacts from the A1-A3 modules are dominant in the life cycle of the Troldtekt Natural Grey FUTURECEM painted panel products. This is primarily caused by the acquisition and use of cement, wood, and paint in the foreground processes. Global Warming Potential net emissions share is much larger in C4 than in A1-A3 (see why in chart (2)), while other impact categories in module D, in general, are avoided in the waste system owing to the incineration of end-of-life panels and substitution of natural gas and Danish electricity mix. C4 also slightly follows emissions of compounds associated to other impact categories. A relatively inefficient transportation of end-of-life panels to waste incineration causes emissions in especially Abiotic depletion of non-fossil resources, Depletion of stratospheric ozone, and Photochemical ozone formation.



The embodied emissions associated to the raw materials (primarily cement and paint) are the main cause of impacts, especially in terms of net Global Warming Potential, with respectively 6.3 kg $CO_{2\text{-eq}}$ and 0.4 kg $CO_{2\text{-eq}}$ followed by minor impacts from additives. In general, direct emissions from the Troldtekt production site are relatively small. Abiotic depletion of fossil resources appears from the burden of producing cement using fossil raw material such as limestone and to a large extent fossil fuels. In terms of carbon balance, biogenic CO_2 in A1-A3 offsets nearly all the fossil CO_2 emissions in A1-A3. All biogenic CO_2 sequestered in A1-A3 and some fossil CO_2 taken up in A1-A3 and B1 is re-emitted in C4. $CO_{2\text{-eq}}$ emissions occurring in the remaining modules are negligible.

The amount of wood stored in the product refers to a negative contribution to Global Warming Potential, reducing the share of Global Warming Potential in A1-A3. This is due to the sequestration of biogenic carbon of wood during tree growth. The sequestered carbon does not contribute to global warming as long as it is stored in the biomass.



Summary
Within the cradle to grave, the following aspects have been identified as major contributors, mainly in the categories Global Warming Potential and Abiotic depletion of fossil resources:

- Emissions from the clinker production from material
- Emissions from the clinker production from fuel
- Substituted emissions from end of life incineration

Additionally, for painted panels, the manufacture of paint contribute significantly to impacts on potentials for Photochemical ozone formation, Acidification, Global Warming and Eutrophication, by order of importance. The treatment of wastewater from the painting cabin also contributes significantly to potential impacts in terms of Eutrophication.

The clinker (cement) production is the most critical process of the Troldtekt product system, but inaccuracies around the amount used will not invalidate the present conclusions.

Notably, by introducing more up-to-date LCA datasets for the grey cement applied, or introducing cements with less carbon footprint into production, as well as improved paint consumption management, could lead to significant reductions of especially the Global Warming Potential indicator.

7. Requisite evidence

7.1 Testing of substances used

A detailed assessment of substances used was conducted by a DAkkS-accredited laboratory, based on a sample (prepared according to *EN 15443*), available in the Test Report 2018P216294, using inductively coupled plasma mass spectrometry (*EN 16171*) and X-ray fluorescence (*EN 15309*), for the following:

- Heavy metals (cadmium, mercury, etc.)
- and other elements

7.2 Leaching

No leaching measurement was conducted according to *EN 717-1*.

7.3 VOC emissions

Testing for VOC emissions has been conducted in accordance with *EN ISO 16000-6*. Analysis of the air sampled on Tenax was performed at the Danish Technological Institute under DANAK accreditation 392. Report no. MAIC-2019-1418. Reporting of measured concentrations in toluene equivalents according to *EN 16516*. This test is the basis for the Finish M1 Material certificate as well as the Danish Indoor Climate labelling certificate.

AgBB overview of results (28 days [µg/m³])

Name	Value	Unit
TVOC (C6 - C16)	12	µg/m³
Sum SVOC (C16 - C22)	0 - 5	µg/m³
VOC without NIK	0 - 5	µg/m³
Carcinogenic Substances	1	µg/m³

AgBB overview of results (3 days [µg/m³])

Name	Value	Unit
TVOC (C6 - C16)	-	µg/m³
Sum SVOC (C16 - C22)	-	µg/m³
R (dimensionless)	-	-
VOC without NIK	-	µg/m³
Carcinogenic Substances	-	µg/m³

8. References

Standards

AgBB
AgBB, Ausschuss zur gesundheitlichen Bewertung von Bauprodukten (Committee for Health-related Evaluation of Building Products)

BBSR
BBSR, Bundesinstitut für Bau-, Stadt- und Raumforschung (Federal Institute for Research on Building, Urban Affairs and Spatial Development). BBSR table: https://www.nachhaltigesbauen.de/fileadmin/pdf/baustoff_gebauededaten/BNB_Nutzungsdauern_von_Bauteilen_2017-02-24.pdf

DIN 4108-4
DIN 4108-4:2017-03, Thermal insulation and energy economy in buildings - Part 4: Hygrothermal design values

DIN 52612-2
DIN 52612-2, Testing of thermal insulating materials; determination of thermal conductivity by means of the guarded hot plate apparatus; conversion of the measured values for building applications. 1 June 1984

DIN EN ISO 14025
DIN EN ISO 14025:2011, Environmental labels and declarations – Type III environmental declarations – Principles and procedures, German and English versions EN ISO 14025:2011

EN 13168
EN 13168:2012+A1:2015, Thermal insulation products for buildings. Factory made wood wool (WW) products. Specification

EN 13964
EN 13964:2014, Suspended ceilings. Requirements and test methods

EN 15309
EN 15309:2007, Characterization of waste and soil. Determination of elemental composition by X-ray fluorescence

EN 15443
EN 15443:2011, Solid recovered fuels. Methods for the preparation of the laboratory sample

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

EN 16171
EN 16171:2016, Sludge, treated biowaste and soil. Determination of elements using inductively coupled plasma mass spectrometry (ICP-MS)

EN 16449
EN 16449:2014, EN 16449:2014, Wood and wood-based products - Calculation of the biogenic carbon content of wood and conversion to carbon dioxide

EN 16516
EN 16516:2017+A1:2020, Construction products: Assessment of release of dangerous substances. Determination of emissions into indoor air

EN 717-1
EN 717-1:2004, Wood-based Panels – Determination of Formaldehyde Release – Formaldehyde emission by the chamber method

European Waste Code: 10 13 11
(wastes from cement-based composite materials)

ISO 16000-6
ISO 16000-6:2011, Indoor air - Part 6: Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA sorbent, thermal desorption and gas chromatography using MS or MS-FID

Product Category Rule A
Product Category Rule A, IBU, 2021, Part A, Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report. v.2.0.1. IBU, 2021.

Product Category Rule B
Product Category Rule B, IBU, 2019, Part B, Requirements on the EPD for Wood cement - Mineral-bonded wooden composites. v.1.7. IBU, 2019.

Regulation (EU) No. 305/2011

Further References

General Programme Instructions, IBU 2021
General Instructions for the EPD programme of Institut Bauen und Umwelt e.V. Version 2.0, Berlin: Institut Bauen und Umwelt e.V., 2021. www.ibu-epd.com

Software/database
OneClick LCA software, Pre-verified EPD tool, Bionova: https://www.oneclicklca.com/

Database: Ecoinvent v.3.6. cut-off (2019)
https://ecoinvent.org/the-ecoinvent-database/

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