



Declaration Owner

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Product

FireBloc™ Plasterboard (12.5mm and 15mm)

Functional Unit

The functional unit is 92.9 square meters of installed
plasterboard with a Reference Service Life of 75- years

EPD Number and Period of Validity

SCS-EPD-07792
EPD Valid April 8, 2022 through April 7, 2027

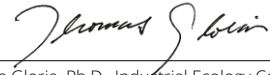
Product Category Rule

NSF Product Category Rule for Gypsum Panel
Products. Version 1.1 April 2020

Program Operator

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Declaration owner:	Knauf India Private Limited	
Address:	Unit No. 610-613, 6 th Floor, Vipul Trade Center, Sector-48, Sohna Road Gurgaon-122001, Haryana, India	
Declaration Number:	SCS-EPD-07792	
Declaration Validity Period:	EPD Valid April 8, 2022 through April 7, 2027	
Program Operator:	SCS Global Services	
Declaration URL Link:	https://www.scsglobalservices.com/certified-green-products-guide	
LCA Practitioner:	Beth Cassese, SCS Global Services	
LCA Software and LCI database:	OpenLCA 1.10.3 software and the Ecoinvent v3.7.1 database	
Product's Intended Application:	False ceilings, drywalls, and wall linings in both residential and commercial markets	
Product RSL:	75 Years	
Markets of Applicability:	India	
EPD Type:	Product-Specific	
EPD Scope:	Cradle-to-Grave	
LCIA Method and Version:	TRACI and CML-IA Baseline	
Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071	☒ internal ☐ external	
LCA Reviewer:	 _____ Wan Ping Chua, SCS Global Services	
Product Category Rule:	NSF Product Category Rule for Gypsum Panel Products. Version 1.1 April 2020	
PCR Review conducted by:	Thomas P. Gloria, Bill Stough, Jack Geibig	
Independent verification of the declaration and data, according to ISO 14025 and the PCR	☐ internal ☒ external	
EPD Verifier:	 _____ Thomas Gloria, Ph.D., Industrial Ecology Consultants	
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Disclaimers: This EPD conforms to ISO 14025, 14040, 14044, and ISO 21930. Scope of Results Reported: The PCR requirements limit the scope of the LCA metrics such that the results exclude environmental and social performance benchmarks and thresholds, and exclude impacts from the depletion of natural resources, land use ecological impacts, ocean impacts related to greenhouse gas emissions, risks from hazardous wastes and impacts linked to hazardous chemical emissions. Accuracy of Results: Due to PCR constraints, this EPD provides estimations of potential impacts that are inherently limited in terms of accuracy. Comparability: The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled. In accordance with ISO 21930:2017, EPDs are comparable only if they comply with the core PCR, use the same sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works.		

1. ABOUT Knauf India Private Limited

The company was established in 2006, and the Rajasthan plant has been operating since 2008. Following the USG Boral joint venture announced at the corporate level in 2013, the company was known as USG Boral India until 2021 when the company was acquired by Knauf Group and the company was rebranded as Knauf India Private Limited. Knauf India operates across India, Nepal, and Bhutan. Knauf India has established a business footprint in Pan India and are well-positioned to supply growth in India from plasterboard manufacturing facilities in Khushkhera District Alwar, Rajasthan and Sricity, Andhra Pradesh and a fully automated all-purpose joint compound and wall putty manufacturing facility at Sholavaram, Chennai.

2. PRODUCT

2.1 Product Description

FireBloc™ Plasterboard is manufactured with mineral additives such as glass fibers and vermiculite in the gypsum core to improve core cohesion at high temperatures and reduce shrinkage when exposed to heat. These boards are made with two heavy duty fire protective paper liners. Its uniform core helps to achieve high system performance, consistent quality, strength, and ease of use.

2.2 Application

Gypsum plasterboard products are designed for a variety of applications, including false ceilings, drywalls, and wall linings in both residential and commercial markets.

2.3 Technical Data

Table 1. FireBloc™ Plasterboard Technical Data

Property	Test Method	Test Results
Flexural Strength (N)	12.5mm – BS-EN-520	Longitudinal direction 720 Transverse direction 400
	15mm - IS: 2095 2011	Longitudinal direction 680 Transverse direction 420

2.4 Delivery Status

Table 2. FireBloc™ Plasterboard Delivery Status

FireBloc™ Plasterboard Thickness	Width	Length
12.5 mm (1.25 cm)	1220 mm (122 cm)	1830 mm (183 cm)
15 mm (1.50 cm)	1220 mm (122 cm)	2440 mm (244 cm)

2.5 Flow Diagram

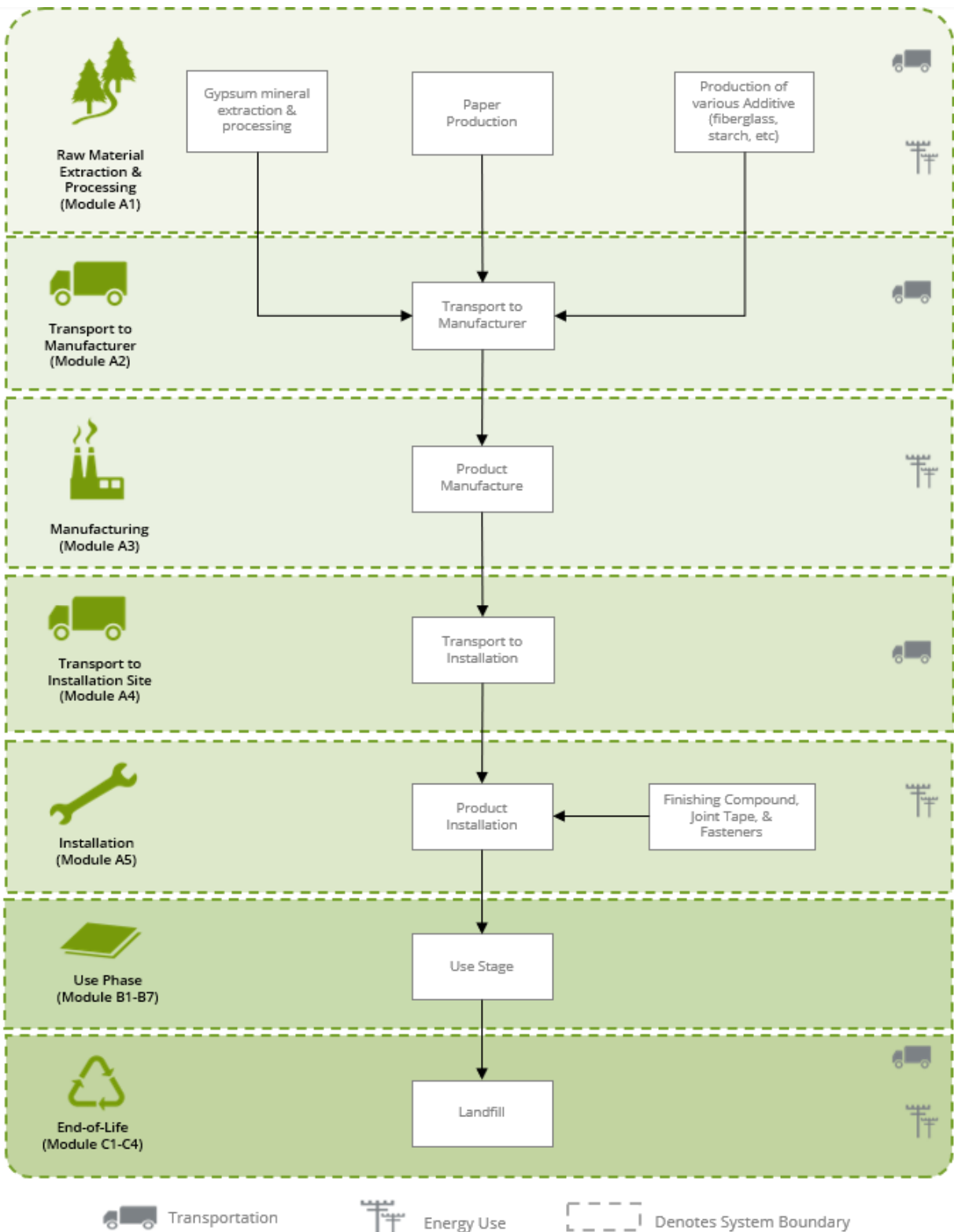


Figure 1. Flow diagram and system boundaries for the FireBloc™ Standard plasterboard.

2.6 Base Materials

Table 3. FireBloc™ Plasterboard Material Components per 92.9 m²

Product	Amount (kg)	Percentage of Total Mass	Product	Amount (kg)	Percentage of Total Mass
12.5 mm Plasterboard			15 mm Plasterboard		
Internal Recycle	22.4	1.98%	Internal Recycle	27.2	2.04%
Gypsum	1025	90.5%	Gypsum	1225	91.5%
Vermiculite	41.8	3.69%	Vermiculite	41.8	3.12%
Fiberglass	6.04	0.53%	Fiberglass	6.04	0.45%
Starch	3.19	0.28%	Starch	3.36	0.25%
Fluidizer	1.72	0.15%	Fluidizer	1.73	0.13%
Additives	1.01	0.09%	Additives	1.21	0.09%
Paper Liner	32.0	2.82%	Paper Liner	31.8	2.38%
Total	1133	100%	Total	1338	100%
Packaging			Packaging		
End Tape	0.411	100%	End Tape	0.411	100%
Total Packaging	0.411	100%	Total Packaging	0.411	100%

2.7 Manufacture

To produce plasterboard panels, gypsum is mixed with water, starch, fluidizer, internal recycle materials, and additives to form a slurry that is fed between continuous layers paper on a board machine. As the board is moved down a conveyer line, the slurry recrystallizes, reverting to its original rock. The board is then cut to length and conveyed through oven dryers to remove any free moisture.

2.8 Environment and Health during Manufacture

There are no known environmental or health programs at the manufacturing facilities.

2.9 Product Processing/ Installation

Typical installation is completed using manual labor but does require additional materials. These materials include fasteners (screws), joint tape, and joint compound.

2.10 Packaging

Plasterboard products are packaged for shipment using only paper end tape.

2.11 Condition of Use

No special conditions of use are noted.

2.12 Environment and Health during use

No environmental or health impacts are expected due to normal use of the plasterboard products.

2.13 Reference Service Life

The Reference Service Life (RSL) of the plasterboard products is 75-years. Based on the manufacturers' expertise, the product's typical life span is 50-years.



2.14 Extraordinary Effects

No environmental or health impacts are expected due to extraordinary effects including fire and/or water damage and product destruction.

2.15 Re-Use Phase

There are currently no scenarios for re-use or recycling of gypsum plasterboard products at end-of-life.

2.16 Disposal

At end-of-life, the gypsum plasterboard products may be disposed of in a landfill or via incineration, following local regulations.

2.17 Further Information

Further information on the product can be found on the manufacturer's website at https://www.usgboral.com/en_in/products/interior-panels/panels-drywall.html.

3. LCA: CALCULATION RULES

3.1 Functional Unit

The functional unit used in the study, is 92.9 m² of gypsum plasterboard panel over a 75-year period.

Table 4. FireBloc™ Plasterboard Functional Unit Properties

SHEETROCK Plasterboard	Functional Unit	Mass	Thickness
Product	m ²	kg	cm
12.5 mm	92.9	1133	1.25
15 mm	92.9	1338	1.50

3.2 Estimates and Assumptions

- Electricity use at the manufacturing facilities was allocated to the products based on the product area as a fraction of the total production.
- The manufacturing facilities are located in India. An Ecoinvent inventory dataset for the Indian energy grid mix was used to model resources and emissions from electricity use at the two manufacturing facilities.
- The Reference Service Life (RSL) of the products was modeled as 75-years, as required by the PCR; however, experts at Knauf India indicated the typical product life span to be 50-years.
- The installation materials and amounts of each material are assumed based on the Knauf India online material estimator: https://www.usgboral.com/en_in/product-resources-and-tools-from-usg-boral/resources-tools/plaster-board-material-estimator.html
- Installation waste is assumed to be 10%.
- Transportation distance of the installation waste to disposal is assumed to be 100 kilometers.
- The use phase (Modules B1, B2, B3, B5, B6, B7) are assumed to have no impacts, as there is no energy or water use associated with these modules.
- The use phase replacement module (B4) is assumed to include replacement of ½ a product after the 50-year typical life span indicated Knauf India experts, in order to meet the 75-year Reference Service Life (RSL) required by the PCR.
- For the product end-of-life, disposal of product is assumed to be in a landfill.
- Transportation distance of the product at the end-of-life is assumed to be 100 kilometers.

It should also be noted that LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

3.3 Cut-off criteria

According to the PCR, processes contributing greater than 1% of the total environmental impact indicator for each impact are included in the inventory. No data gaps were allowed which were expected to significantly affect the outcome of the indicator results.

3.4 System Boundary

The scope of the EPD is cradle-to-grave, including raw material extraction and processing, transportation, product manufacture, product delivery, installation and use, and product disposal.

Table 5. FireBloc™ Plasterboard System Boundaries.

Product			Construction Process		Use								End-of-life				Benefits and loads beyond the system boundary
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	
Raw material extraction and processing Transport to manufacturer Manufacturing			Transport Construction - installation		Use Maintenance Repair Replacement Refurbishment Operational energy use Operational water use							Deconstruction demolition Transport Waste processing Disposal				Reuse, recovery and/or recycling potential	
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	MND	

X = Included in system boundary

MND = Module not declared



FireBloc™ Plasterboard

3.5 Background Data

Primary data were provided by Knauf India Private Limited for the Rajasthan and Andhra Pradesh facilities and from multiple suppliers of component materials for the gypsum plasterboard products. The sources of secondary LCI data are the Ecoinvent database (v3.7.1, 2020).

Table 6. LCI datasets and associated databases used to model the Knauf India gypsum plasterboard products.

Component	Dataset	Data Source	Publication Date
Product			
Accelerator	market for ash, from combustion of straw ash, from combustion of straw Cutoff, U GLO	Ecoinvent 3.7.1	2020
	market for glucose glucose Cutoff, U GLO	Ecoinvent 3.7.1	2020
	market for magnesium sulfate magnesium sulfate Cutoff, U GLO	Ecoinvent 3.7.1	2020
	market for sulfate pulp, unbleached sulfate pulp, unbleached Cutoff, U RoW	Ecoinvent 3.7.1	2020
	market for tap water tap water Cutoff, U IN	Ecoinvent 3.7.1	2020
	market for gypsum, mineral gypsum, mineral Cutoff, U IN	Ecoinvent 3.7.1	2020
	market for silica sand silica sand Cutoff, U GLO	Ecoinvent 3.7.1	2020
Ammonium Sulphate	market for ammonium sulfate ammonium sulfate Cutoff, U RoW	Ecoinvent 3.7.1	2020
Fiberglass	market for glass fibre glass fibre Cutoff, U GLO	Ecoinvent 3.7.1	2020
Fluidizer	market for naphthalene sulfonic acid naphthalene sulfonic acid Cutoff, U GLO	Ecoinvent 3.7.1	2020
	market for sodium sulfate, anhydrite sodium sulfate, anhydrite Cutoff, U RoW	Ecoinvent 3.7.1	2020
	market for tap water tap water Cutoff, U IN	Ecoinvent 3.7.1	2020
Foaming Agent	market for anionic resin anionic resin Cutoff, U RoW	Ecoinvent 3.7.1	2020
Gypsum (Eastern Bulk)	market for gypsum, mineral gypsum, mineral Cutoff, U ZA	Ecoinvent 3.7.1	2020
Gypsum (Tetarwal)	market for gypsum, mineral gypsum, mineral Cutoff, U IN	Ecoinvent 3.7.1	2020
Kraft Liner	market for kraft paper kraft paper Cutoff, U RoW	Ecoinvent 3.7.1	2020
Potash	market for potassium sulfate potassium sulfate Cutoff, U RoW	Ecoinvent 3.7.1	2020
Retarder	market for nylon 6 nylon 6 Cutoff, U RoW	Ecoinvent 3.7.1	2020
	market for tap water tap water Cutoff, U IN	Ecoinvent 3.7.1	2020
Silicone	market for silicone product silicone product Cutoff, U RoW	Ecoinvent 3.7.1	2020
Starch	market for maize starch maize starch Cutoff, U GLO	Ecoinvent 3.7.1	2020
Vermiculite	market for vermiculite vermiculite Cutoff, U GLO	Ecoinvent 3.7.1	2020
Package			
Paper	market for kraft paper kraft paper Cutoff, U RoW	Ecoinvent 3.7.1	2020
Transport			
Truck	market for transport, freight, lorry >32 metric ton, EURO4 transport, freight, lorry >32 metric ton, EURO4 Cutoff, U RoW	Ecoinvent 3.7.1	2020
Train	market for transport, freight train transport, freight train Cutoff, U IN	Ecoinvent 3.7.1	2020
Ship	market for transport, freight, sea, container ship transport, freight, sea, container ship Cutoff, U GLO	Ecoinvent 3.7.1	2020
Manufacture			
Andhra Pradesh Electricity	market for electricity, medium voltage electricity, medium voltage Cutoff, U IN-southern grid	Ecoinvent 3.7.1	2020
Rajasthan Electricity	market for electricity, medium voltage electricity, medium voltage Cutoff, U IN-northern grid	Ecoinvent 3.7.1	2020
Diesel	market for diesel diesel Cutoff, U IN	Ecoinvent 3.7.1	2020
Natural Gas	heat production, natural gas, at industrial furnace >100kW heat, district or industrial, natural gas Cutoff, U RoW	Ecoinvent 3.7.1	2020
Water	market for tap water tap water Cutoff, U IN	Ecoinvent 3.7.1	2020
Waste Oil	market for hazardous waste, for incineration hazardous waste, for incineration Cutoff, U RoW	Ecoinvent 3.7.1	2020
Product Disposal			
Landfill	market for inert waste, for final disposal inert waste, for final disposal Cutoff, U RoW	Ecoinvent 3.7.1	2020

3.6 Data Quality

Table 7. Data quality assessment for FireBloc™ Plasterboard.

Data Quality Parameter	Data Quality Discussion
Time-Related Coverage: Age of data and the minimum length of time over which data is collected	The most recent available data are used, based on other considerations such as data quality and similarity to the actual operations. Typically, these data are less than 5 years old. All of the data used represented an average of a least one year's work of data collection. Manufacturer-supplied data are based on 12-months of production from July 2020 through June 2021. The time period over which inputs to and outputs from the system are accounted for is 100 years from the year for which the data set is deemed representative.
Geographical Coverage: Geographical area from which data for unit processes is collected to satisfy the goal of the study	The data used in the analysis provide the best possible representation available with current data. Electricity use for product manufacture is modeled using representative data for the regional grid in India. Surrogate data used in the assessment are representative of global or European operations. Data representative of European operations are considered sufficiently similar to actual processes.
Technology Coverage: Specific technology or technology mix	For the most part, data are representative of the actual technologies used for processing, transportation, and manufacturing operations. Representative component datasets, specific to the type of material, are used to represent the actual processes, as appropriate.
Precision: Measure of the variability of the data values for each data expressed	Precision of results are not quantified due to a lack of data. Data collected for operations were typically averaged for one more years and over multiple operations, which is expected to reduce the variability of results.
Completeness: Percentage of flow that is measured or estimated	The LCA model included all known mass and energy flows for production of the product. In some instances, surrogate data used to represent upstream and downstream operations may be missing some data which is propagated in the model. No known processes or activities contributing to more than 1% of the total environmental impact for each indicator are excluded.
Representativeness: Qualitative assessment of the degree to which the data set reflects the true population of interest	Data used in the assessment represent typical or average processes as currently reported from multiple data sources and are therefore generally representative of the range of actual processes and technologies for production of these materials. Considerable deviation may exist among actual processes on a site-specific basis; however, such a determination would require detailed data collection throughout the supply chain back to resource extraction.
Consistency: Qualitative assessment of whether the study methodology is applied uniformly to the various components of the analysis	The consistency of the assessment is considered to be high. Data sources of similar quality and age are used; with a bias towards Ecoinvent v3.7.1 data where available. Different portions of the product life cycle are equally considered.
Reproducibility: Qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study	Based on the description of the data and assumptions used, this assessment would be reproducible by other practitioners. All assumptions, models, and data sources are documented.
Sources of the Data: Description of all primary and secondary data sources	Data representing energy use at Knauf's manufacturing facilities represent a 12-month average and are considered of high quality due to the length of time over which these data are collected, as compared to a snapshot that may not accurately reflect fluctuations in production. For secondary LCI data, Ecoinvent v3.7.1 data are used.
Uncertainty of the Information: Uncertainty related to data, models, and assumptions	Uncertainty related to materials in the products and packaging is low. Actual supplier data for upstream operations was not available for all suppliers and the study relied upon the use of existing representative datasets. These datasets contained relatively recent data (<10 years) but lacked geographical representativeness. Uncertainty related to the impact assessment methods used in the study are high. The impact assessment methodology includes impact potentials, which lack characterization of providing and receiving environments or tipping points.

3.7 Period under review

The period of review is based on a 12-month period from July 2020 through June 2021.

3.8 Allocation

Manufacturing resource use was allocated to the products based on area. Impacts from transportation were allocated based on the mass of material and distance transported.

3.9 Comparability

The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled.

4. LCA: SCENARIOS AND ADDITIONAL TECHNICAL INFORMATION

Delivery stage (A4)

Distribution of the plasterboard products to the point of installation was provided by the manufacturer and was modeled as 1,110 km by diesel truck and 115 km by rail freighter.

Table 8. *Module A4 Technical Information*

Truck Transport	FireBloc™ Plasterboard 12.5 mm	FireBloc™ Plasterboard 15mm
	Unit	Value
Fuel type	-	Diesel
Fuel utilization	L/100 km	18.7
Distance	km	1,110
Amount of fuel	Liters	20,800
Capacity utilization		37%
Train Transport	Unit	Value
	Unit	Value
Fuel type	-	Electricity/Diesel
Fuel utilization	L/100 km	7
Distance	km	115
Amount of fuel	Liters	806

Installation stage (A5)**Table 9.** *Module A5 Technical Information per 92.9 m²*

Installation Parameters	Unit	FireBloc™ Plasterboard 12.5 mm	FireBloc™ Plasterboard 15mm
Ancillary materials	kg	60.3	60.3
Fasteners	kg	3.93	3.93
Joint tape	kg	0.585	0.585
Joint compound	kg	55.7	55.7
Product loss	kg	113	134
Electricity consumption	kwh	0.00	0.00
Other energy consumption	kwh	0.00	0.00
Water consumption	m ³	0.00	0.00
Direct emissions to ambient air, soil, and water	kg	0.00	0.00
Waste materials from installation process	kg	114	134
Packaging waste Paper tape	kg	0.411	0.411
Biogenic carbon in packaging waste	kg	0.753	0.753

Use stage (B1)

No impacts are associated with the use of the product over the reference service lifetime.

Maintenance stage (B2)

No maintenance is required with the use of the product over the reference service lifetime.

Repair stage (B3)

No repair is required with the use of the product over the reference service lifetime.

Replacement stage (B4)

Replacement of the plasterboard product is assumed to take place at the end of the 50-year life span, in order to be consistent with the 75-year Reference Service Life.

Refurbishment stage (B5)

No refurbishment is required with the use of the product over the reference service lifetime.

Table 10. *Modules B1-B5 Technical Information per 92.9 m²*

Use Phase Parameters	Unit	Use (B1)	Maintenance (B2)	Repair (B3)	Replacement (B4)	Refurbishment (B5)
Description of process	-	N/A	N/A	N/A	N/A	N/A
Direct emissions to ambient air, soil, and water	kg	0.00	0.00	0.00	0.00	0.00
Number of cycles per RSL	-	0	0	0	0	0
Number of cycles per ESL	-	0	0	0	0.5	0
Ancillary materials	kg	0.00	0.00	0.00	0.00	0.00
Energy consumption	kwh	0.00	0.00	0.00	0.00	0.00
Water consumption	m ³	0.00	0.00	0.00	0.00	0.00
Waste	kg	0.00	0.00	0.00	567 - 669	0.00

Building operation stage (B6 – B7)

There is no operational energy or water use associated with the use of the product over the reference service lifetime.

Table 11. Modules B6-B7 Technical Information per 92.9 m²

Use Phase Parameters	Unit	Operational Energy Use (B6)	Operational Water Use (B7)
Type of energy carrier	-	N/A	N/A
Energy consumption	kwh	0.00	0.00
Water consumption	m ³	0.00	0.00

Disposal stage (C1 - C4)

The disposal stage includes demolition of the products (C1); transport of the plasterboard products to waste treatment facilities (C2); waste processing (C3); and associated emissions as the product degrades in a landfill (C4).

For the plasterboard product, no emissions are generated during demolition (C1) while no waste processing (C3) is required for incineration or landfill disposal. While the PCR specifies a default of 50 miles (80 km) in the absence of specific data for the transport of waste material at the end-of-life, this is specific to the North American market for the PCR. This study assumes transportation of waste materials at end-of-life (C2) to be 100 km average in order to be more consistent with other waste transport assumptions in the study.. As there are currently no known recycling or reuse scenarios for the product at the end-of-life, the disposition at end-of-life is assumed to be inert in a landfill. As required by the PCR, only the biogenic carbon in the starch raw materials is considered for the biogenic carbon leaving the system.

Table 12. Modules C1-C4 Technical Information per 92.9 m²

End-of-Life Phase Parameters	Unit	FireBloc Plasterboard 12.5mm	FireBloc Plasterboard 15mm
Deconstruction (C1) Energy Use	kwh	0.00	0.00
Waste Transport (C2) Distance	km	100	100
Waste Processing (C3) Energy Use	kwh	0.00	0.00
Final Disposal (C4) Landfill	Kg	1020	1204
Biogenic Carbon Content	kg	5.85	6.17

5. LCA: RESULTS

Results of the Life Cycle Assessment are presented below. It is noted that LCA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. All LCA results are stated to three significant figures in agreement with the PCR for this flooring product and therefore the sum of the total values may not exactly equal 100%.

The following environmental impact category indicators are reported using characterization factors using the TRACI 2.1 and CML-IA impact assessment method.

TRACI 2.1 Impact Category	Unit	CMLI-A Impact Category	Unit
GWP: Global Warming Potential	kg CO ₂ eq	GWP: Global Warming Potential	kg CO ₂ eq
ODP: Ozone Depletion Potential	kg CFC 11 eq	ODP: Ozone Depletion Potential	kg CFC 11 eq
AP: Acidification Potential of soil and water	kg SO ₂ eq	AP: Acidification Potential of soil and water	kg SO ₂ eq
EP: Eutrophication Potential	kg N eq	EP: Eutrophication Potential	kg PO ₄ ³⁻ eq
POCP: Photochemical Oxidant Creation Potential	kg O ₃ eq	POCP: Photochemical Oxidant Creation Potential	kg C ₂ H ₄ eq
FFD: Fossil Fuel Depletion	MJ Surplus	ADPE: Abiotic Depletion Potential - Elements	kg Sb eq
		ADPF: Abiotic Depletion Potential – Fossil Fuels	MJ

These impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development. However, the EPD users shall not use additional measures for comparative purposes.

The following inventory parameters, specified by the PCR, are also reported.

Resources	Unit	Waste and Outflows	Unit
RPRE: Renewable primary resources used as energy carrier (fuel)	MJ, LHV	HWD: Hazardous waste disposed	kg
RPRM: Renewable primary resources with energy content used as material	MJ, LHV	NHWD: Non-hazardous waste disposed	kg
NRPRE: Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	RWD: Radioactive waste, conditioned, to final repository	kg
NRPRM: Non-renewable primary resources with energy content used as material	MJ, LHV	CRU: Components for re-use	kg
SM: Secondary materials	MJ, LHV	MR: Materials for recycling	kg
RSF: Renewable secondary fuels	MJ, LHV	MER: Materials for energy recovery	kg
NRSF: Non-renewable secondary fuels	MJ, LHV	EE: Recovered energy exported from the product system	MJ, LHV
RE: Recovered energy	MJ, LHV		
FW: Use of net freshwater resources	m ³		
Biogenic Carbon	Unit		
BCRE _p : Removals and emissions associated with biogenic carbon of bio-based products	kg CO ₂ eq	BCEW _R : Biogenic carbon emissions from combustion of waste from renewable sources used in production	kg CO ₂ eq
BCRE _{PKG} : Removals and emissions associated with biogenic carbon content of bio-based packaging	kg CO ₂ eq	BCEW _{NR} : Biogenic carbon emissions from combustion of waste from non-renewable sources used in production	kg CO ₂ eq
ECUC: Emissions from calcination and uptake from carbonation	kg CO ₂ eq	GWP: Global Warming Potential (EN 15804)	kg CO ₂ eq

Modules B1, B2, B3, B5, B6 and B7 are not associated with any impact and are therefore declared as zero. In addition, module C1 and C3 are likewise not associated with any impact as the plasterboards are manually deconstructed. Module D is not declared. In the interest of space and table readability, these modules are not included in the results presented below.

The TRACI 2.1 and CML Life Cycle Impact Assessment (LCIA) methods were selected for this study as required by the PCR and ISO 21930 for an international market. In order to be more transparent regarding the biogenic carbon uptake and emissions of biomass, the Global Warming Potential (GWP) from the EN 15804 +A2 method was also included with the required biogenic carbon indicators. Results for the gypsum plasterboard products are shown per 92.9 m² of product. All values are rounded to three significant digits.

FireBloc™ Plasterboard 12.5 mm Results

Table 13. Impact indicator results for 12.5mm FireBloc™ Plasterboard.

TRACI	Unit	A1	A2	A3	A1-A3 Total	A4	A5	B4	C2	C4
GWP	kg CO ₂ eq.	86.6	73.7	146	306	120	17.6	229	9.36	8.42
ODP	kg CFC-11 eq.	4.77x10 ⁻⁵	1.73x10 ⁻⁵	1.11x10 ⁻⁵	7.61x10 ⁻⁵	2.85x10 ⁻⁵	1.80x10 ⁻⁶	5.56x10 ⁻⁵	2.28x10 ⁻⁶	3.02x10 ⁻⁶
AP	kg SO ₂ eq.	0.688	0.846	0.303	1.84	0.557	0.076	1.28	0.043	0.064
EP	kg N eq.	0.524	0.089	0.226	0.839	0.143	0.075	0.537	0.010	0.013
POCP	kg O ₃ eq.	13.0	17.0	4.12	34.1	13.4	1.26	25.5	1.03	1.59
FFD	MJ Surplus	134	156	256	545	258	19.1	433	20.6	28.1
CML	Unit	A1	A2	A3	A1-A3 Total	A4	A5	B4	C2	C4
GWP	kg CO ₂ eq.	86.9	73.8	147	308	121	17.8	230	9.37	8.44
ODP	kg CFC-11 eq.	4.47x10 ⁻⁵	1.30x10 ⁻⁵	8.25x10 ⁻⁶	6.59x10 ⁻⁵	2.14x10 ⁻⁵	1.40x10 ⁻⁶	4.61x10 ⁻⁵	1.71x10 ⁻⁶	2.27x10 ⁻⁶
AP	kg SO ₂ eq.	0.611	0.777	0.289	1.68	0.475	0.071	1.15	0.036	0.054
EP	kg PO ₄ ³⁻ eq.	0.287	0.111	0.114	0.512	0.115	0.037	0.340	0.009	0.012
POCP	kg C ₂ H ₄ eq.	0.022	0.021	0.016	0.059	0.015	0.005	0.041	0.001	0.002
ADPE	kg Sb eq.	6.50x10 ⁻⁴	1.50x10 ⁻⁴	5.35x10 ⁻⁵	8.54x10 ⁻⁴	2.80x10 ⁻⁴	3.70x10 ⁻⁴	7.70x10 ⁻⁴	2.20x10 ⁻⁵	2.34x10 ⁻⁵
ADPF	MJ	1130	1080	2060	4270	1830	206	3300	144	195

Table 14. Resource use and waste indicators for the 12.5 mm FireBloc™ Plasterboard products.

Resource Use	Unit	A1	A2	A3	A1-A3 Total	A4	A5	B4	C2	C4
RPR _E	MJ	1340	10.6	56.0	1400	22.1	35.5	734	1.58	2.00
RPR _M	MJ	1870	0.00	0.00	1870	0.00	0.00	936	0.00	0.00
NRPR _E	MJ	1190	1090	2090	4370	1860	227	3380	146	197
NRPR _M	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA
SM	kg	35.4	0.00	0.00	35.4	0.00	0.00	17.7	0.00	0.00
RSF	MJ	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
NRSF	MJ	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
RE	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA
FW	m ³	0.688	0.134	0.541	1.36	0.271	0.194	1.02	0.021	0.171
Waste and Output	Unit	A1	A2	A3	A1-A3 Total	A4	A5	B4	C2	C4
HWD	kg	0.005	0.002	0.001	0.009	0.004	0.003	0.008	3.50x10 ⁻⁴	3.40x10 ⁻⁴
NHWD	kg	37.9	70.2	4.32	112	156	119	766	12.6	1020
RWD	kg	0.005	0.007	8.00x10 ⁻⁴	0.013	0.012	8.50x10 ⁻⁴	0.014	9.70x10 ⁻⁴	0.001
CRU	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MR	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MER	kg	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
EE	MJ, LHV	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Biogenic Carbon	Unit	A1	A2	A3	A1-A3 Total	A4	A5	B4	C2	C4
BCRE _P	kg CO ₂ eq.	-5.85	0.00	0.00	-5.85	0.00	0.00	-2.93	0.00	0.00
BCRE _{PKG}	kg CO ₂ eq.	0.00	0.00	-0.281	-0.281	0.00	0.00	-0.140	0.00	0.00
ECUC	kg CO ₂ eq.	INA	INA	INA	INA	INA	INA	INA	INA	INA
BCEW _R	kg CO ₂ eq.	INA	INA	INA	INA	INA	INA	INA	INA	INA
BCEW _{NR}	kg CO ₂ eq.	INA	INA	INA	INA	INA	INA	INA	INA	INA
GWP (EN 15804)	kg CO ₂ eq.	58.2	74.5	149	282	122	18.3	218	9.48	8.61

INA = Indicator not assessed, | Neg.= Negligible

FireBloc™ Plasterboard 15 mm Results**Table 15.** Impact indicator results for 15mm FireBloc™ Plasterboard. All values are rounded to three significant digits.

TRACI	Unit	A1	A2	A3	A1-A3 Total	A4	A5	B4	C2	C4
GWP	kg CO ₂ eq.	92.4	85.6	146	324	142	17.8	250	11.0	9.93
ODP	kg CFC-11 eq.	5.19x10 ⁻⁵	2.01x10 ⁻⁵	1.11x10 ⁻⁵	8.31x10 ⁻⁵	3.36x10 ⁻⁵	1.87x10 ⁻⁶	6.21x10 ⁻⁵	2.69x10 ⁻⁶	3.57x10 ⁻⁶
AP	kg SO ₂ eq	0.732	0.975	0.303	2.01	0.657	0.077	1.42	0.050	0.075
EP	kg N eq	0.532	0.104	0.226	0.862	0.169	0.075	0.563	0.012	0.016
POCP	kg O ₃ eq	14.1	19.6	4.12	37.7	15.8	1.30	28.7	1.22	1.88
FFD	MJ Surplus	145	181	256	582	305	19.7	479	24.4	33.2
CML	Unit	A1	A2	A3	A1-A3 Total	A4	A5	B4	C2	C4
GWP	kg CO ₂ eq.	92.8	85.7	147	325	142	18.0	251	11.1	9.96
ODP	kg CFC-11 eq.	4.86x10 ⁻⁵	1.51x10 ⁻⁵	8.25x10 ⁻⁶	7.19x10 ⁻⁵	2.52x10 ⁻⁵	1.45x10 ⁻⁶	5.14x10 ⁻⁵	2.02x10 ⁻⁶	2.68x10 ⁻⁶
AP	kg SO ₂ eq	0.647	0.895	0.289	1.83	0.561	0.072	1.27	0.043	0.063
EP	kg PO ₄ ³⁻ eq	0.296	0.128	0.114	0.538	0.135	0.037	0.365	0.010	0.014
POCP	kg C ₂ H ₄ eq.	0.023	0.025	0.016	0.063	0.018	0.006	0.045	0.001	0.002
ADPE	kg Sb eq.	6.70x10 ⁻⁴	1.80x10 ⁻⁴	5.35x10 ⁻⁵	9.04x10 ⁻⁴	3.40x10 ⁻⁴	3.70x10 ⁻⁴	8.20x10 ⁻⁴	2.59x10 ⁻⁵	2.76x10 ⁻⁵
ADPF	MJ	1210	1250	2060	4530	2160	211	3630	170	230

Table 16. Resource use and waste indicators for the 15 mm FireBloc™ Plasterboard products.

Resource Use	Unit	A1	A2	A3	A1-A3 Total	A4	A5	B4	C2	C4
RPR _E	MJ	1340	12.3	56.0	1400	26.1	35.6	736	1.87	2.36
RPR _M	MJ	1860	0.00	0.00	1860	0.00	0.00	930	0.00	0.00
NRPR _E	MJ	1280	1270	2090	4630	2200	231	3710	172	233
NRPR _M	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA
SM	kg	35.2	0.00	0.00	35.2	0.00	0.00	17.6	0.00	0.00
RSF	MJ	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
NRSF	MJ	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
RE	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA
FW	m ³	0.703	0.156	0.541	1.40	0.320	0.198	1.08	0.024	0.202
Waste and Output	Unit	A1	A2	A3	A1-A3 Total	A4	A5	B4	C2	C4
HWD	kg	0.006	0.003	0.001	0.009	0.005	0.003	0.009	4.20x10 ⁻⁴	4.00x10 ⁻⁴
NHWD	kg	42.9	82.0	4.32	129	184	140	902	14.8	1210
RWD	kg	0.006	0.009	8.00x10 ⁻⁴	0.015	0.014	8.80x10 ⁻⁴	0.016	0.001	0.002
CRU	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MR	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MER	kg	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
EE	MJ, LHV	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Biogenic Carbon	Unit	A1	A2	A3	A1-A3 Total	A4	A5	B4	C2	C4
BCRE _P	kg CO ₂ eq	-6.20	0.00	0.00	-6.20	0.00	0.00	-3.10	0.00	0.00
BCRE _{PKG}	kg CO ₂ eq	0.00	0.00	-0.281	-0.281	0.00	0.00	-0.140	0.00	0.00
ECUC	kg CO ₂ eq	INA	INA	INA	INA	INA	INA	INA	INA	INA
BCEW _R	kg CO ₂ eq	INA	INA	INA	INA	INA	INA	INA	INA	INA
BCEW _{NR}	kg CO ₂ eq	INA	INA	INA	INA	INA	INA	INA	INA	INA
GWP (EN 15804)	kg CO ₂ eq	63.9	86.6	149	299	144	18.5	239	11.2	10.2

INA = Indicator not assessed, | Neg.= Negligible

6. LCA: INTERPRETATION

The interpretation phase conforms to ISO 14044. The interpretation included the use of evaluation and sensitivity checks to steer the iterative process during the assessment, and a final evaluation including completeness, sensitivity, and consistency checks, at the end of the study.

The main contributions to indicator results are from the manufacturing phase (A3), replacement phase (B4), and the product distribution phase (A4). Of the remaining life cycle stages, the raw materials extraction and processing phase (A1) and raw material transportation phase (A2) are also significant contributors to the overall impacts for the gypsum plasterboard products.

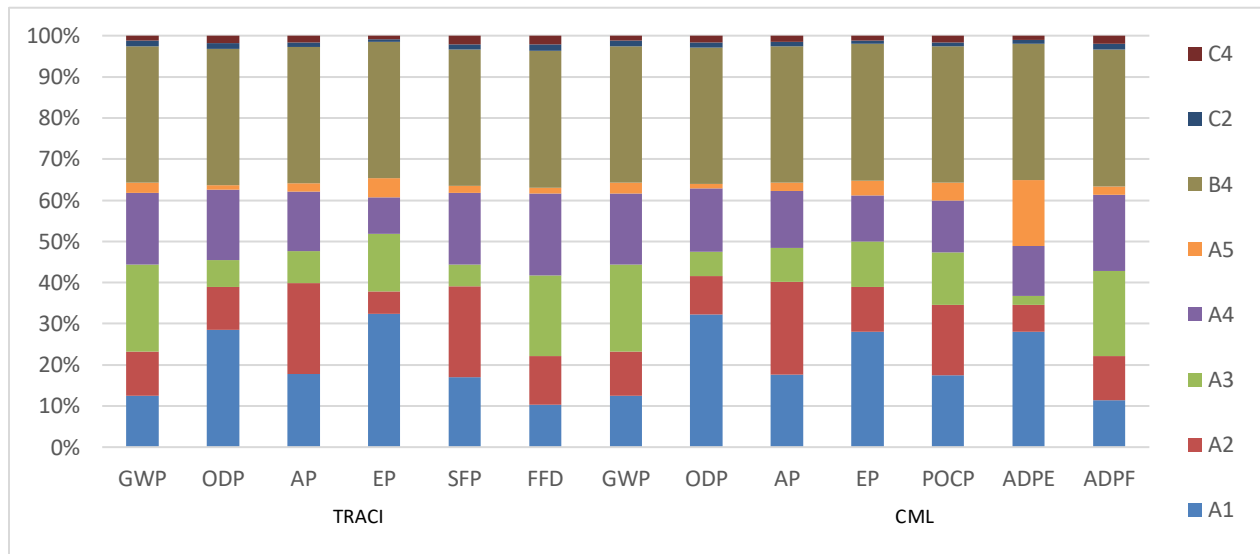


Figure 2. Contribution analysis for the 12.5 mm FireBloc™ Plasterboard.

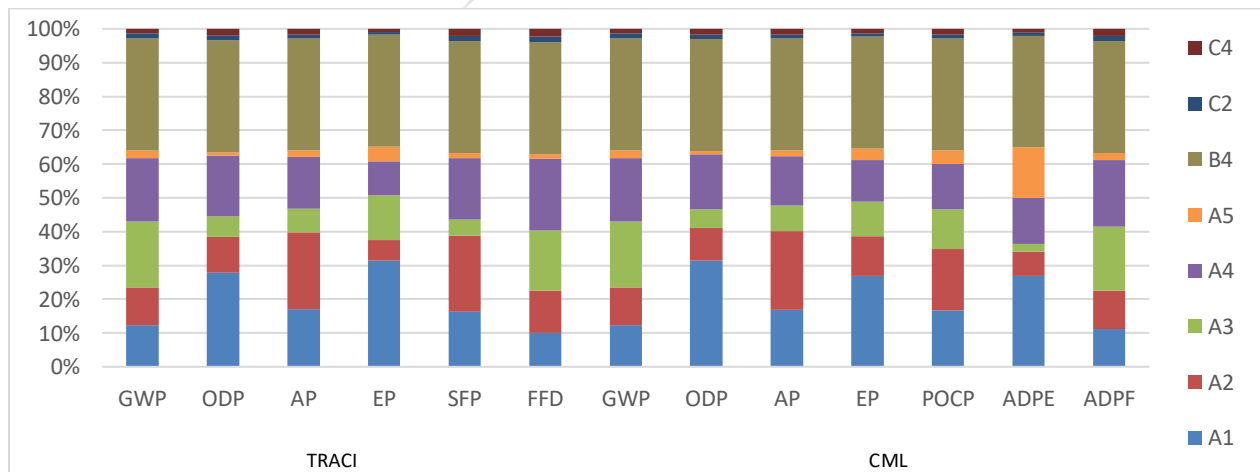


Figure 3. Contribution analysis for the 15 mm FireBloc™ Plasterboard.

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