ENVIRONMENTAL PRODUCT DECLARATION

In accordance with ISO 14025:2016 and ISO 21930:2017 for:

92.9 m^2 (1,000 ft^2) of Gypsum Board Products

Gboard R, Gboard MR, Gboard FR

Programme Operator	NSF Certification, LLC www.nsf.org
EPD Registration Number	EPD10669
Publication Date	2021-11-19
Valid Until	2026-11-19

An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at http://info.nsf.org/Certified/Sustain/epd_search.asp

PROGRAME INFORMATION

PROGRAME OPERATOR

NSF Certification LLC
789 N. Dixboro,
Ann Arbor, MI 48105

www.nsf.org

The EPD owner, Ecobat for Industrial Development, has the sole ownership, liability, and responsibility for the EPD.

DECLARATION HOLDER

Ecobat for Industrial Development
SE Zone Main Building,
Km 114 Kattemeya,
Ain El Sokhna Old Road,
Suez, Egypt

ASK
P.O Box 31387
Street 7, Light Industrial Area,
Yanbu, Madinah
KSA

LCA CONSULTANT

Intertek Deutschland GmbH
Stangenstraße 1
70771
Leinfelden-Echterdingen
Germany

www.intertek.com

PROGRAME DETAILS

Product category rules (PCR):	NSF International, Product Category Rule for Environmental Product Declarations: PCR for Gypsum Panel Products
PCR review was conducted by:	Thomas P. Gloria, PhD (Chair), Industrial Ecology Consultants, t.gloria@industrial-ecology.com Mr. Jack Geibig, EcoForm Mr. Bill Stough, Sustainable Research Group

Independent third-party verification of the declaration and data, according to ISO 14025:2006:

☐ EPD process certification (internal) ☒ EPD verification (external)

Third party verifier: Jack Geibig, jgeibig@ecoform.com

Tony Favilla, afavilla@nsf.com

Accredited or approved by: NSF Certification, LLC

Procedure for follow-up of data during EPD validity involves third party verifier:

☐ Yes ☒ No

GENERAL INFORMATION

COMPANY INFORMATION

Ecobat and ASK group are one of the largest manufacturing groups of finishing building materials and construction solutions in the Middle East, and North Africa who specialize in the design, manufacture, and distribution of gypsum board products. They operate two production sites in Saudi Arabia and Egypt.

This cradle-to-gate environmental product declaration is for 92.9 m^2 (1,000 ft^2) of the following gypsum board products, produced from the locations fully owned and operated by Ecobat for Industrial Development in Saudi Arabia and Egypt:

- Gboard R
- Gboard MR
- Gboard FR

Further information regarding Ecobat for Industrial Development can be accessed from www.gboardweb.com

PRODUCT INFORMATION

As per NSF PCR, gypsum board is the generic name for a family of sheet products consisting of a non-combustible core primarily of gypsum with paper facing. Gypsum board products are used in internal wall applications and provide multiple functions including aesthetics, load carrying capacity, water resistance and insulation to noise, temperature, and air.

The following curtain walling systems are covered by this LCA study:

- Gboard R - Gboard R is regular plasterboard which is ideal for general drywall and ceiling applications. Gboard R can accommodate any architectural design.

- Gboard MR - Gboard MR is a moisture resistant board with silicon oil in the core. The silicone oil acts as a water repellent rendering the core more resistant to moisture. Gboard MR is suited for application in areas of high humidity.

- Gboard FR - Gboard FR is fire resistant gypsum board which is reinforced with fiber glass. The fiber glass acts as a retardant and protection to the board, improving the performance of the system when exposed to fire. Gboard is suitable for application in indoor spaces where high fire protection is needed.

TECHNICAL SPECIFICATIONS OF PRODUCT

The technical and functional specifications for the three products are outlined in the tables below.

TECHNICAL SPECIFICATION FOR GBOARD R

Technical specification	Value	Unit
Density **BS EN 520:2004**	705.95	Kg/m^3
Weight per unit area **BS EN 520:2004**	8.76	Kg/m^3
Tolerance of length **ASTM C 473-03, Section 16**	2401	Mm
Tolerance of width **ASTM C 473-03, Section 17**	1201	Mm
Tolerance of thickness **ASTM C 473-03, Section 18**	12.5	Mm
Depth of taper **ASTM C 1396/ C1396M-00 C.I.4.5.5**	1.23	Mm
Width of taper **ASTM C 473-03, Section 17**	42.57	Mm
Squareness of edges **ASTM C 473-03 Section 15**	1.7	Mm
Core hardness **ASTM C 1396/C1396M-00 CI.4.5.2**	192	N
Edges hardness **ASTM C 1396/C1396M-00 CI.4.5.2**	144	N
Ends hardness **ASTM C 1396/C1396M-00 CI.4.5.2**	200	N
Flexural braking load long edge **ASTM C 1396/C1396M-00 CI.5.1.1**	517	N
Flexural braking load short edge **ASTM C 1396/C1396M-00 CI.5.1.1**	211	N
Nail pull strength **ASTM C 1396/C1396M-00 CI.5.1.3**	363	N
Bending radius **ASTM C 473-03, Section 20**	1875	Mm
Humidified deflection **ASTM C 1396/C 1396M-00 CI.5.1.2**	1.4	Mm
Thermal conductivity	0.1839	w/m.k

TECHNICAL SPECIFICATION FOR GBOARD MR

Technical specification	Value	Unit
Density **BS EN 520:2004**	785	Kg/m^3
Weight per unit area **BS EN 520:2004**	9.8	Kg/m^3
Tolerance of length **ASTM C 473-03, Section 16**	2401	Mm
Tolerance of width **ASTM C 473-03, Section 17**	1200	Mm
Tolerance of thickness **ASTM C 473-03, Section 18**	12.5	Mm
Depth of taper **ASTM C 1396/ C1396M-00 C.I.4.5.5**	1.21	Mm
Width of taper **ASTM C 473-03, Section 17**	42.23	Mm
Squareness of edges **ASTM C 473-03 Section 15**	1.7	Mm
Core hardness **ASTM C 1396/C1396M-00 CI.4.5.2**	231	N
Edges hardness **ASTM C 1396/C1396M-00 CI.4.5.2**	205	N
Ends hardness **ASTM C 1396/C1396M-00 CI.4.5.2**	221	N
Flexural braking load long edge **ASTM C 1396/C1396M-00 CI.5.1.1**	700	N
Flexural braking load short edge **ASTM C 1396/C1396M-00 CI.5.1.1**	310	N
Nail pull strength **ASTM C 1396/C1396M-00 CI.5.1.3**	380	N
Bending radius **ASTM C 473-03, Section 20**	1895	Mm
Humidified deflection **ASTM C 1396/C 1396M-00 CI.5.1.2**	1.2	Mm
Thermal conductivity	0.1701	w/m.k
Water absorption **ASTM C 473-03, Section 20**	H 2<10	%

TECHNICAL SPECIFICATION FOR GBOARD FR

Technical specification	Value	Unit
Density **BS EN 520:2004**	713.77	Kg/m^3
Weight per unit area **BS EN 520:2004**	8.83	Kg/m^3
Tolerance of length **ASTM C 473-03, Section 16**	2399	Mm
Tolerance of width **ASTM C 473-03, Section 17**	1200	Mm
Tolerance of thickness **ASTM C 473-03, Section 18**	12.5	Mm
Depth of taper **ASTM C 1396/ C1396M-00 C.I.4.5.5**	1.27	Mm
Width of taper **ASTM C 473-03, Section 17**	41.76	Mm
Squareness of edges **ASTM C 473-03 Section 15**	1.2	Mm
Core hardness **ASTM C 1396/C1396M-00 CI.4.5.2**	215	N
Edges hardness **ASTM C 1396/C1396M-00 CI.4.5.2**	186	N
Ends hardness **ASTM C 1396/C1396M-00 CI.4.5.2**	209	N
Flexural braking load long edge **ASTM C 1396/C1396M-00 CI.5.1.1**	509	N
Flexural braking load short edge **ASTM C 1396/C1396M-00 CI.5.1.1**	219	N
Nail pull strength **ASTM C 1396/C1396M-00 CI.5.1.3**	361	N
Bending radius **ASTM C 473-03, Section 20**	1920	Mm
Humidified deflection **ASTM C 1396/C 1396M-00 CI.5.1.2**	1.3	Mm
Thermal conductivity	0.1681	w/m.k

PRODUCT COMPOSITION

The product composition for the gypsum board products are provided in the Tables below. The gypsum powder used for the three boards is 100% naturally sourced and contains no synthetic gypsum (DSG). The boards do not contain any substances hazardous to health or the environment (in particular carcinogenic, mutagenic, toxic to reproduction, allergic, PBT5 or vPvB6 substances). No substances that are listed in the "Candidate List of Substances of very high concern for authorization" are contained in the gypsum board products.

The gypsum board products are primarily packaged using gypsum leg pallets and plastic wrap prior to shipping to installation sites.

PRODUCT COMPOSITION OF GBOARD R

Material	Contribution %
Ivory colored paper	4.91%
Gypsum powder	94.19%
Foam	0.10%
Starch	0.80%

PRODUCT COMPOSITION OF GBOARD MR

Material	Contribution %
Green colored paper	4.80%
Gypsum powder	93.8%
Foam	0.10%
Silicone	0.50%
Starch	0.80%

PRODUCT COMPOSITION OF GBOARD FR

Material	Contribution %
Pink colored paper	4.90%
Gypsum powder	94.3%
Foam	0.10%
Starch	0.70%
Fiberglass	0.10%

PRODUCT AVERAGE

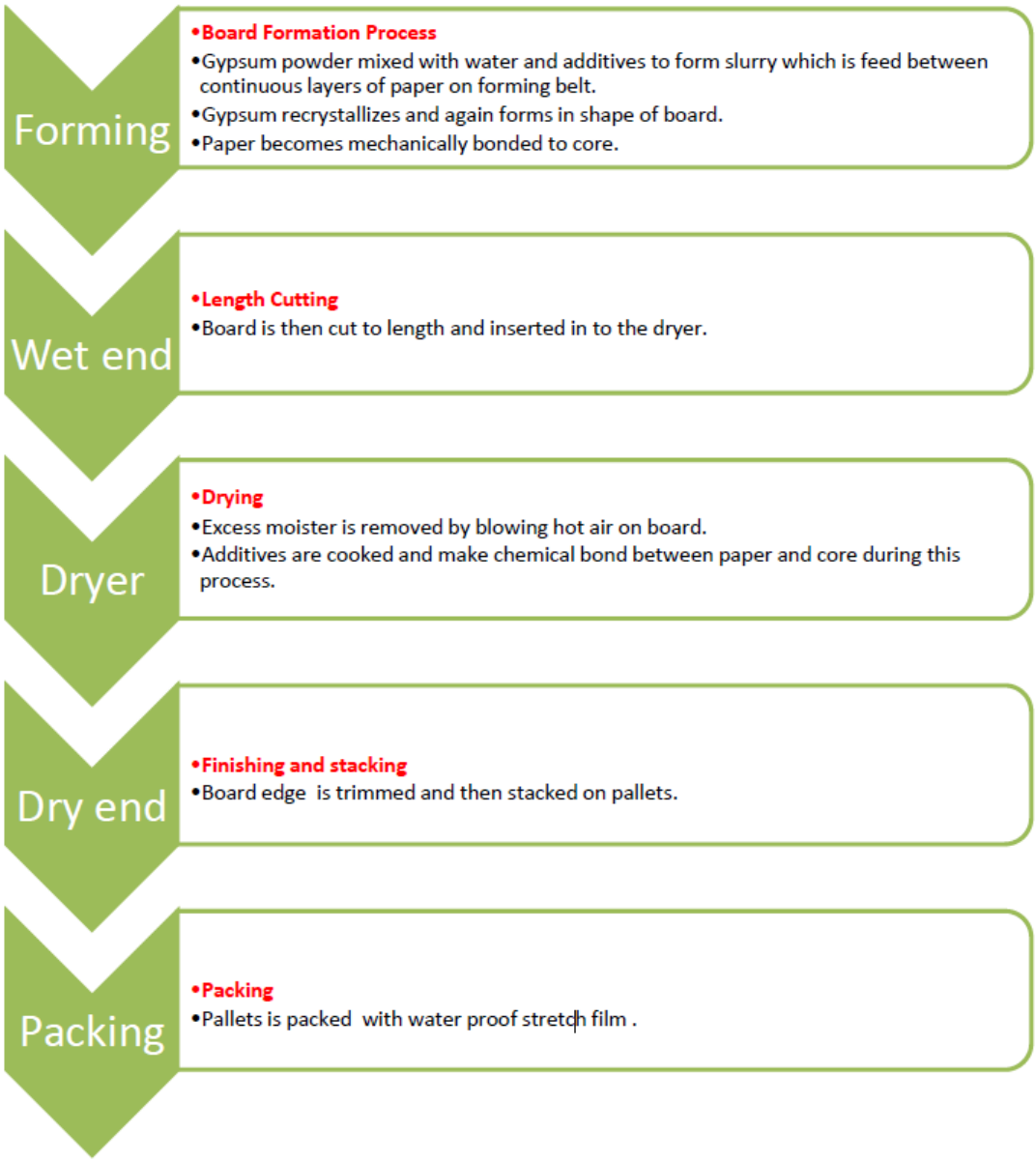
The products covered by the scope of this average EPD are manufactured at a number of locations and therefore the results reflect a typical product, as a weighted average, produced from the following sites:

- Gboard R – produced at Saudi Arabia and Egypt sites
- Gboard MR – produced at Saudi Arabia and Egypt sites
- Gboard FR – produced at the Saudi Arabia and Egypt sites

MANUFACTURING

All Ecobat for Industrial Development gypsum board products are manufactured, finished, and inspected for quality at the production sites in Saudi Arabia and Egypt.

The manufacturing process comprises the following production stages:



The manufacturing process begins with mined gypsum powder which is mixed with water and product specific additives to form a slurry. Rolls of facing and backing paper are loaded onto the manufacturing line and the slurry is fed onto the backing paper and then lined by the facing paper, creating a mechanical bond between the paper and core. The wet board is rolled to ensure thickness and cut to length to be inserted into the dryer. The gypsum boards are trimmed, stacked onto pallets, and covered with protective film.

The gypsum board products are not expected to create exposure conditions that exceed safe thresholds for health impacts to humans or flora/fauna under normal operating conditions. Use stage is outside the scope of this EPD.

LCA INFORMATION

LIFE CYCLE ASSESSMENT – PRODUCT SYSTEM AND MODELING

A cradle to gate analysis using life cycle assessment (LCA) techniques was conducted for this EPD. The analysis was done according to the NSF product category rule (PCR) for gypsum panel products and followed LCA principles, requirements and guidelines laid out in the ISO 14040/12044 standards. EPDs are comparable only if they comply with NSF product category rule (PCR) for gypsum panel products, 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.

DECLARED UNIT

The declared unit for the EPD is 92.9 m^2 (1,000 ft^2) of gypsum wall product. In line with the PCR, the thicknesses, and masses of the gypsum bord products are indicated in the table below.

Product	Mass (Kg/FU)	Thickness (cm)
Gboard R	813.7	12.5
Gboard MR	870.6	12.5
Gboard FR	820.1	12.5

SYSTEM BOUNDARY

In line with the PCR, this cradle to gate analysis provides information on the Product Stage of the gypsum board products, comprising modules A1-A3 as shown in the table below.

Upstream	Core		Downstream													Other environmental information
Product Stage			Construction process stage		Use Stage							End of Life stage				Benefits and loads beyond the system boundary
Raw material supply	Transport	Manufacturing	Transport	Construction	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Demolition	Transport	Waste processing	Disposal	Future reuse, recycling or energy recovery potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

X = included in LCA; MND = Module not declared

ASSUMPTIONS

The following assumptions were made for the collection of the core process data:

- Specific transportation data was not provided for packaging materials. Therefore, as per the PCR, the default distance of 800km has been assumed.
- All waste is consumed within the production process or re-used as packaging material. No solid waste is removed from site for disposal.

ALLOCATION

No multi-output (i.e., co-product) allocation was performed in this study. In terms of generic data, the main database used, ecoinvent v3.6 (cut-off), defaults to an economic allocation for most processes. However, in some cases a mass-based allocation is used, where there is a direct physical relationship. The allocation approach of specific ecoinvent modules is documented on their website and method reports (see www.ecoinvent.org).

CUT-OFF CRITERIA

As required by ISO 21930, in case of insufficient input data or data gaps for a unit process the cut-off criteria were 1% of renewable and non-renewable primary energy usage and 1% of the total mass input of that unit process. The total of neglected input flows per module was a maximum of 5% of energy usage and mass.

In practice, all input and outputs, for which data are available, have neem included in the calculation. Data gaps have been filled by conservative assumptions with average or generic data. Capital items for the production processes (machines, buildings, etc.) were not taken into consideration.

DATA SOURCES AND QUALITY

Specific data for all core processes were collected from Ecobat for Industrial Development from their sites in Saudi Arabia and Egypt for twelve months from 2020.04.01 to 2021.03.31. Selected generic data were collected for the upstream lifecycle stages from the LCI database ecoinvent v3.6 (cut-off).

The data quality can be considered as good. In this LCA the data relating to the manufacturing of the gypsum board products and the background processes for environmental impacts are recent (<2 years). The processes used in the production of the gypsum board products are geographically representative, meaning that the production location lies within the region for which the relevant Ecoinvent environmental records have been selected. The dataset is up-to-date and representative for the current technology used in the processes of manufacturing the product.

The LCA software SimaPro (version 9) was used to build a model for the product systems under investigation using specific and generic inventory data. In addition, SimaPro was used to apply characterization models and factors from the impact assessment methods to generate results.

DECLARATION COMPARABILITY LIMITATION STATEMENT

As per ISO 21930 section 5.5, and the NSF PCR for Gypsum Panel Products the comparability of this EPD is limited as following:

- Only EPDs prepared from cradle-to-grave life cycle results and based on the same function, RSL, quantified by the same functional unit, and meeting all the conditions for comparability listed in ISO 14025:2006 and ISO 21930:2017 can be used to comparison between products.

ENVIRONMENTAL PERFORMANCE

The environmental performance of the assessed product is declared and reported using the parameters as specified in the PCR. These LCIA results and other environmental results are presented in the table below per declared unit to three significant figures.

92.9 M^2 (1,000 FT^2) OF GBOARD R

ENVIRONMENTAL IMPACTS: TRACI 2.1

Parameter	Unit	A1	A2	A3	A1-A3 (Total)
Parameters describing environmental impacts					
Global warming potential (GWP) – total	kg CO_2 equiv.	67.7	58.2	96.0	221.9
Ozone depletion Potential (ODP)	kg CFC-11 equiv.	6.90E-06	1.45E-05	4.17E-05	6.31E-05
Acidification potential (AP)	kg SO_2 equiv.	0.403	0.253	0.490	1.15
Eutrophication potential (EP)	kg N equiv.	0.301	0.060	0.085	0.447
Smog formation potential (SFP)	kg 0_3 equiv.	6.10	5.38	5.53	17.00

RESOURCE USE AND OUTPUT / WASTE PARAMETERS

Parameter	Unit	A1	A2	A3	A1-A3 (Total)
Parameters describing use of resources					
Use of renewable primary energy resources – use as energy carrier	MJ, net calorific value	3010	11.5	14.3	3036
Use of renewable primary energy resources – use as raw materials	MJ, net calorific value	1234	2.19	1.89	1239
Use of non-renewable primary energy resources – use as energy carrier	MJ, net calorific value	1021	893	2834	4748
Use of non-renewable primary energy resources – use as raw materials	MJ, net calorific value	0	0	0	0
Use of secondary material	kg	0	0	0	0
Use of renewable secondary fuels	MJ, net calorific value	0	0	0	0

Parameter	Unit	A1	A2	A3	A1-A3 (Total)
Use of non-renewable secondary fuels	MJ, net calorific value	0	0	0	0
Recovered energy	MJ, net calorific value	0	0	0	0
Net use of fresh water	m^3	1.598	0.078	0.324	2.000
Abiotic depletion potential – ADP surplus (TRACI methodology)	MJ surplus	87.5	130	447	665
Abiotic depletion potential – ADP LHV (CML methodology)	MJ	804	890	2894	4589
Parameters describing waste production					
Hazardous waste disposed	kg	0.00366	0.00838	0.02144	0.03347
Non-hazardous waste disposed	kg	9.4	74.8	13.6	97.9
High level radioactive waste, conditioned, to final repository	kg	1.63E-04	4.34E-04	1.09E-03	1.69E-03
Intermediate and low-level radioactive waste, conditioned, to final repository	kg	2.16E-03	5.76E-03	1.45E-02	2.25E-02
Parameters describing outputs flows					
Components for reuse	kg	0	0	0	0
Material for recycling	kg	0	0	0	0
Materials for energy recovery	kg	0	0	0	0
Recovered energy exported from the product system	MJ	0	0	0	0

Note that the LCIA results are relative expressions and do not predict impacts on category end-points, the exceeding of thresholds, safety margins or risks.

92.9 M^2 (1,000 FT^2) OF GBOARD MR

ENVIRONMENTAL IMPACTS: TRACI 2.1

Parameter	Unit	A1	A2	A3	A1-A3 (Total)
Parameters describing environmental impacts					
Global warming potential (GWP) – total	kg CO_2 equiv.	84.1	64.8	94.8	244
Ozone depletion Potential (ODP)	kg CFC-11 equiv.	1.58E-05	1.62E-05	4.36E-05	7.55E-05
Acidification potential (AP)	kg SO_2 equiv.	0.486	0.288	0.509	1.28
Eutrophication potential (EP)	kg N equiv.	0.350	0.067	0.089	0.506
Smog formation potential (SFP)	kg 0_3 equiv.	7.15	6.10	5.69	18.9

RESOURCE USE AND OUTPUT / WASTE PARAMETERS

Parameter	Unit	A1	A2	A3	A1-A3 (Total)
Parameters describing use of resources					
Use of renewable primary energy resources – use as energy carrier	MJ, net calorific value	3171	12.9	13.6	3198
Use of renewable primary energy resources – use as raw materials	MJ, net calorific value	1297	2.45	1.93	1302
Use of non-renewable primary energy resources – use as energy carrier	MJ, net calorific value	1311	993	2898	5202
Use of non-renewable primary energy resources – use as raw materials	MJ, net calorific value	0	0	0	0
Use of secondary material	kg	0	0	0	0
Use of renewable secondary fuels	MJ, net calorific value	0	0	0	0
Use of non-renewable secondary fuels	MJ, net calorific value	0	0	0	0
Recovered energy	MJ, net calorific value	0	0	0	0
Net use of fresh water	m^3	2.16	0.087	0.324	2.57
Abiotic depletion potential – ADP surplus (TRACI methodology)	MJ surplus	115	145	457	716
Abiotic depletion potential – ADP LHV (CML methodology)	MJ	1037	990	2965	4993
Parameters describing waste production					
Hazardous waste disposed	kg	0.00412	0.00932	0.02264	0.03608
Non-hazardous waste disposed	kg	10.4	82.6	13.7	107
High level radioactive waste, conditioned, to final repository	kg	1.87E-04	4.82E-04	1.16E-03	1.83E-03
Intermediate and low-level radioactive waste, conditioned, to final repository	kg	2.48E-03	6.41E-03	1.54E-02	2.43E-02
Parameters describing outputs flows					
Components for reuse	kg	0	0	0	0
Material for recycling	kg	0	0	0	0
Materials for energy recovery	kg	0	0	0	0
Recovered energy exported from the product system	MJ	0	0	0	0

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

92.9 M^2 (1,000 FT^2) OF GBOARD FR

ENVIRONMENTAL IMPACTS: TRACI 2.1

Parameter	Unit	A1	A2	A3	A1-A3 (Total)
Parameters describing environmental impacts					
Global warming potential (GWP) – total	kg CO_2 equiv.	67.4	59.1	95.8	222
Ozone depletion Potential (ODP)	kg CFC-11 equiv.	8.00E-06	1.47E-05	4.20E-05	6.47E-05
Acidification potential (AP)	kg SO_2 equiv.	0.406	0.256	0.493	1.16
Eutrophication potential (EP)	kg N equiv.	0.306	0.0614	0.0859	0.453
Smog formation potential (SFP)	kg 0_3 equiv.	6.32	5.45	5.55	17.3

RESOURCE USE AND OUTPUT / WASTE PARAMETERS

Parameter	Unit	A1	A2	A3	A1-A3 (Total)
Parameters describing use of resources					
Use of renewable primary energy resources – use as energy carrier	MJ, net calorific value	2620	11.7	14.2	2646
Use of renewable primary energy resources – use as raw materials	MJ, net calorific value	1210	2.23	1.88	1214
Use of non-renewable primary energy resources – use as energy carrier	MJ, net calorific value	1070	907	2840	4820
Use of non-renewable primary energy resources – use as raw materials	MJ, net calorific value	0	0	0	0
Use of secondary material	kg	0	0	0	0
Use of renewable secondary fuels	MJ, net calorific value	0	0	0	0
Use of non-renewable secondary fuels	MJ, net calorific value	0	0	0	0
Recovered energy	MJ, net calorific value	0	0	0	0
Net use of fresh water	m^3	1.83	0.0795	0.324	2.23

Parameter	Unit	A1	A2	A3	A1-A3 (Total)
Abiotic depletion potential – ADP surplus (TRACI methodology)	MJ surplus	95.0	132	449	676
Abiotic depletion potential – ADP LHV (CML methodology)	MJ	828	904	2910	4640
Parameters describing waste production					
Hazardous waste disposed	kg	4.43E-03	8.51E-03	2.16E-02	3.45E-02
Non-hazardous waste disposed	kg	10.9	75.9	13.6	1.00E+02
High level radioactive waste, conditioned, to final repository	kg	2.17E-04	4.40E-04	1.11E-03	1.77E-03
Intermediate and low-level radioactive waste, conditioned, to final repository	kg	2.89E-03	5.85E-03	1.47E-02	2.34E-02
Parameters describing outputs flows					
Components for reuse	kg	0	0	0	0
Material for recycling	kg	0	0	0	0
Materials for energy recovery	kg	0	0	0	0
Recovered energy exported from the product system	MJ	0	0	0	0

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

BIOGENIC CARBON

The table below shows the cradle-to-gate biogenic CO_2 removals associated with bio-based products used in the gypsum board products. As per the PCR, for the gypsum panel products, recycled raw materials used to produce paper are not counted as biogenic carbon whereas starch is counted.

BIOGENIC CO2 REMOVALS (RAW MATERIALS) – 92.9 M2 (1 FU) OF GBOARD R, GBOARD MR, GBOARD FR

Product	Inputs	Chemical Formula	C-Content	Biogenic CO_2 removals (in kg CO_2/FU)
Gboard R	Starch	$(C_6H_{10}O_5)_n$	44%	**-10.5** = -6.50 kgx0.44x44/12
Gboard MR	Starch	$(C_6H_{10}O_5)_n$	44%	**-11.2** = -6.96 kgx0.44x44/12
Gboard FR	Starch	$(C_6H_{10}O_5)_n$	44%	**-9.27** = -5.75 kgx0.44x44/12

Notes: 44 and 12 is the molar mass of CO_2 and C (in g/mol) respectively.

BIOGENIC CO2 REMOVALS (PACKAGING) 92.9 M2 (1 FU) OF GBOARD R, GBOARD MR, GBOARD FR

Product	Inputs	Chemical Formula	C-Content	Biogenic CO_2 removals (in kg CO_2/FU)
Gboard R – Gypsum legs	Starch	$(C_6H_{10}O_5)_n$	44%	**-0.149** = -0.092 kgx0.44x44/12
Gboard MR – Gypsum legs	Starch	$(C_6H_{10}O_5)_n$	44%	**-0.149** = -0.092kgx0.44x44/12
Gboard FR – Gypsum legs	Starch	$(C_6H_{10}O_5)_n$	44%	**-0.130** = -0.081 kgx0.44x44/12

Notes: 44 and 12 is the molar mass of CO_2 and C (in g/mol) respectively.

REFERENCES

- Boulay et al (2017). The WULCA consensus characterization model for water scarcity footprint: assessing impacts of water consumption bases on available water remaining (AWARE). Water Use in LCA, 23.
- Centrum voor Milieuwetenschappen Leiden (CML) (2012). CML-IA baseline v4.1 / EU25 characterisation factors. CML, Leiden.
- NSF PCR for Gypsum Panel Products, Version 1.1, April 2020
- ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services.
- Ecoinvent (2017). Ecoinvent v3.4, Swiss Centre for Life Cycle Inventories. Available from www.ecoinvent.ch
- Guo (2012). Life Cycle Assessment (LCA) of Light-Weight Eco-composites. Springer, Berlin
- Huijbregts, Steinmann, Elshout, Stam, Verones, Vieira, Zijp, Hollander, van Zelm. ReCiPe 2016: a harmonized life cycle impact assessment method at midpoint and endpoint level. International Journal of LCA, DOI 10.1007/s11367-016-1246-y.
- ISO (2000), ISO 14020:2000, Environmental labels and declarations – General principles
- ISO (2004), ISO 8601:2004 Data elements and interchange formats – Information interchange – Representation of dates and times
- ISO (2006a), ISO 14025:2006, Environmental labels and declarations – Type III environmental declarations – Principles and procedures
- ISO (2006b), ISO 14040:2006, Environmental management – Life cycle assessment – Principles and framework ISO (2006c)
- ISO 14044: 2006, Environmental management – Life cycle assessment – Requirements and guidelines ISO (2013)
- ISO/TS 14067:2013, Greenhouse gases – Carbon footprint of products – Requirements and guidelines for quantification and communication
- ISO (2014), ISO 14046:2014, Environmental management – Water footprint – Principles, requirements and guidelines
- IPCC (2007). Working Group I Contribution to the IPCC Fourth Assessment Report Climate Change 2007: The Physical Science Basis, Summary for Policymakers. Intergovernmental Panel on Climate Change, Geneva
- IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use. IPCC, Geneva
- JRC (2011). ILCD Handbook: recommendations for life cycle impact assessment in the European context. European Commission Joint Research Centre Institute for Environment and Sustainability. http://eplca.jrc.ec.europa.eu/?page_id=86
- Pre Consultants (2019). SimaPro v8.5. Pre Consultant, Amersfoort

  Weidema B P, Bauer C, Hischier R, Mutel C, Nemecek T, Reinhard J, Vandenbo C O, Wernet G (2013). Overview and methodology: data quality guideline for the ecoinvent database version 3 (final). Swiss Centre for Life Cycle Inventories: St Gallen

Intertek is a leading Total Quality, Safety and Sustainability Assurance provider to industries worldwide. Through our network of more than 1,000 laboratories and offices and over 44,000 people in more than 100 countries, we are re-refining the industry with our innovative and bespoke Assurance, Testing, Inspection and Certification solutions for our customers' operations and value chains.

Intertek's Total Sustainability Assurance (TSA) proposition recognizes that with increasing value chain complexity, our clients need a trusted partner and integrative sustainable solutions. Powered by our independent technical expertise and supply chain management tools our sustainability services enable our customers to uniquely and authentically demonstrate their end-to-end commitment to sustainability, building stakeholder trust and corporate value.

FOR MORE INFORMATION

Intertek Deutschland GmbH
Stangenstraße 1
70771
Leinfelden-Echterdingen
Germany

lca@intertek.com

intertek.com

intertek sustainability