

ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	Knauf Gips KG
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
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Plasterboard Knauf Diamant GKFI
Knauf Gips KG

www.bau-umwelt.com / <https://epd-online.com>



1. General Information

<p>Knauf Gips KG</p> <p>Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany</p> <hr/> <p>Declaration number EPD-KNA-20150104-IBD1-EN</p> <hr/> <p>This Declaration is based on the Product Category Rules: Plasterboard, 07.2014 (PCR tested and approved by the SVR)</p> <hr/> <p>Issue date 13/01/2016</p> <hr/> <p>Valid to 12/01/2021</p>	<p>Plasterboard Knauf Diamant GKFI</p> <p>Owner of the Declaration Knauf Gips KG Am Bahnhof 7 97436 Iphofen Germany</p> <hr/> <p>Declared product / Declared unit Plasterboard Knauf Diamant GKFI Type GKFI according to /DIN 18180:2014/ respectively DFH2IR according to /EN 520:2009/, 1 m², board thickness 12.5-20 mm, weight of board 12.8-20 kg</p> <hr/> <p>Scope: This EPD is valid for the plasterboard Knauf Diamant GKFI and was calculated with average data from the manufacturing sites in Iphofen (D), Lauffen (D), Stadtoldendorf (D), Rottleberode (D), Weißenbach (AT), Oosterhout (NL), Knin (HR), and Izmit (TR). It covers 70 % of the total production of plasterboard Knauf Diamant GKFI. Moreover, this EPD applies for the plasterboards Knauf Diamant GKFI from other manufacturing sites, if they are in conformity with the following composition: - at least 50 % gypsum - 0.4 – 39 % mineral fillers - at least 3 % board liner This declaration refers to the following members of the product family - Diamant GKFI 12.5, Diamant GKFI 15, Diamant GKFI 18 - Diamant GKFI 20 Paneel - Diamant GKFI 1Mann 10, Diamant GKFI 1Mann 12.5 - Diamant X GKFI 12.5, Diamant X GKFI 15 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.</p> <hr/> <p>Verification</p> <p>The CEN Norm /EN 15804/ serves as the core PCR</p> <p>Independent verification of the declaration according to /ISO 14025/</p> <p><input type="checkbox"/> internally <input checked="" type="checkbox"/> externally</p>
<p></p> <hr/> <p>Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt e.V.)</p>	<p></p> <hr/> <p>Christina Bocher (Independent verifier appointed by SVR)</p>
<p></p> <hr/> <p>Dr. Burkhard Lehmann (Managing Director IBU)</p>	

2. Product

2.1 Product description

Plasterboards Knauf Diamant GKFI are used in all areas of interior construction as cladding in premium drywall systems with increased demands on sound insulation, fire protection, and/or increased demands on robustness as well as in moderate wet rooms (maximum permanent relative humidity 70 %, e.g., domestic bathrooms).

This environmental product declaration is calculated as a weighted average based on the shares of the stated manufacturing sites in relation to the total production of plasterboard Knauf Diamant GKFI in these manufacturing sites.

2.2 Application

Plasterboards Knauf Diamant GKFI can be used in the following systems:

- Cladding of ceilings and suspended ceilings
- Cladding of attics
- Metal stud partition systems
- Wood frame partitions (non-bearing)
- Installation shaft walls
- Room-in-room systems Knauf Cubo

2.3 Technical Data

The following technical data in condition on delivery are relevant for the declared product:

Constructional data

Name	Value	Unit
Gross density	>= 1000	kg/m ³
Flexural breaking load according to EN 520:2009, longitudinal (Diamant 12,5 mm, Diamant 15 mm, Diamant 18 mm, Diamant 20 Paneel, Diamant 1 Mann 10 mm, Diamant 1 Mann 12,5 mm)	580 - 1160	N
Flexural breaking load according to EN 520:2009, transversal (Diamant 12,5 mm, Diamant 15 mm, Diamant 18 mm, Diamant 20 Paneel, Diamant 1 Mann 10 mm, Diamant 1 Mann 12,5 mm)	240 - 480	N
Flexural strength (longitudinal) according to ETA-13/0800, (Diamant X 12,5 mm, Diamant X 15 mm)	6 - 7,5	N/mm ²
Flexural strength (transversal) according to ETA-13/0800 (Diamant X 12,5 mm, Diamant X 15 mm)	2,5	N/mm ²
Modulus of elasticity (longitudinal) according to DIN 18180:2014 (Diamant 12,5 mm, Diamant 15 mm, Diamant 18 mm, Diamant 1 Mann 12,5 mm)	>= 2800	N/mm ²
Modulus of elasticity (transversal) according to DIN 18180:2014, (Diamant 12,5 mm, Diamant 15 mm, Diamant 18 mm, Diamant 1 Mann 12,5 mm)	>= 2200	N/mm ²
Modulus of elasticity (longitudinal) according to ETA-13/0800, (Diamant X 12,5 mm, Diamant X 15 mm)	4500	N/mm ²
Modulus of elasticity (transversal) according to ETA-13/0800 (Diamant X 12,5 mm, Diamant X 15 mm)	3500	N/mm ²
Surface hardness according to EN 520:2009	<= 15	mm
Calculation value for thermal conductivity according to EN ISO 10456:2011	0.25	W/(mK)
Specific heat capacity at 20 °C according to Gips-Datenbuch	0.96	kJ/kgK
Water vapour diffusion resistance factor (dry) according to EN ISO 10456:2011	10	-
Water vapour diffusion resistance factor (wet) according to EN ISO 10456:2011	4	-
Moisture content at 20 °C, 65% humidity according to Gips-Datenbuch	0.6 - 1	M.-%
Elongation/Vibration when humidity changes by 30% (20°C)	0.005 - 0.008	mm/m

according to EN 318:2002, per 1% change of relative humidity		
Swelling (air-dry to water-saturated) according to Gips-Datenbuch	0.35	%

Further information is available in the technical datasheets available under www.knauf.de.

2.4 Placing on the market / Application rules

Plasterboards Knauf Diamant GKFI require a declaration of performance as well as a CE marking in the EU/EFTA region according to EU Construction Products Regulation /CPR2011/. Further national application rules are to be observed.

In Germany, the following standards apply:

- /DIN 18180:2014/ types and requirements
- /EN 520:2009/ definitions, requirements and test methods
- /DIN 18181:2008/ application
- /DIN 4103-1:2014/ internal non-loadbearing partitions, requirements and verification
- /DIN 4103-4:1988/ internal non-loadbearing partitions, partitions with timber framing
- /DIN 18183-1:2009/ partitions and wall linings with gypsum boards on metal framing
- /DIN 18168-1:2007/ and /DIN 18168-2:2008/ ceiling linings and suspended ceilings with gypsum plasterboards

2.5 Delivery status

Plasterboards Knauf Diamant GKFI are delivered with the following dimensions:

- Diamant GKFI 12.5: 2000 mm x 1250 mm x 12.5 mm, 2500 mm x 1250 mm x 12.5 mm, approx. 12.8 kg/m²
- Diamant GKFI 15: 2000 mm x 1250 mm x 15 mm, 2500 mm x 1250 mm x 15 mm, approx. 15.5 kg/m²
- Diamant GKFI 18: 2500 mm x 625 mm x 18 mm, 2600 mm x 625 mm x 18 mm, approx. 18 kg/m²
- Diamant GKFI 20 Paneel: 2500 mm x 625 mm x 20 mm, 2600 mm x 625 mm x 20 mm, approx. 20 kg/m²
- Diamant GKFI 1 Mann 10: 1500 mm x 1000 mm x 10 mm, approx. 10.4 kg/m²
- Diamant GKFI 1 Mann 12.5: 1500 mm x 1000 mm x 12.5 mm, approx. 12.8 kg/m²
- Diamant X GKFI 12.5: 2750 mm x 1250 mm x 12.5 mm, approx. 12.8 kg/m²
- Diamant X GKFI 15: 2750 mm x 1250 mm x 15 mm, 15.5 kg/m²

2.6 Base materials / Ancillary materials

Plasterboards Knauf Diamant GKFI consist of set gypsum (at least 50 %), a board liner covering (at least 3 %), fibres for reinforcement and increased fire resistance as well as mineral fillers (0.4-39 %). For easier processing and fine adjustment of desired properties, small amounts of starch, surfactants, and hydrophobing agents are added. The sum of these ancillary materials is usually less than 5 % by weight. No substances classified according to the candidate list of Substances of Very High Concern (SVHC) /ECHA 2014/ are used in the product exceeding 0.1 w/w%.

2.7 Manufacture

The components of plasterboards Knauf Diamant GKFI are suspended in water and spread on a continuous sheet of board liner (visible face, lower layer). Beforehand, the board liner is cut on the sides

for edge shaping. The slurry is covered with a second sheet of board liner (back surface) in the forming station and the edges of the visible face board liner are flipped upwards. On the subsequent board line the gypsum is setting continuously and is dried in a multi-level drier to the permitted residual moisture level. Drying is followed by the cutting of the boards to the desired lengths.

All processes within the listed Knauf manufacturing sites are certified according to /ISO 9001:2008/.

2.8 Environment and health during manufacturing

Plasterboards Knauf Diamant GKFI are produced at manufacturing sites which are subject to national emission control regulations. At the manufacturing sites Iphofen (D), Lauffen (D), Weissenbach (AT), and Knin (HR) CO₂ emissions are measured due to CO₂ emissions trading. Six out of the eight manufacturing sites are certified according to /ISO 50001:2011/.

Manufacturing sites in Weissenbach (AT), Oosterhout (NL), Knin (HR), and Izmit (TR) are certified according to /BS OHSAS 18001:2007/. The manufacturing plants in Iphofen (D), Lauffen (D), Stadtoldendorf (D), and Rottleberode (D) are certified with the standard "Sicher mit System" (Systematic Safety) from the German trade association /BG RCI/.

Gypsum from the flue-gas desulphurization plants of coal-fired power stations is used in addition to natural gypsum. Production waste as well as dust from the filtration plants are recycled internally and fed back into the production of plasterboards.

2.9 Product processing/Installation

Storage

Plasterboards Knauf Diamant GKFI should be stored in closed rooms under dust-free and dry conditions in a horizontal position.

Application

During application, dust thresholds are to be observed according to /TRGS 900:2006/ and /TRGS 559:2010/. The application and installation should follow the instruction sheets provided under www.knauf.de (e.g., W11, D11).

Like in other fire protection boards, endless filament glass fibres /EPD-BVG20140076-IAG1-DE/ are used in the manufacturing of plasterboards Knauf Diamant GKFI. These fibres do not fan out during application and therefore no fibre dusts according to /TRGS 521:2008/ emerge.

2.10 Packaging

Plasterboards Knauf Diamant GKFI are piled up on reusable pallets or squared timber, and are protected against damage by strapping tape (polypropylene), T-squares, and if necessary by stretch film. Pallets are re-used whereas all other packing materials are externally recycled/disposed of.

2.11 Condition of use

Plasterboards Knauf Diamant GKFI are utilized for interior construction of buildings in rooms with a maximum permanent relative humidity of 70 %. They feature high levels of robustness against mechanical impacts and serve increased demands on sound as well as fire protection.

2.12 Environment and health during use

Plasterboards Knauf Diamant GKFI are able to condition the air of a room due to the reversible water absorption and release.

According to emission tests of the Fraunhofer Institute for Building Physics /IBP2012/ following the AgBB test scheme, no hazardous substances are emitted above permissible thresholds during use.

2.13 Reference service life

According to the Guideline for Sustainable Building /BBSR2011/ a reference service life of 50 years can be considered for gypsum plasterboards. There are no influences on ageing of plasterboards Knauf Diamant GKFI during use following the established engineering practice.

2.14 Extraordinary effects

Fire

The reaction to fire of plasterboards Knauf Diamant GKFI is classified as follows according to /EN 520/ in conjunction with /EN 13501-1/:

Fire protection

Name	Value
Building material class	A2
Burning droplets	d0
Smoke gas development	s1

The core of plasterboards Knauf Diamant GKFI contains about 20 % water of crystallization. This water evaporates at high temperatures and thus, keeps the surface temperature at a constant level for a considerable time. Furthermore, the resulting dehydrated layer of gypsum provides increased thermal insulation.

Water

Plasterboards Knauf Diamant GKFI are suitable for application in domestic wet rooms. However, a permanent exposure to wet conditions or relative humidities above 70 % may lead to a decrease in strength. An instruction sheet about restoration of flood damage is available under www.knauf.de /BSDH2013/. Information about the removal of flood damage can be downloaded from www.gypsum.org.

Mechanical destruction

Plasterboards Knauf Diamant GKFI are characterized by an increased surface hardness, which makes them very robust against damage. Minor damage can be mended with suitable gypsum based filling materials. The installation with screws and brackets allows an easy exchange of heavily damaged boards. In this case, the substructure should be examined, too, and replaced if necessary.

2.15 Re-use phase

Re-use

Once plasterboards Knauf Diamant GKFI are installed, they are not suited for re-use in an unchanged way. Prior to collection, plasterboards Knauf Diamant GKFI should be separated from other used building materials

and pruned of foreign matter, e.g., metals from the substructure on site for easier recycling or disposal.

Further use

Residual materials from new plasterboards Knauf Diamant GKFI, e.g., from cut waste at the building site, can be further used after processing, e.g., crushing and if necessary, removal of board liner. They are suited for reclamation of mining sites, as soil conditioner, fertilizer component or as setting and hardening regulating agent for cement. However, this procedure requires agreement with the purchaser and consideration of national regulations.

Recycling

Due to the reversible absorption and dehydration of water of crystallization, gypsum products can be recycled by suitable processes. Therefore, gypsum waste should be collected as mono-fraction and processed in gypsum recycling plants. For recycling, the adherent board liner is peeled from the gypsum core and returned to the paper recycling system or thermally utilized. Remaining metallic components are removed with magnetic separators and recycled as scrap. Afterwards, the gypsum core is fed into the recycling plant and crushed. The resulting recycled

gypsum can be re-used for the production of gypsum based building materials.

2.16 Disposal

Plasterboards Knauf Diamant GKFI have to be disposed of in compliance with the following waste codes of the European Waste Catalogue /EWC/:

- 17 08 02 gypsum-based construction materials other than those mentioned in 17 08 01
- 17 09 04 mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03

National disposal guidelines have to be observed. In Germany, plasterboards Knauf Diamant GKFI are to be disposed of at landfills of landfill category 1 or higher according to the regulation of landfills /DepV2009/.

2.17 Further information

Further information about plasterboards Knauf Diamant GKFI, e.g., technical data sheets or material safety data sheets are available at www.knauf.de or from the Technical Advisory Service Knauf Direct (knauf-direkt@knauf.de).

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit is 1 m² of plasterboard Knauf Diamant GKFI with a thickness of 12.5 mm. Further board thicknesses vary only in the weight of the gypsum core as well as in the energy demand for drying.

Declared unit

Name	Value	Unit
Declared unit	1	m ²
Conversion factor to 1 kg	0.078	-

3.2 System boundary

In addition to the manufacturing of plasterboard Knauf Diamant GKFI (modules A1-A3), this EPD contains the transport from the manufacturing to the building site (A4) and the processing at the building site (A5, only cutting without installation) as well as the collection (C2), the recycling (C3) and disposal (C4). Accordingly, the EPD is a cradle-to-gate declaration with options.

During manufacturing, the provision and transport of raw materials, the manufacturing of the board including the provision of energy, emissions as well as the provision of packaging materials are considered. The modelling of recycling includes the separation of materials, the feedback of board liner to the waste paper recycling system, and the processing of the gypsum core. Residual non-recyclable components are disposed of.

3.3 Estimates and assumptions

For transport, a general payload of 50% is assumed. Further assumptions are made during the recycling of plasterboards Knauf Diamant GKFI. These are described in more detail in section 4.

3.4 Cut-off criteria

All raw materials for the manufacturing of plasterboards Knauf Diamant GKFI, the required energy, water and the resulting emissions are considered in the life cycle assessment. That way, recipe components with a share even less than 1 % are included. All neglected processes contribute less than 5 % to the total mass or less than 5 % to the total energy consumption.

3.5 Background data

The software GaBi 6 from Think step /GaBi2015/ is used for modelling the LCA. The LCA is based on production data from different European Knauf manufacturing sites as well as a Knauf manufacturing site in Turkey. Datasets for the European region are used as much as possible for the life cycle inventory. This is especially true for the provision of electricity and thermal energy.

3.6 Data quality

The LCA of plasterboards Knauf Diamant GKFI is modelled by using GaBi datasets, exclusively. Therefore, the data quality is considered to be good.

3.7 Period under review

The modelling is based on the annual production in 2014.

3.8 Allocation

Allocations are avoided in the modelling. Beyond that, allocations are only applied in the background data.

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.

4. LCA: Scenarios and additional technical information

Product Stage (A1-A3)

Supply of raw materials

Plasterboards Knauf Diamant GKFI consist of a gypsum core which is reinforced with mineral fillers and covered with board liner. The natural gypsum is mainly extracted from open-cast mining in close vicinity to the manufacturing site. Furthermore, gypsum from the flue-gas desulphurization of coal-fired power stations (FGD gypsum) is used as a raw material.

Board liner for the covering of gypsum core is produced from recycled waste paper which is partly certified by FSC.

Additives are added for an easier processing and a fine adjustment of properties of plasterboards Knauf Diamant GKFI. These additives add up to less than 5 % of the overall mass of the product.

Transport of raw materials

Natural gypsum is extracted from mines close to the manufacturing sites of plasterboard Knauf Diamant GKFI. Accordingly, transport distances are short and trucks can be used. FGD gypsum is mainly transported by freight train from coal-fired power plants. Further raw materials are supplied by truck from manufacturers within Germany or from neighbouring countries. Only some exceptional additives are delivered from overseas via container ship and truck to the respective manufacturing plant.

Manufacturing

Natural gypsum as well as gypsum from the flue-gas desulphurization is calcined prior to the mixing with other components. FGD gypsum is usually delivered as damp material and, thus, must be dried before calcination.

Stucco, mineral fillers and additives are mixed with water and processed as described in section 2.7. The addition of water allows the incorporation of water of crystallization into the molecules of calcium sulfate. By the addition of water, gypsum becomes settled and hardened. Redundant surface water is removed in a multi-level dryer.

Transport to building site (A4)

Name	Value	Unit
Litres of fuel (diesel, density: 0.83 kg/L)	0.00235	l/100km
Transport distance	230	km
Capacity utilisation (including empty runs)	50	%
Gross density of products transported	>= 1000	kg/m ³
Capacity utilisation volume factor	0.27	-

Reference service life

Name	Value	Unit
Reference service life according to /BBSR2011/	50	a

End of Life (C1-C4)

Name	Value	Unit
Collected separately	12.8	kg
Collected as mixed construction waste	0	kg
Reuse	0	kg
Recycling	12.2	kg
Energy recovery	0	kg
Landfilling	0.6	kg

5. LCA: Results

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

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	MND	MND	MNR	MNR	MNR	MND	MND	MND	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m² plasterboard Knauf Diamant GKFI

Parameter	Unit	A1-A3	A4	A5	C2	C3	C4	D
GWP	[kg CO ₂ -Eq.]	3.92E+0	2.10E-1	9.17E-2	1.54E-1	7.77E-2	1.03E-2	-6.37E-1
ODP	[kg CFC11-Eq.]	1.72E-10	9.55E-13	2.36E-9	7.00E-13	4.66E-12	1.01E-13	1.80E-10
AP	[kg SO ₂ -Eq.]	7.75E-3	5.85E-4	2.00E-4	4.29E-4	1.12E-4	6.18E-5	-9.30E-4
EP	[kg (PO _x) ³ -Eq.]	1.68E-3	1.38E-4	3.36E-5	1.01E-4	1.78E-5	8.41E-6	-1.05E-4
POCP	[kg ethene-Eq.]	7.00E-4	-1.82E-4	1.60E-5	-1.33E-4	8.31E-6	5.94E-6	-1.12E-4
ADPE	[kg Sb-Eq.]	2.34E-4	1.38E-8	-4.57E-8	1.01E-8	3.48E-8	3.57E-9	-1.59E-4
ADPF	[MJ]	5.97E+1	2.86E+0	3.70E-1	2.10E+0	7.67E-1	1.34E-1	-8.88E+0

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 - RESOURCE USE: 1 m² plasterboard Knauf Diamant GKFI

Parameter	Unit	A1-A3	A4	A5	C2	C3	C4	D
PERE	[MJ]	2.16E+1	1.63E-1	1.32E-2	1.19E-1	3.93E-1	1.58E-2	-1.11E+0
PERM	[MJ]	1.33E+1	IND	IND	IND	IND	IND	IND
PERT	[MJ]	3.49E+1	1.63E-1	1.32E-2	1.19E-1	3.93E-1	1.58E-2	-1.11E+0
PENRE	[MJ]	6.10E+1	2.87E+0	4.67E-1	2.11E+0	1.00E+0	1.39E-1	-1.04E+1
PENRM	[MJ]	1.82E+0	IND	IND	IND	IND	IND	IND
PENRT	[MJ]	6.28E+1	2.87E+0	4.67E-1	2.11E+0	1.00E+0	1.39E-1	-1.04E+1
SM	[kg]	3.30E+0	IND	IND	IND	IND	IND	IND
RSF	[MJ]	IND	IND	IND	IND	IND	IND	IND
NRSF	[MJ]	IND	IND	IND	IND	IND	IND	IND
FW	[m ³]	2.02E-2	4.07E-4	2.21E-3	2.99E-4	2.95E-4	2.83E-5	-1.79E-3

Caption: PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of non-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 – OUTPUT FLOWS AND WASTE CATEGORIES:

1 m² plasterboard Knauf Diamant GKFI

Parameter	Unit	A1-A3	A4	A5	C2	C3	C4	D
HWD	[kg]	3.11E-7	2.17E-7	0.00E+0	1.59E-7	1.18E-9	3.18E-9	-1.19E-8
NHWD	[kg]	6.66E+0	1.12E-2	5.03E-2	8.20E-3	1.10E+0	2.46E-2	-1.05E+0
RWD	[kg]	1.21E-3	4.11E-6	2.92E-5	3.01E-6	9.44E-5	1.92E-6	-5.89E-4
CRU	[kg]	IND	IND	IND	IND	IND	IND	IND
MFR	[kg]	IND	IND	7.00E-3	IND	1.22E+1	IND	IND
MER	[kg]	IND	IND	IND	IND	IND	IND	IND
EEE	[MJ]	IND	IND	1.66E+0	IND	IND	IND	IND
EET	[MJ]	IND	IND	5.29E+0	IND	IND	IND	IND

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; EEE = Exported thermal energy

6. LCA: Interpretation

Life cycle impacts and contributions to the life cycle inventory result to at least 75 % from the manufacturing (A1-A3) of plasterboards Knauf Diamant GKFI (exceptions: Depletion potential of the stratospheric ozone layer **ODP** 6 %, abiotic depletion potential for non-fossil resources **ADPE** 60 %, formation potential of tropospheric ozone

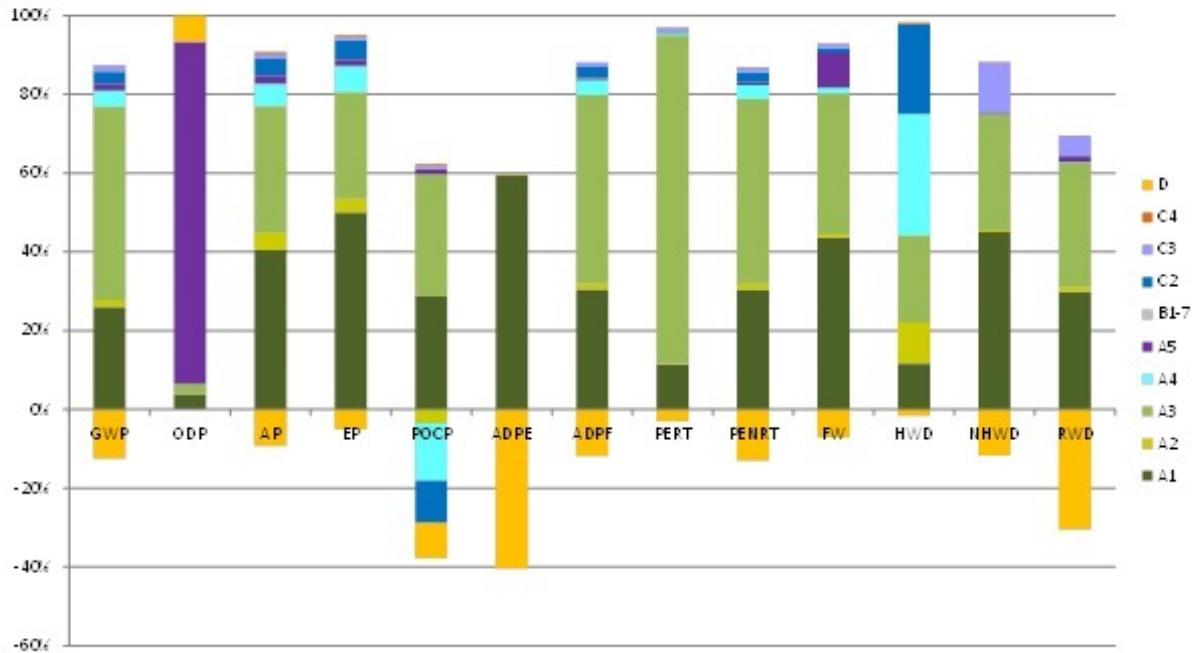
photochemical oxidants **POCP** 63 %, radioactive waste disposed **RWD** 63 %, hazardous waste disposed **HWD** 46 %). By contrast, transports in modules A4 and C2 contribute only 7 % at maximum (exceptions: formation potential of tropospheric ozone photochemical oxidants **POCP** 15 %, hazardous waste disposed **HWD** 32 %). The contribution of recycling and disposal of non-

recyclable fractions (C3, C4) to the overall results is 1.8 % at maximum (exceptions: non-hazardous waste disposed **NHWD** 13 %, radioactive waste disposed **RWD** 5 %).

The supply of raw materials including transports influence the LCA results to at least 30 % (see figure below) (exception: global warming potential **GWP** 26 %, total use of renewable primary energy resources **PERT** 11 %, depletion potential of the stratospheric ozone layer **ODP** 4 %, hazardous waste disposed **HWD** 12 %)). As was to be expected, the supply of raw

material contributes to more than 99 % to the overall abiotic depletion potential for non-fossil resources **ADPE**. This result is dominated by the provision of stucco (from natural gypsum and FGD gypsum, incl. energy for calcination). The provision of stucco dominates the abiotic depletion potential for non-fossil resources **ADPE** by 81 % and influences the impact categories of the global warming potential **GWP**, abiotic depletion potential for fossil resources **ADPF** as well as the total use of non-renewable primary energy resources **PENRT** by 27 to 32 %.

Relative contributions of the considered modules to the environmental impact potentials and selected life cycle inventory indicators



7. Requisite evidence

7.1 Leaching (sulphates and heavy metals)
Plasterboards Knauf Diamant GKFI show a leaching behaviour typical for gypsum based building products. Thus, sulphates are leached in the saturation region /Dre2006/. That is why disposal is only allowed in landfills from landfill category 1 in Germany /DepV2009/.

Heavy metal concentrations were verified significantly below the assignment criteria according to landfill category 1 complying with /DepV2009/.

Plasterboards Knauf Diamant GKFI are classified in water hazard class 1 (slightly water-hazardous).

7.2 Radioactivity

According to /Geh2012/ and RP 112 dose values and radon concentrations of gypsum based building products are below 0.3 mSv/a. Thus, they can be used without restrictions.

7.3 VOC emissions

Plasterboards Knauf Diamant GKFI were tested randomly by the Fraunhofer Institute for Building Physics, Holzkirchen (D) according to the AgBB test scheme /IBP2012, IBP2013/. The requirements of the AgBB protocol /AgBB2015/ are fully met.

VOC emissions, 28 days

Name	Value	Unit
TVOC (C6 - C16)	< 1000	µg/m ³
Sum SVOC (C16 - C22)	< 100	µg/m ³
R (dimensionless)	< 1	-
VOC without NIK	< 100	µg/m ³
Carcinogenic Substances	< 1	µg/m ³

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