





ENVIRONMENTAL PRODUCT DECLARATION

OF KNAUF PLASTERBOARDS

In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC 2021 This EPD covers multiple products.

EPD PROGRAM

PROGRAM OPERATOR
CPC CODE
EPD REGISTRATION NUMBER
PUBLICATION DATE
VALID UNTIL
GEOGRAPHICAL SCOPE

The international EPD System, https://environdec.com/

EPD INTERNATIONAL AB

37530 Articles of plaster or of composition based on plaster

S-P-07072

2022-11-25

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Global



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▶ Company Information

Knauf is one of the world's leading manufacturers of modern insulation materials, drylining systems, plasters and accessories, thermal insulation composite systems, paints, floor dry floor systems, and construction equipment and tools.

Knauf's factory in Stanos, Amphilochia, Greece, covers 100 acres of land, of which 13 acres is building cover. In the same geographical area, it operates a gypsum quarry (180 acres) owned by the company. The factory operates on a 24-hour basis while a significant part of its production is exported to the Balkan countries, Eastern Mediterranean and North Africa. Knauf has a vertical production from the raw material, gypsum, a product of its own mining that is processed in its facilities into complete structural elements (gypsum, plasterboard) with maximum added value. Inspection of all raw materials is carried out daily by the well-equipped quality control department, before their use in the production lines.

Product Information

This is an average EPD for plasterboards produced by Amphilochia plant in Greece. The LCIA results of the LCA represents the weighted average product. There is no significant differentiation among the environmental performance of each product. The products included are:

- Type A plasterboards (GKB)
- Type DF fire-resistant plasterboards (GKF)
- Type H2 impregnated plasterboards (GKI)
- Type DFH2 fire-resistant
 - & impregnated plasterboards (GKFI)
- Ultra Board DFIR special fire-resistant pasteboard, with increased core density and surface hardness





► Type A plasterboards (GKB)

Knauf type A (GKB) standard plasterboards are suitable for basic drywall systems

Properties	Unit	Value	Standard
Туре	-	A/GKB	EN 520/DIN 18180
Fire-resistance	-	A2-s1, d0 (B)	EN 520
Vapor permeability (Dry)		10	EN ISO 10456
Vapor permeability (Humid)		4	EN ISO 10456
Thermal conductivity λ	W/m*K	0,21	EN ISO 10456
Specific weight	kg/m³	≥ 680	DIN 18180
Weight (9,5 mm)	kg/m²	≥ 6,5	DIN 18180
Weight (12,5 mm)	kg/m²	≥ 8,5	DIN 18180
Crushing strength f c,90, k	N/mm ²	≥ 3,5	DIN 1052
Tensile strength $f_{m,k}$ (longitudinal)	N/mm^2	≥ 6,5	DIN 1052
Tensile strength $f_{m,k}$ (transverse)	N/mm ²	2	DIN 1052
Young's modulus (longitudinal)	N/mm ²	≥ 2800	DIN 1052
Young's modulus (transverse)	N/mm ²	≥ 2200	DIN 1052

► Type DF Fire-resistant plasterboards (GKF)

Knauf DF (GKF) fire-resistant gypsum boards are used for internal fire-resistant constructions.

Properties	Unit	Value	Standard
Туре	-	DF/GKF	EN 520/DIN 18180
Fire-resistance	-	A2-s1, d0 (B)	EN 520
Vapor permeability (Dry)		10	EN ISO 10456
Vapor permeability (Humid)		4	EN ISO 10456
Thermal conductivity λ	W/m*K	0,21	EN ISO 10456
Specific weight	kg/m³	≥ 800	DIN 18180
Weight (12,5 mm)	kg/m²	≥ 10	DIN 18180
Weight (15 mm)	kg/m²	≥ 12	DIN 18180
Weight (18 mm)	kg/m²	≥ 14,4	DIN 18180
Crushing strength f c,90, k	N/mm^2	≥ 3,5	DIN 1052
Tensile strength f _{m,k} (longitudinal)-12,5 mm	N/mm ²	≥ 6,5	DIN 1052
Tensile strength f _{m,k} (transverse)-12,5 mm	N/mm^2	≥ 2	DIN 1052
Tensile strength f _{m,k} (longitudinal)-15 mm	N/mm ²	≥ 5,4	DIN 1052
Tensile strength f _{m,k} (transverse)-15 mm	N/mm^2	≥ 1,8	DIN 1052
Tensile strength f _{m,k} (longitudinal)-18 mm	N/mm ²	≥ 4,2	DIN 1052
Tensile strength f _{m,k} (transverse)-18 mm	N/mm^2	≥ 1,5	DIN 1052
Young's modulus (longitudinal)	N/mm ²	≥ 2800	DIN 1052
Young's modulus (transverse)	N/mm ²	≥ 2200	DIN 1052





► Type H2 impregnated plasterboards (GKI)

Waterproof Knauf H2 (GKI) is used for constructions in internal sanitary spaces.

Properties	Unit	Value	Standard
Туре	-	H2/GKI	EN 520/DIN 18180
Fire-resistance	-	A2-s1, d0 (B)	EN 520
Vapor permeability (Dry)		10	EN ISO 10456
Vapor permeability (Humid)		4	EN ISO 10456
Thermal conductivity \(\lambda \)	W/m*K	0,21	EN ISO 10456
Water absorption	%	≤ 10	EN 520
Specific weight	kg/m³	≥ 680	DIN 18180
Weight (12,5 mm)	kg/m²	≥ 8,5	DIN 18180
Crushing strength f c,90, k	N/mm ²	≥ 3,5	DIN 1052
Tensile strength f m,k (longitudinal)	N/mm^2	≥ 6,5	DIN 1052
Tensile strength f m,k (transverse)	N/mm^2	≥ 2	DIN 1052
Young's modulus (longitudinal)	N/mm^2	≥ 2800	DIN 1052
Young's modulus (transverse)	N/mm ²	≥ 2200	DIN 1052

► Type DFH2 fire-resistant & impregnated plasterboards (GKFI)

Knauf DFH2 (GKI) is used in internal sanitary spaces that require fire protection.

Properties	Unit	Value	Standard
Туре	-	DFH2/GKFI	EN 520/DIN 18180
Fire-resistance	-	A2-s1, d0 (B)	EN 520
Vapor permeability (Dry)		10	EN ISO 10456
Vapor permeability (Humid)		4	EN ISO 10456
Thermal conductivity λ	W/m*K	0,23	EN ISO 10456
Water absorption	%	≤ 10	DIN 18180
Specific weight	kg/m³	≥ 800	DIN 18180
Weight (12,5 mm)	kg/m²	≥ 12	DIN 18180
Crushing strength f c,90, k	N/mm^2	≥ 5,5	DIN 1052
Tensile strength f m,k (longitudinal)	N/mm^2	≥ 5,4	DIN 1052
Tensile strength f m,k (transverse)	N/mm ²	≥ 1,8	DIN 1052
Young's modulus (longitudinal)	N/mm^2	≥ 2800	DIN 1052
Young's modulus (transverse)	N/mm ²	≥ 2200	DIN 1052





► ULTRA BOARD® DFIR special fire-resistant pasteboard

Knauf ULTRA BOARD® is a fire resistant plasterboard with increased core density, reinforced with polymers and glass fibers, increased surface hardness and bending strength.

Properties	Unit	Value	Standard
Туре	-	DFIR	EN 520
Fire-resistance	-	A2-s1, d0 (B)	EN 520
Vapor permeability (Dry)		10	EN ISO 10456
Vapor permeability (Humid)		4	EN ISO 10456
Thermal conductivity λ	W/m*K	0,25	EN ISO 12664
Specific weight	kg/m³	≥ 1000	
Weight (15 mm)	kg/m²	15	
Tensile strength f m,k (longitudinal)	N/mm^2	≥ 8	EN 520
Tensile strength f m,k (transverse)	N/mm ²	≥ 3,3	EN 520
Surface hardness	mm	≤ 15	EN 520

The composition of the products is presented in Table below:

Material	Percentage (%) by mass	Mass (kg) per declared unit
Gypsum	92-96	6,90-7,20
Paper	3-5	0,23-0,38
Other minerals & additives	<3	< 0,23

Packaging material	Mass (kg) per declared unit
Wooden pallets	<i>7</i> ,33E-02
Polyethylene film	7,6E-05

No substance in the "Candidate List of Substances of Very High Concern (SVHC) for authorization" exceeds 0.1% wt in the final products.





System Boundaries

Plasterboards System Boundaries Diagram

X= Included, MND= Module Not Declared																	
	Product stage				ruction ige	Use stage				E	End-of-li	ife stag	e	Resource recovery stage			
	Raw Materials Supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction and demolition	Transport	Waste processing for reuse, recovery and/or recycling	Disposal	Reuse-Recovery-Recycling-potential
Module	A1	A2	А3	A4	A5	В1	В2	В3	В4	В5	В6	B7	C1	C2	С3	C4	D
Modules declared	x	x	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	x	x	x	х
Geography	GLO	GLO	GR														
Specific data used		>90%															
Variation- products		<10%															
Variation- sites	No	t relev	ant														

A1: Raw Material Supply

The production starts with the material supply. This stage includes the mining and processing of raw materials, the generation of electricity and fuels required for the manufacturing stage. Gypsum (CaSO₄·2H₂O) is the main raw material while rest are materials such as starch, glass and other additives.

A2: Transportation of raw materials to manufacturer

Transport is relevant for delivery of raw materials from the supplier to the gate of manufacturing plant. The main material for the production, gypsum, is extracted and transported by trucks from owned quarries which are located 10 km from the manufacturing plant, while the rest are transported by trucks and vessels from different countries all over the world.

A3: Manufacturing

Manufacturing starts with the crushing and baking of raw gypsum in specially formed mills to form stucco (calcium sulphate hemihydrate). Baked gypsum is combined with other solid and liquid mixing materials and the produced slurry is transferred in a formatting table in order to obtain a certain width and edge configuration. The slurry ends up in a 250 m length conveyor belt and in the end of this route the plasterboard (after a drying process) takes its final structure.



C1: De-construction, demolition

The deconstruction and demolition of the product takes place with the demolition of the whole building. It is assumed that energy for the binder is minor compared to the other materials of the building, thus the environmental impact of this module is set to be zero.

C2: Transportation of waste

A distance of 100 km by lorry 16-32 tonnes from construction/demolition sites to disposal sites has been chosen as a conservative assumption.

C3: Waste processing for reuse, recovery and/or recycling

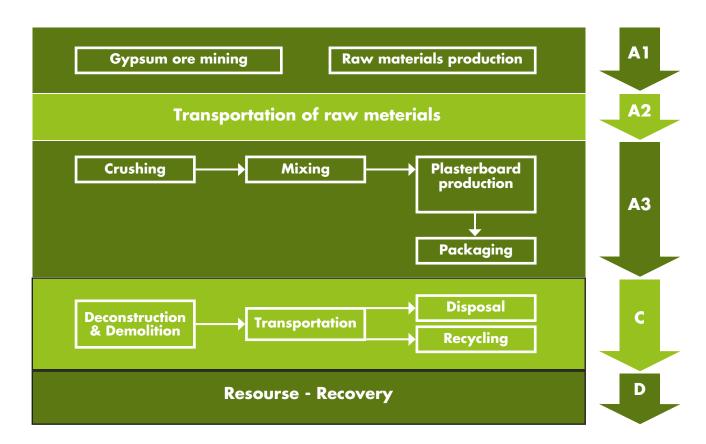
It is assumed that gypsum binder will be 100% landfilled after its life cycle, thus the environmental impact of this module is set to be zero.

C4: Disposal

As it is mentioned above, gypsum binder will be 100% landfilled after its life cycle.

D: Reuse-Recovery-Recycling potential

Since the product is 100% landfilled, the benefits and loads resulting from reuse and recycling is zero.







LCA Information

Declared unit: The declared unit is 1 m² of plasterboards.

Goal and Scope: This EPD evaluates the environmental impacts of the production of 1 m² of plasterboards from Cradle to gate with module C1-C4 and D System Boundary: The system boundaries are set to be cradle to gate (A1-A3) with modules C+D Cut-off rules: The cut-off criteria adopted is as stated in "EN 15804:2012+A2:2019". Where there is insufficient data for a unit process, the cut-off criteria are 1% of the total mass of input of that process. The total of neglected input flows per module is a maximum of 5% of energy usage and mass. The cutoff rule was used in cases of some additives used for the mixing of baked gypsum. The total mass is approximately 0,226%.

Allocations: Wherever possible, allocation was avoided by dividing the unit process to be allocated into two or more sub-processes and collecting the input and output data related to these sub-processes. Where allocation cannot be avoided, the inputs and outputs of the system were partitioned between its different products or functions in a way that reflects the underlying physical or economic relationships between them. In this case, the allocation concerns the electricity for lighting and the diesel consumption for other general utilities in the manufacturing plant and it is based on the mass of the final products.

Assumptions:

<u>Transportation</u>: In modules A2 and C2, a EURO4 lorry 16-32 metric ton was utilized for road transportation and a bulk carrier for dry goods for sea transportation.

Module C1: It is assumed that energy used for the demolition of the plasterboard has minor significance, thus the environmental impact of this module is set to be zero.

Module C2: a conservative assumption of 100 km by lorry 16-32 metric ton was used.

Module C3: There is no provision for plasterboards' waste reuse and it is 100% landfilled.

Module C4: As it is said above, plasterboards' waste will be 100% landfilled.

Data quality: ISO 14044 was applied in terms of data collection and quality requirements. The impact of the production of raw materials recovered from Ecoinvent database v.3.8. The data concerning the modules A2 (Transportation) and A3 (Product manufacturing) were provided by Knauf and they were extracted from the company's SAP system and BDE. Regarding electricity mix, the latest (2020) national residual electricity mix as published in DAPEEP SA was utilized. The emission factor for natural gas is provided from National Inventory Report of 2020 for Greece. The end-of-life are based on the most representative scenarios for this product. Background data for these stages are retrieved from Ecoinvent v.3.8.

Geographical Scope: Worldwide

Time representativeness: Data obtained refer to the year 2021

Software used: OpenLCA v.1.10.3





► Environmental Performance

ENVIRONMENTAL IMPACTS	Unit	A1-A3	C1	C2	С3	C4	D
GWP-total	kg CO2 eq	2,27E+00	0,00E+00	1,23E-01	0,00E+00	9,74E-02	0,00E+00
GWP-fossil	kg CO2 eq	2,26E+00	0,00E+00	1,23E-01	0,00E+00	9,69E-02	0,00E+00
GWP-biogenic	kg CO2 eq	7,03E-03	0,00E+00	4,16E-05	0,00E+00	3,56E-04	0,00E+00
GWP-luluc	kg CO2 eq	7,22E-03	0,00E+00	4,19E-05	0,00E+00	1,00E-04	0,00E+00
GWP-GHG ¹	kg CO2 eq	2,25E+00	0,00E+00	1,22E-01	0,00E+00	9,50E-02	0,00E+00
ODP	kg CFC-11 eq	4,56E-07	0,00E+00	2,82E-08	0,00E+00	2,51E-08	0,00E+00
АР	mol H+ eq	8,37E-03	0,00E+00	6,18E-04	0,00E+00	2,41E-01	0,00E+00
EP-freshwater ²	kg PO4-3 eq	1,75E-03	0,00E+00	2,56E-05	0,00E+00	6,57E-05	0,00E+00
EP-freshwater ²	kg P eq	5,71E-04	0,00E+00	8,36E-06	0,00E+00	2,14E-05	0,00E+00
EP-marine	kg N eq	1,70E-03	0,00E+00	2,16E-04	0,00E+00	2,53E-04	0,00E+00
EP-terrestrial	mol N eq	1,66E-02	0,00E+00	2,36E-03	0,00E+00	2,74E-03	0,00E+00
POCP	kg NMVOC eq	4,76E-03	0,00E+00	6,71E-04	0,00E+00	1,57E-02	0,00E+00
ADPe ³	kg Sb eq	9,08E-06	0,00E+00	4,48E-07	0,00E+00	3,08E-07	0,00E+00
ADPf ³	WI	3,53E+01	0,00E+00	1,88E+00	0,00E+00	2,12E+00	0,00E+00
WDP ³	m3 eq	1,14E+00	0,00E+00	8,74E-03	0,00E+00	9,33E-02	0,00E+00

¹ GWP-GHG indicator includes all greenhouse gases included in GWP-total but excludes biogenic carbon dioxide emissions and uptake and biogenic carbon stored in the product, with characterization factors (CFs) based on IPCC (2013).

³ The results of these environmental impact indicators shall be used with care as the uncertainties of these results are high or as there is limited experienced with the indicator.

RESOURCE USE	Unit	A1-A3	C1	C2	С3	C4	D
PERE	WI	1,07E+01	0,00E+00	2,54E-02	0,00E+00	7,08E-02	0,00E+00
PERM	WJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	WJ	1,07E+01	0,00E+00	2,54E-02	0,00E+00	7,08E-02	0,00E+00
PENRE	WJ	3,53E+01	0,00E+00	1,88E+00	0,00E+00	2,12E+00	0,00E+00
PENRM	WI	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PENRT	WI	3,53E+01	0,00E+00	1,88E+00	0,00E+00	2,12E+00	0,00E+00
SM	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RSF	WI	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF	WJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
FW	m3	2,66E-02	0,00E+00	2,03E-04	0,00E+00	2,17E-03	0,00E+00



 $^{^{2}}$ Eutrophication aquatic freshwater shall be given in both kg PO4 eq and kg P eq.



► Environmental Performance

OUTPUT FLOWS AND WASTE CATEGORIES	Unit	A1-A3	C1	C2	C3	C4	D
HWD	kg	1,04E-04	0,00E+00	4,90E-06	0,00E+00	3,06E-06	0,00E+00
NHWD	kg	1,67E-01	0,00E+00	9,02E-02	0,00E+00	7,56E+00	0,00E+00
RWD	kg	2,07E-04	0,00E+00	1,29E-05	0,00E+00	1,25E-05	0,00E+00
CRU	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MFR	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MER	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EE	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

ADDITIONAL IMPACTS	Unit	A1-A3	C1	C2	C3	C4	D
PM	Disease incidence	6,14E-08	0,00E+00	8,89E-09	0,00E+00	1,96E-07	0,00E+00
IRP ⁴	kBq U235 eq	2,54E-01	0,00E+00	9,83E-03	0,00E+00	1,35E-02	0,00E+00
ETP-FW	CTUe	2,66E+01	0,00E+00	1,38E+00	0,00E+00	2,58E+00	0,00E+00
НТР-с	CTUh	6,91E-10	0,00E+00	5,11E-11	0,00E+00	2,47E-10	0,00E+00
HTP-nc	CTUh	1,68E-08	0,00E+00	1,46E-09	0,00E+00	1,19E-08	0,00E+00
SQP	dimensionless	5,71E+01	0,00E+00	1,26E+00	0,00E+00	2,11E+00	0,00E+00

⁴ Ionizing radiation potential (IRP) impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

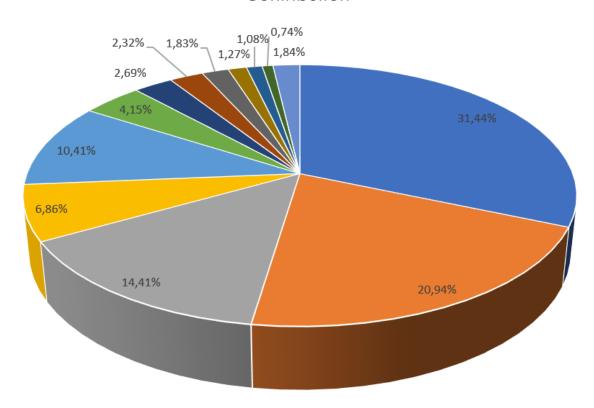




Interpretation

Plasterboard production - Global Warming Potential Contribution

Plasterboard production - Global Warming Potential Contribution



- Emissions from plasterboard production
- Paper production
- Electricity
- Plasticiser production
- Emissions from gypsum ore mining
- Vinyl acetate production
- Other

- Emissions from gypsum crushing and baking
- LPG production
- Transportation
- Heavy fuel oil production
- Glass fibre production
- Packaging

Additional information

The EPD does not give information on release of dangerous substances to soil, water and indoor air because the horizontal standards on measurement of release of regulated dangerous substances from construction products using harmonized test methods according to the provisions of the respective technical committees for European product standards are not available.





Programme related information

The international EPD System www.environdec.com



Programme









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The CEN standard EN 15804 serves as the core Product Category Rules PCR 2019:14 Construction products (EN 15804:A2); Version 1.2.4; 2022-09-07 PCR review was conducted by

The Technical Committee of the International EPD® System.

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

EPD process certification

X EPD verification

Verification by:



Business Quality Verification P.C, Accredited by E.S.Y.D, Accreditation No. 1218 144 Septemvriou 3rd Str., Athens 112 51

EPD owner



www.knauf.gr

LCA Accountability



www.envirometrics.gr

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

Yes X

The EPD owner has the sole ownership, liability and responsibility of the EPD. EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g.

identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.





References

General Programme Instructions of the International EPD® System. Version 4.0, 2021-03-29

PCR 2019:14 v.1.2.4 Construction products. EPD System. Date 2022-09-07. Valid until 2024-12-20

EN 15804:2012+A2:2019, Sustainability of construction works - Environmental Product Declarations — Core rules for the product category of construction products

ISO 14020:2000 Environmental labels and declarations — General principles

ISO 14025:2006 Environmental labels and declarations - Type III environmental declarations — Principles and procedures

ISO 14040:2006 Environmental management - Life cycle assessment-Principles and framework

ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines

Ecoinvent / Ecoinvent Centre, www.Ecoinvent.org

Residual Energy Mix 2020 from Renewable Energy Sources Operator & Guarantees of Origin (DAPEEP SA)



List of abbreviations

LCA Life Cycle assessment

Environmental Product Declaration

PCR Product category rules

GLO Global Europe

RoW Rest of the world

GWP-total
GWP-fossil
GWP-biogenic
Global Warming Potential total
Global Warming Potential fossil
Global Warming Potential biogenic

GWP-Iuluc Global Warming Potential land use and land use change

ODP Ozone Depletion Potential
AP Acidification Potential

EP-freshwater EP-marineEutrophication potential, fraction of nutrients reaching freshwater end compartment
Eutrophication Potential fraction of nutrients reaching marine end compartment

EP- terrestrial Eutrophication potential, Accumulated Exceedance

POCP Formation potential of tropospheric ozone photochemical oxidants

ADPe Abiotic depletion potential for non-fossil resources
ADPf Abiotic depletion potential for fossil resources

WDP Water use

PERE Use of renewable primary energy excluding resources used as raw materials

PERMUse of renewable primary energy resources used as raw materials

PERTTotal use of renewable primary energy resources

PENREUse of non-renewable primary energy excluding resources used as raw materials

PENRMUse of non-renewable primary energy resources used as raw materials

PENRTTotal 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
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

EE Exported Energy

PM Particulate matter emissions
IRP lonizing radiation, human health

ETP-FW Ecotoxicity, freshwater
HTP-c Human toxicity, cancer
HTP-nc Human toxicity, non-cancer

SQP Land use related impacts/Soil quality









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