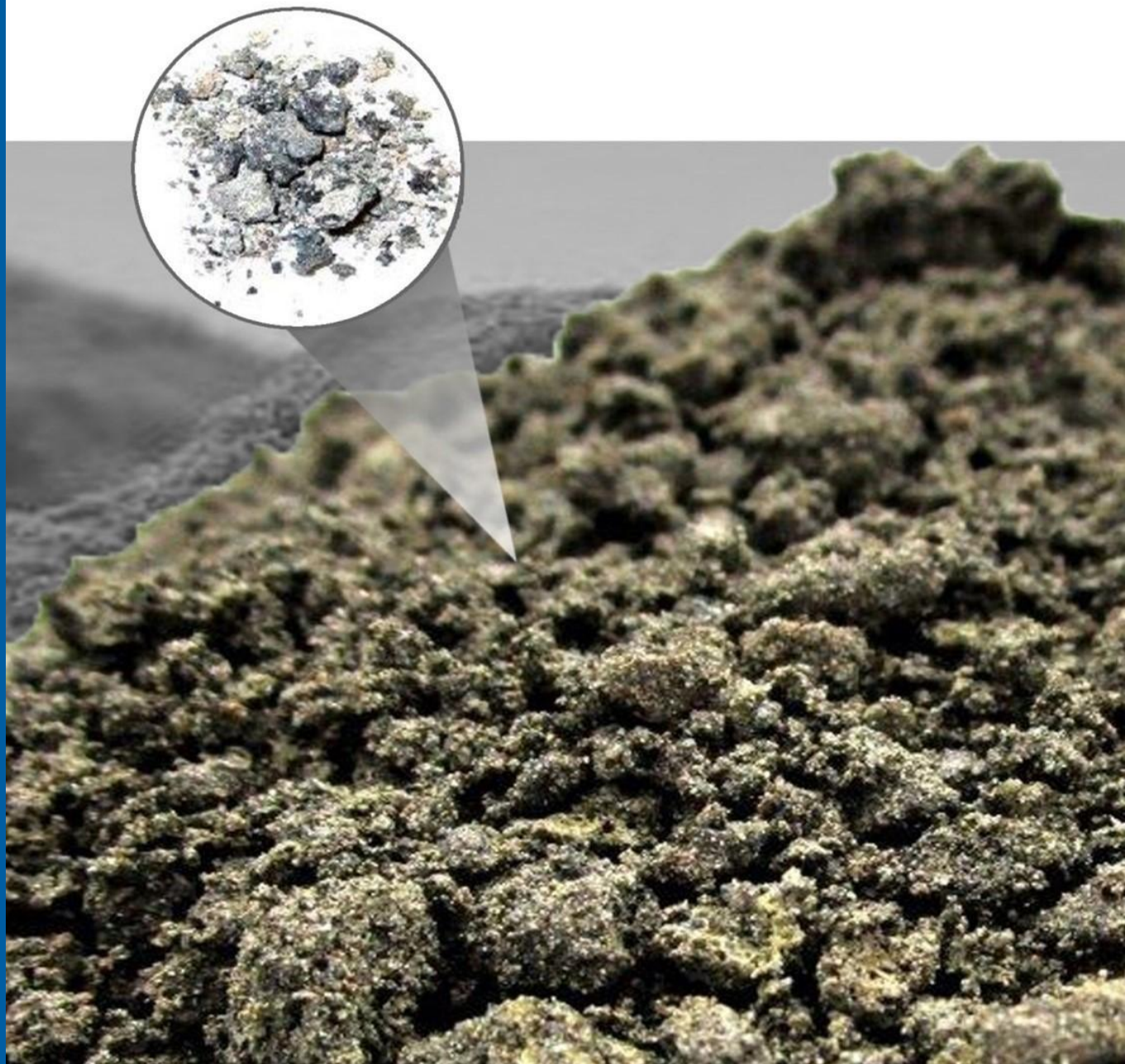
Environmental Product Declaration (EPD)
According to ISO 14025 and EN 15804

Grobalith®



Registration number:	EPD-Kiwa-EE-155676-EN
Issue date:	11-12-2023
Valid until:	11-12-2028
Declaration owner:	BauMineral GmbH
Publisher:	Kiwa-Ecobility Experts
Program operator:	Kiwa-Ecobility Experts
Status:	verified

1 General information

1.1 PRODUCT

Grobalith®

1.2 REGISTRATION NUMBER

EPD-Kiwa-EE-155676-EN

1.3 VALIDITY

Issue date: 11-12-2023

Valid until: 11-12-2028

1.4 PROGRAM OPERATOR

Kiwa-Ecobility Experts
Voltastraße 5
13355 Berlin
DE

Frank Huppertz

(Head of Kiwa-Ecobility Experts)

Prof. Dr. Frank Heimbecher

(Chairman of the independent expert committee - Kiwa-Ecobility Experts)

1.5 OWNER OF THE DECLARATION

Manufacturer: BauMineral GmbH

Address: Hiberniastraße 12, 45699 Herten

E-mail: baumineral@baumineral.de

Website: www.baumineral.de

Production location: Reference power plant

Address production location: Im Löringhof 10, 45711 Datteln

1.6 VERIFICATION OF THE DECLARATION

The independent verification is in accordance with the ISO 14025:2011. The LCA is in compliance with ISO 14040:2006 and ISO 14044:2006. The EN 15804:2012+A2:2019 serves as the core PCR.

☐ Internal ☑ External

Lucas Pedro Berman, Senda

1.7 STATEMENTS

The owner of this EPD shall be liable for the underlying information and evidence. The programme operator Kiwa-Ecobility Experts shall not be liable with respect to manufacturer data, life cycle assessment data and evidence.

1.8 PRODUCT CATEGORY RULES

PCR A
Kiwa-Ecobility Experts (Kiwa-EE) – General Product Category Rules (2022-02-14)

PCR B
EN 16908:2017+A1:2022: Cement and building lime - Environmental product declarations - Product category rules complementary to EN 15804

1 General information

1.9 COMPARABILITY

In principle, a comparison or assessment of the environmental impacts of different products is only possible if they have been prepared in accordance with EN 15804. For the evaluation of the comparability, the following aspects have to be considered in particular: PCR used, functional or declared unit, geographical reference, the definition of the system boundary, declared modules, data selection (primary or secondary data, background database, data quality), scenarios used for use and disposal phases, and the life cycle inventory (data collection, calculation methods, allocations, validity period). PCRs and general program instructions of different EPDs programs may differ. Comparability needs to be evaluated. For further guidance, see EN 15804+A2 (5.3 Comparability of EPD for construction products) and ISO 14025 (6.7.2 Requirements for comparability).

1.10 CALCULATION BASIS

LCA method R<THiNK: Ecobility Experts | EN15804+A2

LCA software*: Simapro 9.1

Characterization method: EN 15804 +A2 Method v1.0

LCA database profiles: EcoInvent version 3.6

Version database: v3.15 (2023-07-12)

** Used for calculating the characterized results of the Environmental profiles within R<THiNK.*

1.11 LCA BACKGROUND REPORT

This EPD is generated on the basis of the LCA background report 'Grobalith®' with the calculation identifier ReTHiNK-55676.

2 Product

2.1 PRODUCT DESCRIPTION

Grobalith® is trade name for bottom ash (coarse ash) from burning hard coal, where applicable with co-combustion of secondary fuels . Bottom ash is generated within the power plant's boiler room, resulting from the agglomeration of melted mineral compounds in hard coal combustion. It is considered a by-product of coal combustion. Bottom ash is not extracted with the flue gases, but collected in a water-filled hopper at the boiler end. Due to its physical properties bottom ash is applicable in a large variety. Similar to hard coal fly ash its chemical-mineralogical composition results from the used type of coal and varies from residual carbon and minerals to trace elements. Bottom ash is highly porous and in terms of its particle density comparable with natural lightweight aggregates. Bottom ash has irregularly ruptured, coarse surfaces and is suitable for the production such as light concrete products and light bricks.

The production of Grobalith® takes place at the following sites:

- Grobalith® HP Heyden power plant in Petershagen
- Grobalith® MR 3 Maasvlakte power plant, Block 3 near Rotterdam
- Grobalith® Scholven power plant in Gelsenkirchen
- Grobalith® D4 Datteln power plant, Block 4

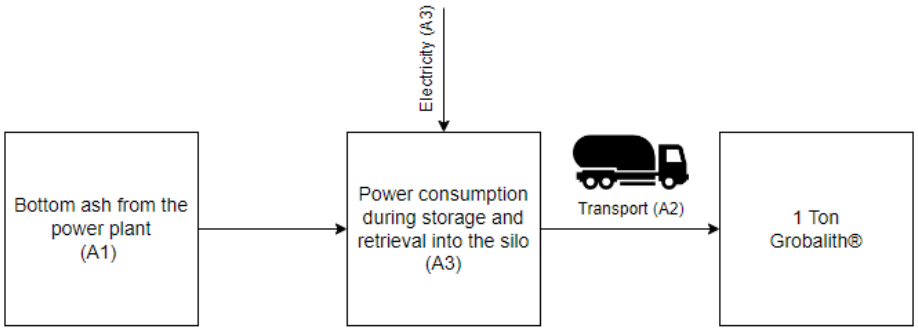


Figure 1: Simplified process flow chart of the production of Grobalith®

2.2 APPLICATION (INTENDED USE OF THE PRODUCT)

Bottom ash Grobalith® is used in the construction industry as a lightweight aggregate for concrete, mortar and grout in accordance with DIN EN 13055. It is suitable for the production of lightweight masonry mortar, lightweight concrete products, and lightweight masonry blocks, characterized by low weight and good thermal insulation properties. Other fields of application for bottom ash Grobalith® include road construction, as well as backfilling, dam construction, and soil improvement measures.

2.3 REFERENCE SERVICE LIFE

RSL PRODUCT

The declaration of Reference service life is voluntarily, since the extent of the study is not considering the whole life cycle of the bottom ash. Bottom ash is used as lightweight aggregate in concrete products. According to the BBSR-table 2011 / Nr. 363.512 the reference service life of concrete components amounts to ≥ 50 years.

USED RSL (YR) IN THIS LCA CALCULATION:

50

2.4 TECHNICAL DATA

Average chemical and physical properties of bottom ash Grobalith® (mean values from 2015):

- Elutriable components grain content < 0.063 mm: < 10 M.-%
- Elutriable components after impact stress at Proctor test : < 15 M.-%
- Grain solidness – value of slag disintegration: 25 - 35 M.-%
- Bulk density: 0.6 - 0.8 t/m3
- Particle density: 1.1- 1.4 t/m3
- Water absorption: 20 - 30 M.-%
- Moisture content: 25 - 35 M.-%
- Loss on ignition: < 10 M.-%
- Sulphur: < 1 M.-%
- Sulphate acid-soluble: 0.1 M.-%
- Chloride: < 0.01 M.-%

2.5 SUBSTANCES OF VERY HIGH CONCERN

The product does not contain substances of very high concern (SVHC).

2 Product

2.6 DESCRIPTION PRODUCTION PROCESS

Bottom ash Grobalith® inevitably occurs as a solid, dispersed residue during the combustion process in the power plant. The primary goal of the power plant is the generation of electricity and heat. Bottom ash is produced in dry firing boilers and collected in a water-filled hopper at the end of the boiler, which seals the boiler hermetically. During the storage stage in heads no additional expenses occur (no heating, no cooling, no aeration) and thus no energy consumption. The following figure shows the processes of coal-fired power generation.

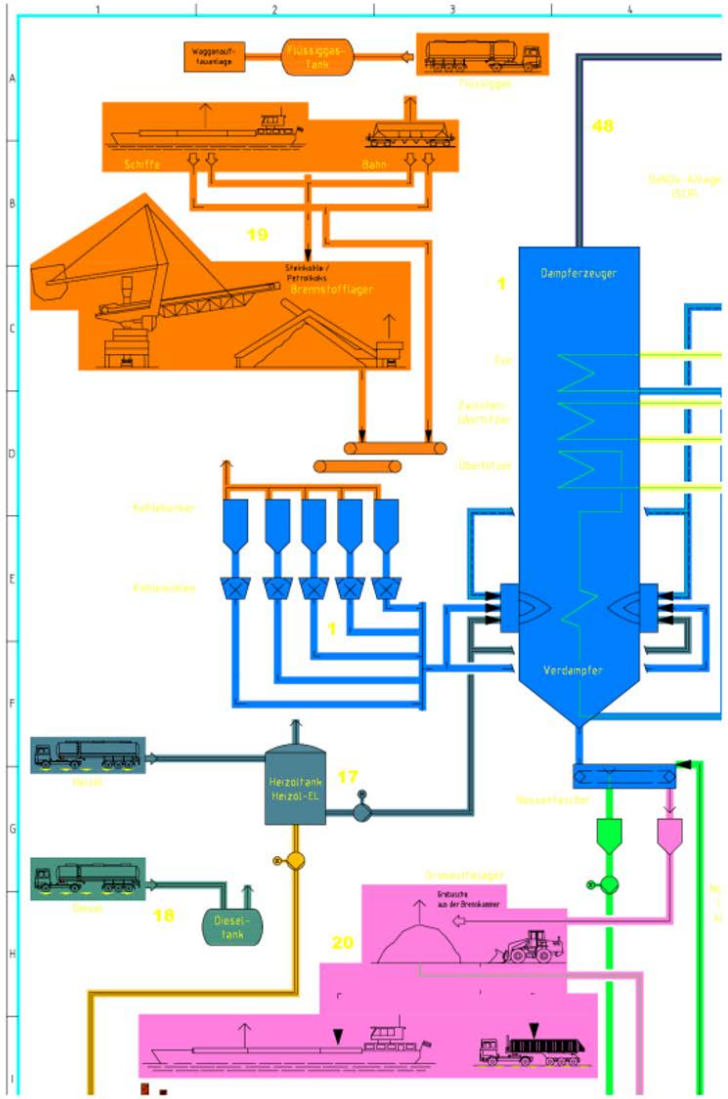


Figure 2. Diagram of bottom ash from the power plant Datteln 4

3 Calculation rules

3.1 DECLARED UNIT

reference_unit: ton (ton)

3.2 CONVERSION FACTORS

Description	Value	Unit
reference_unit	1	ton
weight_per_reference_unit	1000.000	kg
Conversion factor to 1 kg	0.001000	ton

3.3 SCOPE OF DECLARATION AND SYSTEM BOUNDARIES

This is a Cradle to gate LCA. The life cycle stages included are as shown below:

(X = module included, ND = module not declared)

A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

The modules of the EN15804 contain the following:

Module A1 = Raw material supply	Module B5 = Refurbishment
Module A2 = Transport	Module B6 = Operational energy use
Module A3 = Manufacturing	Module B7 = Operational water use
Module A4 = Transport	Module C1 = De-construction / Demolition
Module A5 = Construction - Installation process	Module C2 = Transport
Module B1 = Use	Module C3 = Waste Processing
Module B2 = Maintenance	Module C4 = Disposal
Module B3 = Repair	Module D = Benefits and loads beyond the product system boundaries
Module B4 = Replacement	

3.4 REPRESENTATIVENESS

This EPD is representative for Grobalith®, a product of BauMineral GmbH. The results of this EPD are representative for Germany.

3.5 CUT-OFF CRITERIA

In the Life cycle assessment the following cut-off criteria are applied:

PRODUCT STAGE (A1-A3)

All input flows (e.g. raw materials, transportation, energy use, packaging, etc.) and output flows (e.g. production waste) are considered in this LCA. The total neglected input flows do therefore not exceed the limit of 5% of energy use and mass.

3.6 ALLOCATION

Allocations are avoided as part of the life cycle assessment. However, bottom ash is a by-product of coal-fired power generation. It is assumed that coal-fired power generation is carried out exclusively for the purpose of providing energy and not for the production of bottom ash. No bottom ash would be produced without the energy production by coal. Therefore, the environmental impacts of coal-fired power generation are not attributed to bottom ash, but exclusively to energy production.

3.7 DATA COLLECTION & REFERENCE TIME PERIOD

Raw material data, production waste, energy consumption and supplier information are based on the reference year 2022.

3.8 ESTIMATES AND ASSUMPTIONS

The reference power plant for our analysis is Datteln 4, and Grobalith® D4 data is used to illustrate the consumption of bottom ashes from BauMineral, with Grobalith® D4 chosen as the worst-case scenario due to its highest consumption of transports and energy among bottom ashes from various power plants.

Bottom ash is stored in piles on the power plant site and brought to the customer in dump trucks or by ship. Generally, the trucks transport 25 to 27 t of bottom ash. Storage in a silo requires no energy input (no heating, cooling, or aeration). The worst-case distance between the bottom ash storage site and the factory gate is estimated to be 500 m for all power plants.

3 Calculation rules

To represent the worst-case scenario, the average energy consumption data from 2022 at the Datteln 4 power plant is utilized for Grobalith®. This choice is made because the manufacturing of Grobalith® at the Datteln 4 power plant is the most energy-intensive among the considered power plants. An electricity dataset sourced from hard coal is used to depict the electricity supply at the power plant, and no CO2 certificates are taken into account.

Excluded are the manufacturing of capital equipment, construction undertakings, and infrastructure development, along with the maintenance and operation of capital equipment. Additionally, activities related to personnel, as well as energy and water consumption associated with company management and sales, are also excluded.

3.9 DATA QUALITY

All process-specific data are collected for the reference year 2022. The data are based on the annual average. Generic datasets from the EcoInvent database are used for the secondary data. This database is regularly maintained and meets the requirements of EN 15804 +A2 (background data not older than 10 years). All consistent datasets contained in the EcoInvent database are documented and can be viewed in the online EcoInvent documentation. In the operating data survey all relevant process-specific data could be collected. The quality of the data can be thus considered as good.

The primary data are collected and provided by BauMineral GmbH. The R<THiNK EPD web application from the company NIBE is used to model the life cycle stages of the declared product systems. The electricity dataset chosen for the LCA refers to Germany as the geographic reference, while the transportation is represented by a global dataset for the lorry.

4 Results

For the impact assessment, the characterization factors of the LCIA method EN 15804 +A2 Method v1.0 are used. Long-term emissions (>100 years) are not considered in the impact assessment. The results of the impact assessment are only relative statements that do not make any statements about end-points of the impact categories, exceedance of threshold values, safety margins or risks. The following tables show the results of the indicators of the impact assessment, of the use of resources as well as of waste and other output flows.

4.1 ENVIRONMENTAL IMPACT INDICATORS PER TON

CORE ENVIRONMENTAL IMPACT INDICATORS EN15804+A2

Abbreviation	Unit	A1	A2	A3
AP	mol H+ eqv.	0.00E+0	3.91E-4	3.42E-1
GWP-total	kg CO2 eqv.	0.00E+0	6.75E-2	1.26E+2
GWP-b	kg CO2 eqv.	0.00E+0	3.12E-5	-5.19E-1
GWP-f	kg CO2 eqv.	0.00E+0	6.75E-2	1.27E+2
GWP-luluc	kg CO2 eqv.	0.00E+0	2.47E-5	1.30E-2
EP-m	kg N eqv.	0.00E+0	1.38E-4	8.17E-2
EP-fw	kg P eqv.	0.00E+0	6.81E-7	6.29E-2
EP-T	mol N eqv.	0.00E+0	1.52E-3	8.08E-1
ODP	kg CFC 11 eqv.	0.00E+0	1.49E-8	1.32E-6
POCP	kg NMVOC eqv.	0.00E+0	4.34E-4	2.03E-1
ADP-f	MJ	0.00E+0	1.02E+0	1.32E+3
ADP-mm	kg Sb-eqv.	0.00E+0	1.71E-6	7.60E-5
WDP	m3 world eqv.	0.00E+0	3.64E-3	1.56E+0

AP=Acidification (AP) | **GWP-total**=Global warming potential (GWP-total) | **GWP-b**=Global warming potential - Biogenic (GWP-b) | **GWP-f**=Global warming potential - Fossil (GWP-f) | **GWP-luluc**=Global warming potential - Land use and land use change (GWP-luluc) | **EP-m**=Eutrophication marine (EP-m) | **EP-fw**=Eutrophication, freshwater (EP-fw) | **EP-T**=Eutrophication, terrestrial (EP-T) | **ODP**=Ozone depletion (ODP) | **POCP**=Photochemical ozone formation - human health (POCP) | **ADP-f**=Resource use, fossils (ADP-f) | **ADP-mm**=Resource use, minerals and metals (ADP-mm) | **WDP**=Water use (WDP)

4 Results

ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS EN15084+A2

Abbreviation	Unit	A1	A2	A3
ETP-fw	CTUe	0.00E+0	9.07E-1	2.22E+3
PM	disease incidence	0.00E+0	6.07E-9	8.90E-7
HTP-c	CTUh	0.00E+0	2.94E-11	1.86E-8
HTP-nc	CTUh	0.00E+0	9.93E-10	1.20E-6
IR	kBq U235 eqv.	0.00E+0	4.26E-3	1.13E+0
SQP	Pt	0.00E+0	8.83E-1	1.82E+2

ETP-fw=Ecotoxicity, freshwater (ETP-fw) | **PM**=Particulate Matter (PM) | **HTP-c**=Human toxicity, cancer (HTP-c) | **HTP-nc**=Human toxicity, non-cancer (HTP-nc) | **IR**=Ionising radiation, human health (IR) | **SQP**=Land use (SQP)

CLASSIFICATION OF DISCLAIMERS TO THE DECLARATION OF CORE AND ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS

ILCD classification	Indicator	Disclaimer
ILCD type / level 1	Global warming potential (GWP)	None
	Depletion potential of the stratospheric ozone layer (ODP)	None
	Potential incidence of disease due to PM emissions (PM)	None
ILCD type / level 2	AAcidification potential, Accumulated Exceedance (AP)	None
	Eutrophication potential, Fraction of nutrients reaching freshwater end compartment (EP-freshwater)	None
	Eutrophication potential, Fraction of nutrients reaching marine end compartment (EP-marine)	None
	Eutrophication potential, Accumulated Exceedance (EP-terrestrial)	None
	Formation potential of tropospheric ozone (POCP)	None
	Potential Human exposure efficiency relative to U235 (IRP)	1
ILCD type / level 3	Abiotic depletion potential for non-fossil resources (ADP-minerals&metals)	2
	Abiotic depletion potential for fossil resources (ADP-fossil)	2
	Water (user) deprivation potential, deprivation-weighted water consumption (WDP)	2
	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	2
	Potential Comparative Toxic Unit for humans (HTP-c)	2

4 Results

ILCD classification	Indicator	Disclaimer
	Potential Comparative Toxic Unit for humans (HTP-nc)	2
	Potential Soil quality index (SQP)	2

Disclaimer 1 – This 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.

Disclaimer 2 – The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

4.2 INDICATORS DESCRIBING RESOURCE USE AND ENVIRONMENTAL INFORMATION BASED ON LIFE CYCLE INVENTORY (LCI)

PARAMETERS DESCRIBING RESOURCE USE

Abbreviation	Unit	A1	A2	A3
PERE	MJ	0.00E+0	1.27E-2	1.36E+1
PERM	MJ	0.00E+0	0.00E+0	0.00E+0
PERT	MJ	0.00E+0	1.27E-2	1.36E+1
PENRE	MJ	0.00E+0	1.08E+0	1.39E+3
PENRM	MJ	0.00E+0	0.00E+0	0.00E+0
PENRT	MJ	0.00E+0	1.08E+0	1.39E+3
SM	Kg	0.00E+0	0.00E+0	0.00E+0
RSF	MJ	0.00E+0	0.00E+0	0.00E+0
NRSF	MJ	0.00E+0	0.00E+0	0.00E+0
FW	M3	0.00E+0	1.24E-4	2.35E-1

PERE=renewable primary energy ex. raw materials | **PERM**=renewable primary energy used as raw materials | **PERT**=renewable primary energy total | **PENRE**=non-renewable primary energy ex. raw materials | **PENRM**=non-renewable primary energy used as raw materials | **PENRT**=non-renewable primary energy total | **SM**=use of secondary material | **RSF**=use of renewable secondary fuels | **NRSF**=use of non-renewable secondary fuels | **FW**=use of net fresh water

4 Results

OTHER ENVIRONMENTAL INFORMATION DESCRIBING WASTE CATEGORIES

Abbreviation	Unit	A1	A2	A3
HWD	Kg	0.00E+0	2.58E-6	2.14E-4
NHWD	Kg	0.00E+0	6.46E-2	3.44E+0
RWD	Kg	0.00E+0	6.68E-6	6.87E-4

HWD=hazardous waste disposed | **NHWD**=non hazardous waste disposed | **RWD**=radioactive waste disposed

ENVIRONMENTAL INFORMATION DESCRIBING OUTPUT FLOWS

Abbreviation	Unit	A1	A2	A3
CRU	Kg	0.00E+0	0.00E+0	0.00E+0
MFR	Kg	0.00E+0	0.00E+0	0.00E+0
MER	Kg	0.00E+0	0.00E+0	0.00E+0
EET	MJ	0.00E+0	0.00E+0	0.00E+0
EEE	MJ	0.00E+0	0.00E+0	0.00E+0

CRU=Components for re-use | **MFR**=Materials for recycling | **MER**=Materials for energy recovery | **EET**=Exported Energy Thermic | **EEE**=Exported Energy Electric

4 Results

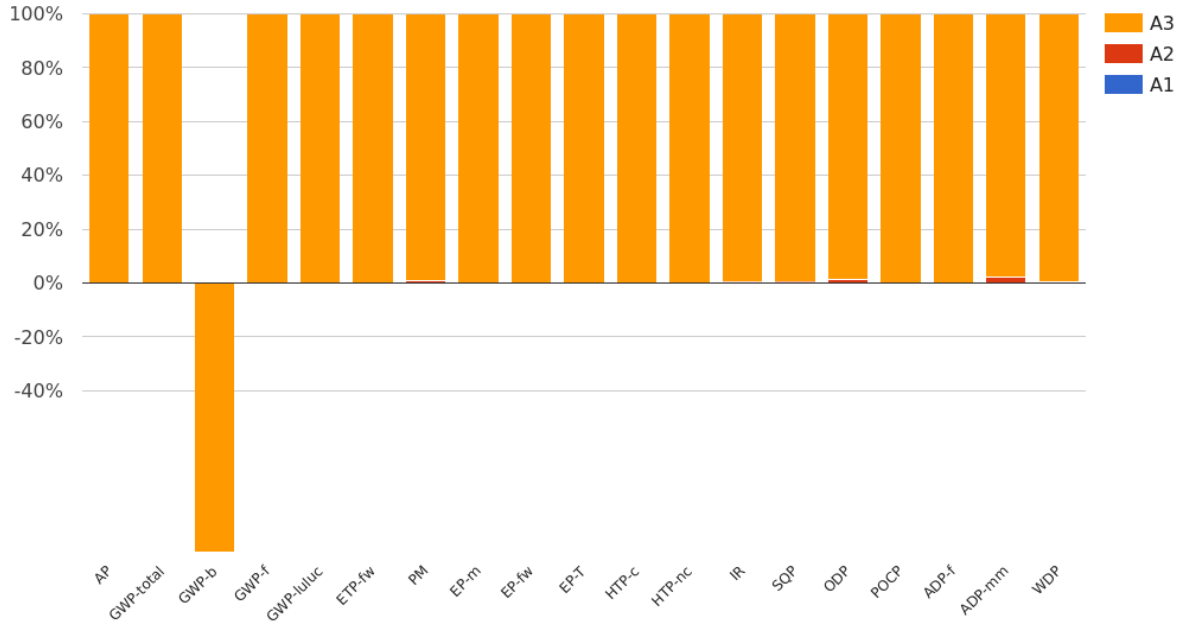
4.3 INFORMATION ON BIOGENIC CARBON CONTENT PER TON

BIOGENIC CARBON CONTENT

The following Information describes the biogenic carbon content in (the main parts of) the product at the factory gate per ton:

Biogenic carbon content	Amount	Unit
Biogenic carbon content in the product	0	kg C
Biogenic carbon content in accompanying packaging	0	kg C

5 Interpretation of results



As shown in the graph above, the module A3 (Manufacturing) has the largest impact on all impact categories. As bottom ash is identified as a burden-free raw material, there is no contribution to the environmental impacts during the A1 phase.

The electricity consumption in A3 contributes to 99.9% of the total global warming potential while the transportation from the silo to the gate in A2 has a limited contribution to the total global warming potential (0.1%).

6 References

ISO 14040
ISO 14040:2006-10, Environmental management - Life cycle assessment - Principles and framework; EN ISO 14040:2006

ISO 14044
ISO 14044:2006-10, Environmental management - Life cycle assessment - Requirements and guidelines; EN ISO 14040:2006

ISO 14025
ISO 14025:2011-10: Environmental labels and declarations — Type III environmental declarations — Principles and procedures

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

General PCR Ecobility Experts
Kiwa-Ecobility Experts (Kiwa-EE) – General Product Category Rules (2022-02-14)

EN 16908+A1
EN 16908:2017+A1:2022: Cement and building lime - Environmental product declarations - Product category rules complementary to EN 15804

DIN EN 13055
DIN EN 13055:2016-11: Lightweight aggregates

BBSR
BBSR, NBB 2011, Nutzungsdauern_von_Bauteilen Table 2011 / No. 363.513, 2011-11-03

7 Contact information

Publisher	Operator	Owner of declaration

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