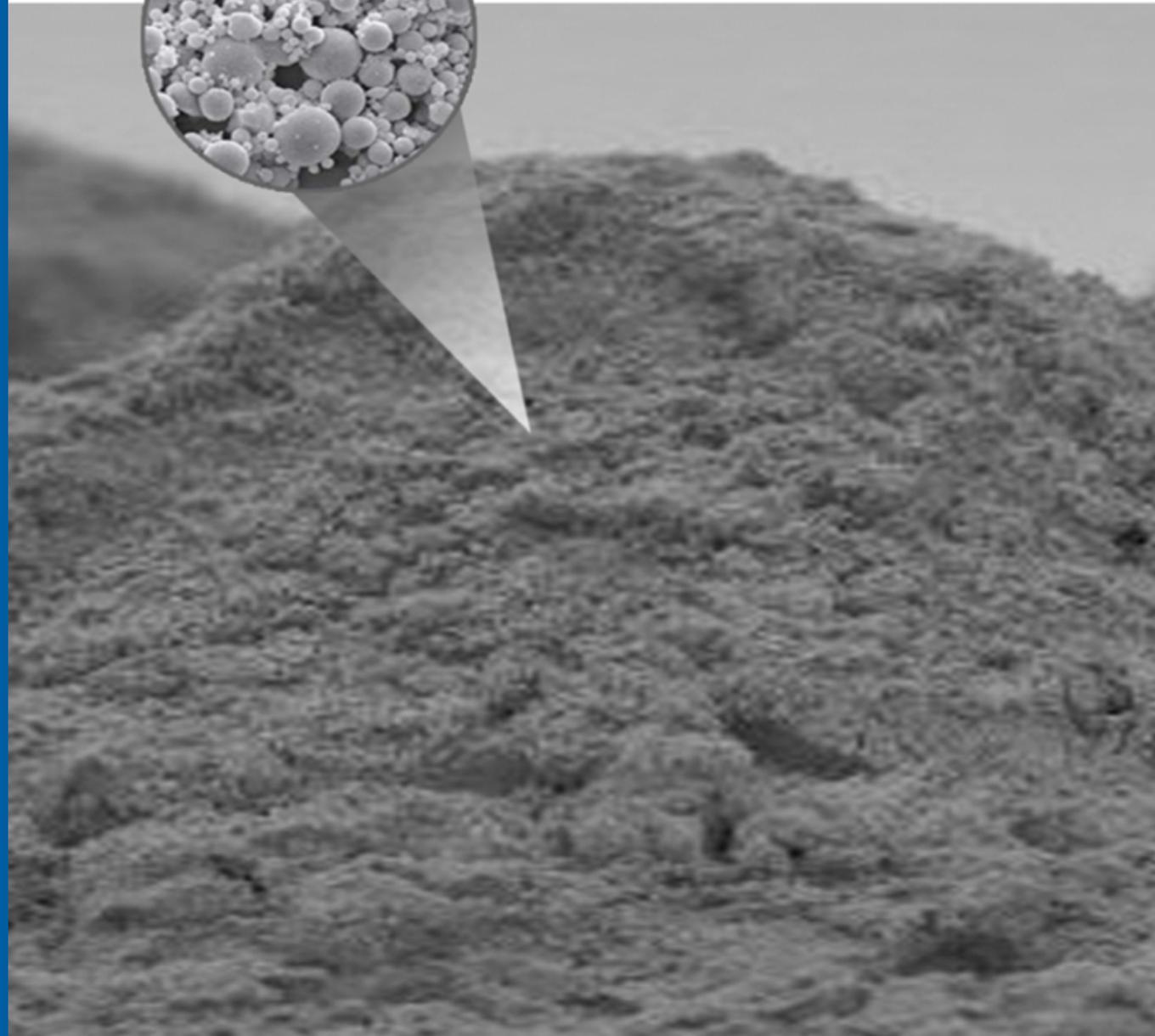
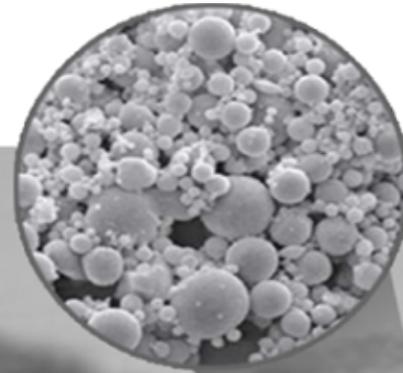


Environmental Product Declaration (EPD)  
According to ISO 14025 and EN 15804



# EFA-Füller®



Registration number:	EPD-Kiwa-EE-154810-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

EFA-Füller®

## 1.2 REGISTRATION NUMBER

EPD-Kiwa-EE-154810-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)*

## 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 'EFA-Füller®' with the calculation identifier ReTHiNK-54810.

## 2 Product

### 2.1 PRODUCT DESCRIPTION

EFA-Füller is a hard coal fly ash according to EN 450-1, which is directly delivered from the power plant to the customer without processing. Hard coal fly ash is a fine-grained pozzolanic binder consisting essentially of  $\text{SiO}_2$  and  $\text{Al}_2\text{O}_3$ . The content of reactive  $\text{SiO}_2$  is at least 25% by mass. Hard coal fly ash is produced as a combustion residue during coal-fired power generation. It is separated from the flue gases by electric filters. The composition of the coal fly ash results from the types of coal used and ranges from residual carbon and minerals to trace elements. The manufacturing of BauMineral GmbH's EFA-Füller® takes place at several sites, each exhibiting slight compositional differences:

- EFA-Füller® D 4 at the Datteln power plant, Block 4
- EFA-Füller® MR 3 at the Maasvlakte power plant, Block 3 near Rotterdam
- EFA-Füller® HP at the Heyden power plant in Petershagen
- EFA-Füller® HM at the Mehrum power plant in Hohenhameln
- EFA-Füller® SG 5 at the Staudinger power plant, Block 5 in Großkrotzenburg

Among these power plants, EFA-Füller® D 4 is chosen as the representative for EFA-Füller® due to its involvement in numerous processes related to fly ash before loading at the gate. This selection is considered conservative, representing a worst-case scenario.

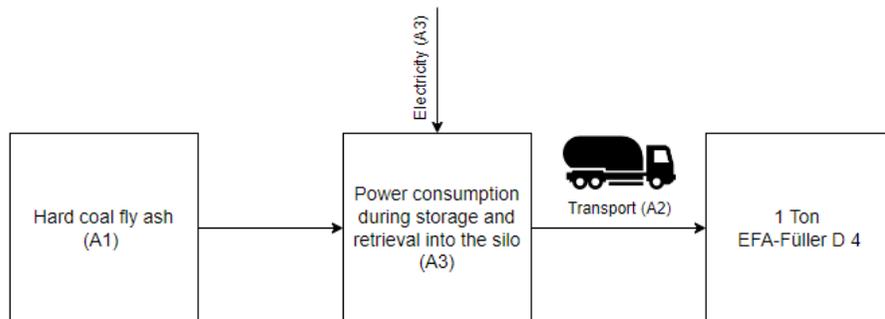


Figure 1: Simplified process flow chart of the production of EFA-Füller® D 4

### 2.2 APPLICATION (INTENDED USE OF THE PRODUCT)

Due to its chemical and physical properties, such as pozzolanic reactivity, spherical grain shape and grain distribution, coal fly ash is a high-quality secondary raw material in construction. It is utilized in the construction industry as both a cement component and a concrete additive.

Furthermore, coal fly ash can be employed in the production of cementitious bricks or aerated concrete, as well as a filler for paints, varnishes, plastics, tires, etc.

DIN 1045-2, together with DIN EN 206-1, regulates the application of hard coal fly ash as a concrete additive. This includes:

- the creditability to the cement content – usually with  $k=0.4$
- the minimum cement content
- the maximum permissible equivalent water cement value  $W/C_{eq}$
- the production of concrete with high sulphate resistance
- the combination with silica dust
- the limit values for the flour grain content
- use in underwater concrete, bored piles, and diaphragm walls

For underwater concrete, bored piles (according to DIN EN 1536) and diaphragm walls (according to DIN EN 1538), the hard coal fly ash considered here can be assigned with a k-value of 0.7.

The composition of the concrete must always be determined by an initial test according to DIN EN 206-1 in conjunction with DIN 1045-2.

The advantages of using coal fly ash as a concrete additive include:

- Cement saving
- Reduction of water demand
- Improvement of workability and pumpability of fresh concrete
- Increased compaction readiness of fresh concrete
- Reduction of heat of hydration
- Reduction of efflorescence
- Increased durability of concrete and reinforcement in the event of chemical attacks
- Higher post-curing

The use of building materials from coal-fired power plants conserves natural resources and alleviates environmental impacts by substituting comparable raw materials that would otherwise need extraction, processing or energy-intensive production.

## 2 Product

### 2.3 REFERENCE SERVICE LIFE

#### RSL PRODUCT

Since the scope of the study does not consider the entire life cycle of hard coal fly ash, the indication of the reference service life (RSL) is voluntary. Fly ash is used as a binder additive for concrete elements. According to BBSR Table 2011 / No. 363.512, the reference service life (RSL) of concrete components is  $\geq 50$  years.

#### USED RSL (YR) IN THIS LCA CALCULATION:

50

### 2.4 TECHNICAL DATA

Average chemical and physical properties of fly ash EFA-Füller® (mean values from 2022/2023):

Loss on ignition: 0.5 – 7.0 wt.-%

SiO<sub>2</sub>: 48 – 60 wt.-%

Al<sub>2</sub>O<sub>3</sub>: 20 - 30 wt.-%

Fe<sub>2</sub>O<sub>3</sub>: 3 - 12 wt.-%

CaO: 2 - 10 M.-%

MgO: 0.5 - 4 M.-%

K<sub>2</sub>O: ca. 2 M.-%

Na<sub>2</sub>O: ca. 1 M.-%

Na<sub>2</sub>O-equivalent: 0.5 – 5 wt.-%

Fineness - Grain content > 45 µm: 5 - 40 M.-%

Bulk density, uncompacted: ca. 0.7 – 1.1 kg/dm<sup>3</sup>

Grain density: 2.0 - 2.5 kg/dm<sup>3</sup>

### 2.5 SUBSTANCES OF VERY HIGH CONCERN

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

### 2.6 DESCRIPTION PRODUCTION PROCESS

During combustion in large power plants, hard coal fly ash inevitably persists as a solid, dispersed residue. The aim of the power plant is the generation of electricity and heat. The flue gas purification usually follows three steps.

Initially, the reduction of nitrogen oxide compounds is conducted with a denox catalyst. During the second step the hard coal fly ash is captured by electrostatic precipitators. In the last step of the flue gas purification a desulphurisation is conducted in a SO<sub>2</sub>-washer. During this process step the so-called FGD-gypsum occurs.

While streaming through the electrostatic air filter, hard coal fly ash particles get electrically charged and accumulate on collecting electrode. The resulting “dust layer” is removed at regular intervals by punches of a hammer mill and the fly ash particles are transported through a closed piping system in silos for storage.

Inside the silo the conformity with EN 450-1 is controlled. The hard coal fly ash is loaded from the silo to the transport. Generally, silo trucks transport 25 to 27 t of hard coal fly ash to the customer.

## 2 Product

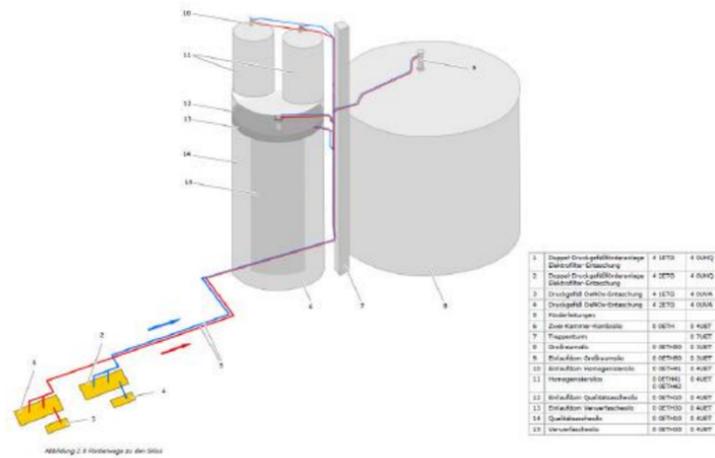


Figure 2. Pipeline connections between electrostatic precipitator and silos in power plant Datteln 4

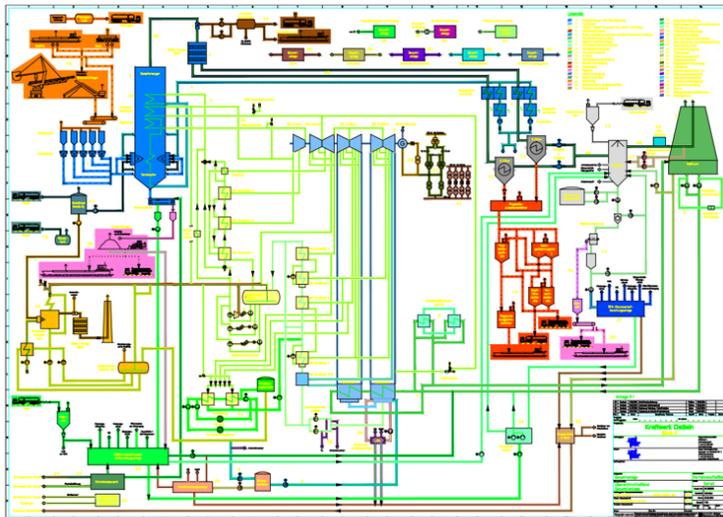


Figure 3. Overview of the power plant Datteln 4

### 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													

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 EFA-Füller®, 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, hard coal fly 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 coal ash. No coal ash would be produced without the energy production by coal. Therefore, the environmental impacts of coal-fired power generation are not attributed to coal fly 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

There is no energy needed for the storage in a silo (no heating, no cooling, no aeration). Energy is only needed for the opening and closing of the silo. The distance between silo and factory gate is 500 m.

The average energy consumption data from 2022 at the Datteln 4 power plant is utilized for EFA-Füller®, as the manufacturing of EFA-Füller® at the Datteln 4 power plant is the most energy-intensive, representing the worst-case scenario. An electricity dataset from hard coal is employed to depict the electricity supply at the power plant. No CO2 certificates were considered.

## 3 Calculation rules

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	7.49E-2
GWP-total	kg CO2 eqv.	0.00E+0	6.75E-2	2.77E+1
GWP-b	kg CO2 eqv.	0.00E+0	3.12E-5	-1.14E-1
GWP-f	kg CO2 eqv.	0.00E+0	6.75E-2	2.78E+1
GWP-luluc	kg CO2 eqv.	0.00E+0	2.47E-5	2.85E-3
EP-m	kg N eqv.	0.00E+0	1.38E-4	1.79E-2
EP-fw	kg P eqv.	0.00E+0	6.81E-7	1.38E-2
EP-T	mol N eqv.	0.00E+0	1.52E-3	1.77E-1
ODP	kg CFC 11 eqv.	0.00E+0	1.49E-8	2.90E-7
POCP	kg NMVOC eqv.	0.00E+0	4.34E-4	4.44E-2
ADP-f	MJ	0.00E+0	1.02E+0	2.91E+2
ADP-mm	kg Sb-eqv.	0.00E+0	1.71E-6	1.67E-5
WDP	m3 world eqv.	0.00E+0	3.64E-3	3.42E-1

**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	4.87E+2
PM	disease incidence	0.00E+0	6.07E-9	1.95E-7
HTP-c	CTUh	0.00E+0	2.94E-11	4.08E-9
HTP-nc	CTUh	0.00E+0	9.93E-10	2.63E-7
IR	kBq U235 eqv.	0.00E+0	4.26E-3	2.48E-1
SQP	Pt	0.00E+0	8.83E-1	3.98E+1

**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
	AAcidification potential, Accumulated Exceedance (AP)	None
	Eutrophication potential, Fraction of nutrients reaching freshwater end compartment (EP-freshwater)	None
ILCD type / level 2	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	2.98E+0
PERM	MJ	0.00E+0	0.00E+0	0.00E+0
PERT	MJ	0.00E+0	1.27E-2	2.98E+0
PENRE	MJ	0.00E+0	1.08E+0	3.06E+2
PENRM	MJ	0.00E+0	0.00E+0	0.00E+0
PENRT	MJ	0.00E+0	1.08E+0	3.06E+2
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	5.16E-2

**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	4.68E-5
NHWD	Kg	0.00E+0	6.46E-2	7.54E-1
RWD	Kg	0.00E+0	6.68E-6	1.51E-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

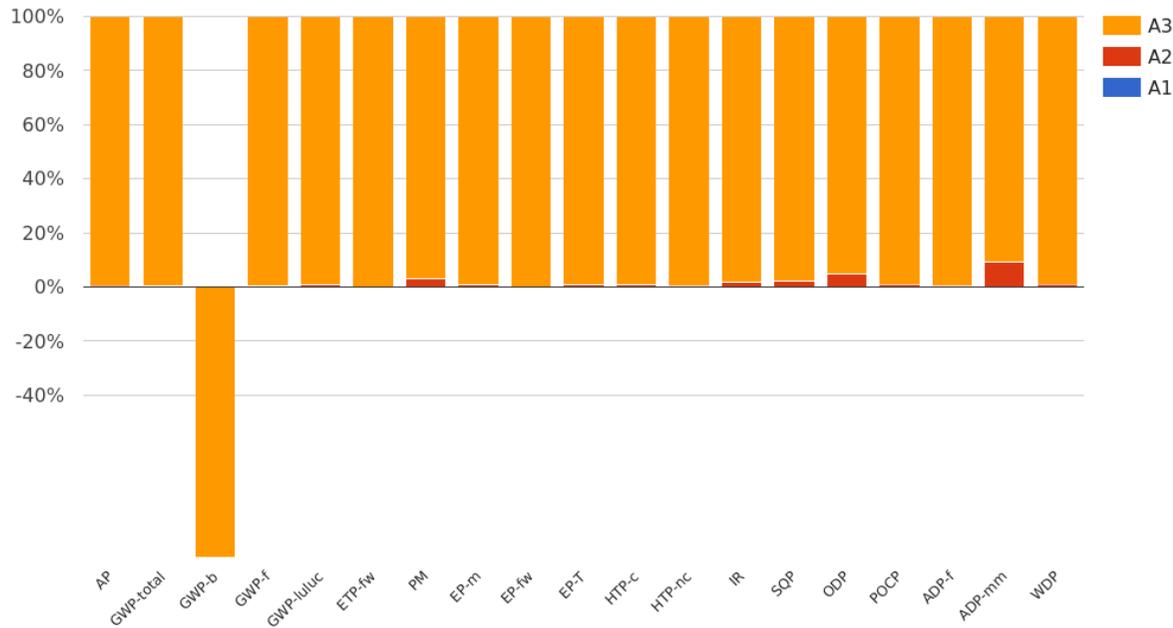
### 4.3 INFORMATION ON BIOGENIC CARBON CONTENT PER TON

#### 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, accounting for over 95% of the total impacts.

As fly ash is identified as a burden-free raw material, there is no contribution to the environmental impacts from the A1 module.

The electricity consumption in A3 contributes to 99.8% 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 (0.2%).

## 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 206**

DIN EN 206:2017-01: Concrete - Definition, properties, manufacture and conformity

### **DIN EN 197-1**

DIN EN 197-1: Cement – Part 1: Composition, specifications and conformity criteria for common cements

### **DIN EN 450-1**

DIN EN 450-1:2012-10: Fly ash for concrete – Part 1: Definition, requirements and conformity criteria

### **DIN 1045-2**

DIN 1045-2:2008-08: Structures of concrete, reinforced concrete and prestressed concrete -Part 2: Concrete - Definition, properties, manufacture and conformity - Application rules for DIN EN 206-1

### **DIN EN 1536**

DIN EN 1536:2015-10: Execution of work in special foundation engineering - Bored piles

### **DIN EN 1538**

DIN EN 1538:2015-10: Execution of work in special foundation engineering - diaphragm walls

## 7 Contact information

Publisher	Operator	Owner of declaration
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<p><b>E-mail:</b>                      DE.Ecobility.Experts@kiwa.com</p> <p><b>Website:</b>  <a href="https://www.kiwa.com/de/en/themes/ecobility-experts/ecobility-experts-epd-program/">https://www.kiwa.com/de/en/themes/ecobility-experts/ecobility-experts-epd-program/</a></p>	<p><b>E-mail:</b>                      DE.Ecobility.Experts@kiwa.com</p> <p><b>Website:</b>  <a href="https://www.kiwa.com/de/en/themes/ecobility-experts/ecobility-experts-epd-program/">https://www.kiwa.com/de/en/themes/ecobility-experts/ecobility-experts-epd-program/</a></p>	<p><b>E-mail:</b>                      baumineral@baumineral.de</p> <p><b>Website:</b>  <a href="http://www.baumineral.de">www.baumineral.de</a></p>

Kiwa-Ecobility Experts is established member of the 