Environmental Product Declaration

In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC:2021 for:

Concrete Mixture for LVT block production

from

Vigier Rail AG

Programme:	The International EPD® System, www.environdec.com
Programme operator:	EPD International AB
EPD registration number:	S-P-12329
Publication date:	2024-01-23
Valid until:	2029-01-22

An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com

General information

Programme information

Programme:	The International EPD® System
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Accountabilities for PCR, LCA and independent, third-party verification
Product Category Rules (PCR)
CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
Product Category Rules (PCR): PCR 2019:14 Construction Products, Version 1.3.1 c-PCR-003 2019:14 Concrete and concrete elements, Version 2023-01-02
PCR review was conducted by: The Technical Committee of the International EPD® System. See www.environdec.com for a list of members. Review chair: Claudia A. Peña, University of Concepción, Chile. The review panel may be contacted via the Secretariat www.environdec.com/contact.
Life Cycle Assessment (LCA)
LCA accountability: Neosys AG, Privatstrasse 10, 4563 Gerlafingen
Third-party verification
Independent third-party verification of the declaration and data, according to ISO 14025:2006, via: ☒ EPD verification by individual verifier Niels Jungbluth ESU-services; Vorstadt 10; CH-8200 Schaffhausen www.esu-services.ch jungbluth@esu-services.ch +41 44 940 61 32 Approved by: The International EPD® System
Procedure for follow-up of data during EPD validity involves third party verifier: ☐ Yes ☒ No

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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.

Company information

Owner of the EPD: Vigier Rail AG

Contact: Frank Sporbeck, frank.sporbeck@vigier.ch, www.vigier-rail.ch

Description of the organisation: Vigier Rail is the leading Swiss concrete product manufacturer for the railway industry. As a company with a long-standing tradition, Vigier Rail has over 70 years of experience and international expertise. At the facility in Müntschemier, Vigier Rail annually produces between 200,000 and 300,000 sleepers using state-of-the-art technology and various methods.

Product-related or management system-related certifications: Vigier Rail is ISO 9001 and ISO 14001 certified. In addition, we undergo an annual EcoVadis CSR assessment. In 2023, we were awarded Gold by EcoVadis.

Name and location of production site(s): Vigier Rail AG, Industriezone 3, 3225 Müntschemier, Switzerland. Main Inputs for concrete production were obtained from a cement plant with adjacent limestone quarry in Péry-La Heutte operated by Ciments Vigier SA, and a gravel and sand quarry in Finsterhennen, operated by Vigier Beton. Modelling of upstream processes utilizes primary data from these plants.

Product information

Product name: Concrete Mixture for LVT-block production

Product identification: Concrete Mixture 563062 BM Single Block NESA CEM II

Product description: Concrete Mixture for LVT-concrete blocks used for rail supports (density of concrete mixture 2405 kg /m^3). The Low Vibration Track (LVT) system is a highly specialized railway track system designed to minimize vibrations and provide efficient support for railway infrastructure. The concrete mixture is not sold to third parties, but used exclusively in house by Vigier Rail for the manufacturing of Low Vibration Track (LVT) concrete rail supports.

UN CPC code: UN CPC 375

Geographical scope: The product stage (module A1-A3) was modelled to represent Switzerland. Since the concrete mixture modelled in this EPD is used to manufacture concrete sleepers sold worldwide (on average 70% sales to Swiss projects; 30% sales to international projects), the End-of-Life stage and the Resource Recovery Stage were modelled in the global context, taking the mentioned sales statistics into consideration.

LCA information

Declared unit: 1 kg concrete mixture

Description of the manufacturing processes

The concrete mixture is produced by mixing cement of type CEM II/A-LL 52.5 N, obtained from the cement plant in Pèry-La Heutte operated by Ciments Vigier SA, sand and gravel from a quarry in Finsterhennen operated by Vigier Beton, and calcite from a quarry in southern Germany, in a concrete-mixer, further adding groundwater, a superplasticiser and a viscosity regulator. Cleaning the concrete mixing plant with process water produces alkaline residual concrete water, which is neutralised by adding CO_2. The waste material that remains in the form of concrete sludge is disposed of in an inert material landfill.

Time representativeness

Primary data used to model manufacturing (A3) represents average data of production years 2020 – 2022. Upstream processes of cement production, clinker production, limestone quarry operation, and sand and gravel quarry operation, were modelled with primary data obtained for production year 2021 from Vigier Ciment and Vigier Beton, respectively, partially supplemented with generic data. EECS-certificates for the use of hydro power electricity are provided for 2022 until the end of 2024. Certificates for the rest of the validity period of this EPD will be purchased when available.

Database(s) and LCA software used

The LCA is based on the Ecoinvent database version 3.9.1, and the system model 'Allocation, cut-off, EN 15804' implemented by Ecoinvent, using characterization factors from the EN 15804 reference package EF 3.1. LCA calculations were conducted in Excel. Characterization factors implemented by Ecoinvent were adjusted for full alignment with PCR 2019.14, Version 1.3.1 (characterization factor methane, biogenic = 29.8) and c-PCR-003 2019:14 Concrete and concrete elements, Version 2023-01-02 (addition of characterization factors for sand, gravel, clay and bentonite, assimilated to silicon, for environmental impact indicator Abiotic depletion of non-fossil resources (ADPE)).

Description of system boundaries:

The Environmental Product Declaration is of type Cradle to gate with modules C1–C4 and module D (A1–A3+C+D). Within the product stage (modules A1-A3), all processes related to the extraction of raw materials, the production of constituent products and of ancillary materials, the transportation of inputs to the concrete manufacturing site, the manufacturing of the concrete mixture (i.e. concrete mixing), and the treatment of all wastes, including waste transportation, were included. Infrastructure related to concrete manufacturing, as well as to the upstream processes of cement and clinker production (including limestone quarry operation) and gravel and sand quarry operation, were excluded from the system boundaries, in line with PCR 2019:14. By contrast, infrastructure processes were not removed from upstream Ecoinvent processes, on the grounds of unreasonable effort, as permitted by PCR 2019:14.

Packaging material of inputs to concrete production, and to upstream processes of cement and clinker production was excluded. Since the quantitatively most significant inputs to these manufacturing processes are delivered without packaging, this methodological choice is in line with the cut-off rules as per EN 15804 and PCR 2019:14 (neglected input flows for modules A1-A3 may correspond to 5% mass and energy usage at the maximum).

Within the end-of-life stage (modules C1- C4), the demolition of concrete (C1), the transport of concrete debris to recycling facilities and inert material landfill, the crushing of concrete (C3), and the disposal of concrete waste in inert material landfills were considered. The resource recovery stage was modelled considering sizing of crushed concrete into grain size fractions, as well as substitution of primary material in concrete production by recycled concrete granulate.

Allocation:

In line with the 'polluter pays' principle' adopted by EN 15804 and the specifications provided in PCR 2019:14, alternative fossil fuels and alternative raw materials used in clinker production that have hazardous waste status according to Swiss legislation, were considered not to have reached the end-of-waste state when entering the clinker kiln. The environmental burdens associated with the combustion of these alternative fuels are thus fully attributed to the systems generating these fuels. Allocation of alternative biogenic fuels used in clinker production was based on co-product allocation in the case of animal meal, wood and sawdust (conservatively assumed to originate 100% from modules A1-A3 of preceding product systems), and waste allocation in the case of dried sewage sludge. Likewise, allocation of alternative raw materials used in clinker production followed co-product allocation

in the case of pyrite ash and bauxite substitutes (assumed to originate 100% from modules A1-A3 of preceding product systems), and waste allocation in the case of paper ash. Co-product allocation followed economic allocation. With the exception of wood and sawdust co-production, allocated based on an Ecoinvent dataset for residual wood by-products, economic allocation of co-products used as inputs in clinker production was based on the assumption that revenue generated from co-products amounts to less than 1% of revenue from the overall product portfolio of the relevant manufacturing processes. In line with economic allocation examples provided in EN 16908 of co-products for which the same holds true, environmental burdens associated with the transport of these co-product inputs to the cement production plant were allocated to clinker production. An equivalent, conservative approach was followed in waste allocation of paper ash and sewage sludge, by assuming that both materials reach the end-of-waste state at the gate of the entities producing the waste.

Owing to the fact that the alternative fossil fuels used in clinker production have hazardous waste status according to Swiss legislation, CO_2 emissions from the combustion of these alternative fuels were not included in the calculation of the impact parameter GWP-total provided in the results table in section 'Mandatory impact category indicators according to EN 15804'. To facilitate the comparison with GWP results declared in other EPDs, regardless of the waste status of alternative fossil fuels in different countries, the contribution of CO_2 emissions from the combustion of alternative fossil fuels in clinker production is however likewise declared: In line with section 6.3.5.1 of EN 16908, a second, gross value of GWP-total, in which the CO_2 emissions from the combustion of alternative fossil fuels in clinker production, are included, is provided (see note in section 'Mandatory impact category indicators according to EN 15804').

Energy sources of the electricity used in manufacturing processes:

The electricity used by the manufacturing plant, as well as by manufacturing plants upstream from which primary data was obtained, is 100% renewable electricity from hydropower, imported from Europe. The climate impact of this electricity source was modelled as 0.0108 kg CO_2 eq / kWh (GWP-GHG). This conservatively includes electricity losses during voltage transformation and transmission, modelled with residual Swiss electricity mix, and contributions from electricity transmission and transformation infrastructure.

Scenario adopted for modelling the End-of-Life and resource Recovers Stage

The End-of-Life stage and the Resource Recovery Stage were modelled assuming 70% product deployment in Switzerland, and 30% international deployment (based on Vigier Rail sales statistics of LVT-sleepers), and based on the following assumptions:

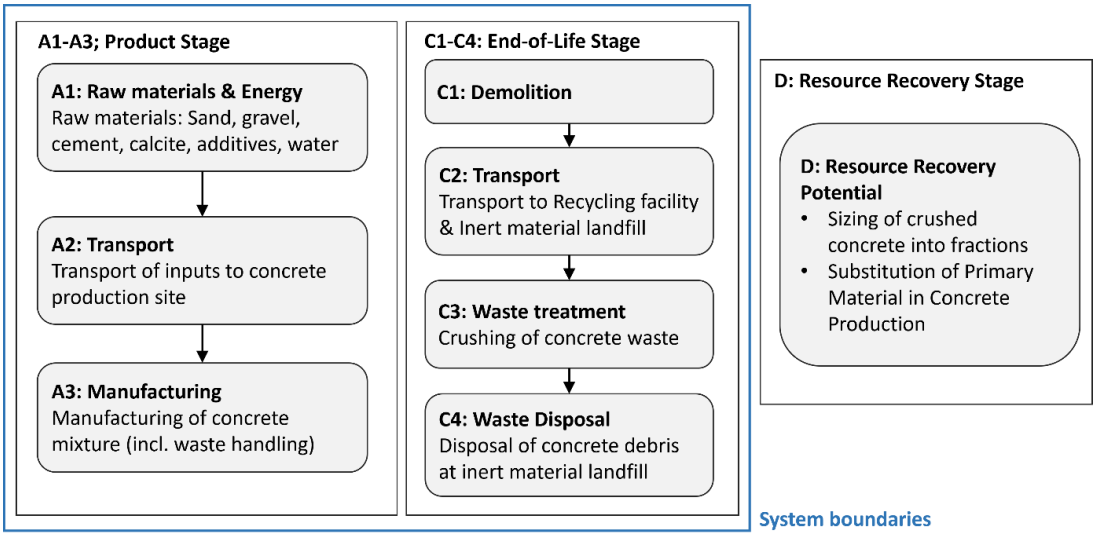
- Demolition of concrete sleepers takes place with two hydraulic excavators (one with concrete tongs, one with backhoe bucket), which consume a total of 15.28 MJ diesel per m^3 of concrete removed.
- 100% of demolished concrete is treated (no loss of material on the construction site)
- On average, demolished concrete material is transported for a total of 50 km by diesel-fueled lorry (16-32 t, EURO 6), both in Switzerland and abroad. This includes all transport between the demolition site, the recycling plant and the inert material landfill.
- The fraction of demolished concrete processed into recycled concrete granulate is 98% in Switzerland and 59% in the global context without Switzerland[1]. Material loss during the recycling process amounts to 5% of material processed, both in Switzerland and abroad. The

[1] The concrete recycling rate in the global context is based on assumed recycling rates in the Ecoinvent dataset 'Market for waste concrete gravel - RoW' (Ecoinvent, Version 3.9.1). The concrete recycling rate in Switzerland corresponds to assumptions for End-of-Life stage modelling in EPDs of concrete products published by the Swiss Association of the Swiss gravel and concrete industry (FSKB).

net percentage of demolished concrete turned into recycled concrete granulate is thus 93% in Switzerland and 56% abroad. Recycled concrete granulate substitutes natural raw material in concrete manufacturing.

- The residual fraction of demolished concrete (7% in Switzerland; 44% elsewhere) is disposed of in inert material landfills.
- Processing of demolished concrete debris occurs via diesel-powered excavator crushers (pre-crushing), impact crushers (shredding) and screening equipment (sizing), with average diesel consumption of 0.28 L/t (pre-crushing), 0.72 L/t (shredding) and 0.17 L/t (screening), respectively, assumed to represent current recycling practice both in Switzerland and abroad.
- Utilization of recycled concrete granulate in concrete manufacturing is assumed to occur soon after demolition and sizing; carbonation of concrete debris during the end-of-life stage is therefore not taken into consideration.

System diagram:



Modules declared, geographical scope, share of specific data (in GWP-GHG results) and data variation (in GWP-GHG results):

	Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
Module	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Modules declared	x	x	x	ND	ND	ND	ND	ND	ND	ND	ND	ND	x	x	x	x	x
Geography	CH												Global				Global
Specific data used	>90%					-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	Not relevent					-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	Not relevant					-	-	-	-	-	-	-	-	-	-	-	-

Content information

Product components	**Weight, kg**	**Post-consumer material, weight-%**	**Biogenic material, weight-% and kg C/kg**
Sand	3.29E-01	0%	0 resp. 0
Gravel	3.88E-01	0%	0 resp. 0
Cement (CEM II/A-LL 52.5 N, Vigier Ciment)	1.54E-01	0%	0 resp. 0
Calcite	6.02E-02	0%	0 resp. 0
Superplasticizer	2.03E-03	0%	0 resp. 0
Viscosity regulator	4.60E-04	0%	0 resp. 0
Water	6.76E-02	0%	0 resp. 0
TOTAL	1.00	0%	0 resp. 0
Packaging materials	**Weight, kg**	**Weight-% (versus the product)**	**Weight biogenic carbon, kg C/kg**
Not relevant			

Dangerous substances from the candidate list of SVHC for Authorisation	**EC No.**	**CAS No.**	**Weight-% per functional or declared unit**
none			

Results of the environmental performance indicators

Mandatory impact category indicators according to EN 15804

		Results per declared unit					
Indicator	**Units**	**A1- A3**	**C1**	**C2**	**C3**	**C4**	**D**
Core environmental impact indicators *							
Global warming potential - fossil fuels (GWP-fossil)	kg CO2-Eq	8.19E-02	6.30E-04	9.24E-03	3.06E-03	5.31E-03	-1.09E-03
Global warming potential - biogenic (GWP-biogenic)	kg CO2-Eq	1.02E-04	8.69E-08	2.96E-06	4.21E-07	5.01E-07	-1.04E-05
Global warming potential - land use and land use change (GWP-luluc)	kg CO2-Eq	3.66E-05	7.08E-08	4.56E-06	3.43E-07	3.65E-06	-4.84E-07
Global warming potential - total (GWP-total)	kg CO2-Eq	8.20E-02	6.31E-04	9.25E-03	3.06E-03	5.32E-03	-1.10E-03
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC-11-Eq	2.26E-10	1.00E-11	2.01E-10	4.86E-11	3.27E-11	-2.04E-11
Acidification potential, accumulated exceedance (AP)	mol H+-Eq	1.54E-04	5.84E-06	2.02E-05	2.83E-05	8.12E-06	-7.76E-06
Eutrophication potential - freshwater (EP-freshwater)	kg P-Eq	1.93E-06	1.93E-08	6.56E-07	9.36E-08	7.94E-08	-1.19E-07
Eutrophication potential - marine (EP-marine)	kg N-Eq	5.91E-05	2.71E-06	5.09E-06	1.31E-05	3.42E-06	-3.24E-06
Eutrophication potential - terrestrial (EP-terrestrial)	mol N-Eq	7.22E-04	2.94E-05	5.17E-05	1.43E-04	3.45E-05	-3.52E-05
Photochemical ozone creation potential (POCP)	kg NMVOC-Eq	2.22E-04	8.72E-06	3.13E-05	4.23E-05	1.21E-05	-1.10E-05
Abiotic depletion potential - non-fossil resources (ADPE)**	kg Sb-Eq	3.23E-07	2.21E-10	3.09E-08	1.07E-09	1.53E-09	-3.27E-09
Abiotic depletion potential - fossil resources (ADPF)**	MJ, net calorific value	2.45E-01	8.31E-03	1.32E-01	4.03E-02	2.71E-02	-2.36E-02
Water (user) deprivation potential (WDP)**	m3 world eq. deprived	1.64E-02	2.05E-05	6.56E-04	9.96E-05	8.66E-05	-1.24E-02

Disclaimers:
** The estimated impact results are only relative statements, which do not indicate the endpoints of the impact categories, exceeding threshold values, safety margins and/or risks.*
*** The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator. The results of this indicator may be highly uncertain in LCAs that include capital goods/infrastructure in generic datasets, in case infrastructure/capital goods contribute greatly to the total results. This is because the LCI data of infrastructure/capital goods used to quantify these indicators in currently available generic datasets sometimes lack temporal, technological and geographical representativeness. Caution should be exercised when using the results of these indicators for decision-making purposes.*

Note:
The impact parameter GWP-total reported in the table above does not include CO_2 emissions from the combustion of alternative fossil fuels considered as hazardous waste by Swiss legislation, during clinker production. The above reported value therefore corresponds to the net value of GWP-total, as defined in section 6.3.5.1 of EN 16908. To facilitate the comparison with GWP results declared in other EPDs, regardless of the waste status of alternative fossil fuels in different countries, and in line with section 6.3.5.1 of EN 16908, the gross value of GWP-total, in which CO_2 emissions from the combustion of alternative fossil fuels considered hazardous waste by Swiss legislation are included is likewise declared: The gross value of GWP-total amounts to 0.101 kg $CO_{2\,eq}$ per kg of LVT-concrete mixture.

Additional mandatory and voluntary impact category indicators

		Results per declared unit					
Indicator	**Units**	**A1- A3**	**C1**	**C2**	**C3**	**C4**	**D**
Additional mandatory environmental impact indicators *							
Global warming potential (GWP-GHG)[1]	kg CO2-Eq	8.20E-02	6.31E-04	9.25E-03	3.06E-03	5.32E-03	-1.10E-03
Additional voluntary environmental impact indicators *							
Particulate matter emissions (PM)	disease incidence	1.68E-09	1.63E-10	6.88E-10	7.90E-10	1.79E-10	-2.40E-10
Ionizing radiation, human health (IRP)***	kBq U235-Eq	1.07E-03	3.91E-06	1.78E-04	1.90E-05	1.94E-05	-6.56E-04
Eco-toxicity - freshwater (ETP-fw)**	CTUe	8.74E-02	3.94E-03	6.49E-02	1.91E-02	1.49E-02	-6.86E-03
Human toxicity, cancer effect (HTP-c)**	CTUh	1.49E-11	1.93E-13	4.23E-12	9.37E-13	1.38E-12	-1.10E-12
Human toxicity, non-cancer effects (HTP-nc)**	CTUh	4.86E-10	1.35E-12	9.38E-11	6.55E-12	1.78E-11	-8.03E-12
Land use related impacts/Soil quality (SQP)**	dimensionless	2.10E-01	5.54E-04	7.93E-02	2.69E-03	5.40E-02	-5.45E-02

[1] *This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such, the indicator is identical to GWP-total except that the CF for biogenic CO_2 is set to zero.*

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*** The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator. The results of this indicator may be highly uncertain in LCAs that include capital goods/infrastructure in generic datasets, in case infrastructure/capital goods contribute greatly to the total results. This is because the LCI data of infrastructure/capital goods used to quantify these indicators in currently available generic datasets sometimes lack temporal, technological and geographical representativeness. Caution should be exercised when using the results of these indicators for decision-making purposes.*
**** This impact category mainly deals with the possible effect of low dose ionising radiation on human health in the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents and occupational exposure, nor due to the disposal of radioactive waste in underground facilities. Ionising radiation potentially emitted from soil, radon and certain building materials is also not measured by this indicator.*

Resource use indicators

Indicator	Units	Results per declared unit					
		A1- A3	C1	C2	C3	C4	D
Indicators describing resource use							
Use of renewable primary energy as energy carrier (PERE)	MJ	1.30E-01	4.68E-05	2.06E-03	2.27E-04	3.07E-04	-1.24E-02
Use of renewable primary energy resources used as raw materials (PERM)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of renewable primary energy (PERT)	MJ	1.30E-01	4.68E-05	2.06E-03	2.27E-04	3.07E-04	-1.24E-02
Use of non renewable primary energy as energy carrier (PENRE)	MJ	2.30E-01	8.31E-03	1.32E-01	4.03E-02	2.71E-02	-2.36E-02
Use of non renewable primary energy resources used as raw materials (PENRM)	MJ	1.44E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of non renewable primary energy resource (PENRT)	MJ	2.45E-01	8.31E-03	1.32E-01	4.03E-02	2.71E-02	-2.36E-02
Use of secondary material (SM)	kg	2.14E-04	3.41E-06	6.03E-05	1.65E-05	6.45E-06	8.20E-01
Use of renewable secondary fuels (RSF)	MJ	1.69E-02	8.98E-09	7.68E-07	4.35E-08	1.46E-07	-7.62E-08
Use of non-renewable secondary fuels (NRSF)	MJ	2.78E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net use of fresh water (FW)	m3	4.55E-04	4.45E-07	1.60E-05	2.16E-06	2.88E-05	-2.87E-04

Note:
In line with the recommendation in EN 16908, Annex F, the use of imported energy from the combustion of alternative fossil fuels classified as hazardous waste by Swiss legislation, is included in the indicator 'use of non-renewable secondary fuel' provided for modules A1-A3, in view of the lack of a more appropriate indicator.

Waste indicators

Indicator	Units	Results per declared unit					
		A1- A3	C1	C2	C3	C4	D
Environmental information describing waste categories							
Hazardous waste disposed (HWD)	kg	2.93E-04	3.83E-06	8.99E-05	1.85E-05	1.17E-05	-2.57E-05
Non-harzardous waste disposed (NHWD)	kg	7.55E-03	7.62E-05	2.73E-03	3.69E-04	1.80E-01	-4.88E-04
Radioactive waste disposed (RWD)	kg	1.98E-06	9.03E-10	4.31E-08	4.38E-09	4.45E-09	-1.47E-07

Output flow indicators

Indicator	Units	Results per declared unit					
		A1- A3	C1	C2	C3	C4	D
Environmental information describing output flows							
Components for re-use (CRU)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling (MFR)	kg	4.79E-05	2.62E-08	9.81E-07	8.20E-01	1.16E-07	-4.30E-05
Materials for energy recovery (MER)	kg	1.23E-06	1.03E-10	8.24E-09	4.99E-10	4.09E-10	-5.77E-10
Exported electrical energy (EEE)	MJ	5.57E-05	3.49E-07	2.14E-05	1.69E-06	1.93E-06	-9.60E-05
Exported thermal energy (EET)	MJ	7.56E-05	1.91E-07	2.84E-05	9.27E-07	9.72E-07	-1.73E-06

Disclaimer, applicable to all results provided:
Use of results of modules A1-A3 without considering the results of module C is discouraged.

References

General Programme Instructions of the International EPD® System. Version 4.0.

PCR 2019:14 Construction Products, Version 1.3.1, 2023-06-20

c-PCR-003 to PCR 2019:14 Concrete and concrete elements (EN 16757:2022), Version 2023-01-02

c-PCR-001 to PCR 2019:14 Cement and Building Lime (EN 16908:2017+A1:2022), Version 2022-05-18

EN 16757: 2022. Sustainability of construction works – Environmental product declarations – Product Category Rules for concrete and concrete elements

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

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