ENVIRONMENTAL PRODUCT DECLARATION

IN ACCORDANCE WITH EN 15804+A2 & ISO 14025 / ISO 21930

GEOPOLYMER SOLUTIONS, LLC

Red Mud Cold Fusion Cement

EPD HUB, HUB-0575

Publishing on 13 July 2023, last updated on 27 March 2024, valid until 13 January 2025

Created by McMac CX with

GENERAL INFORMATION

MANUFACTURER

Manufacturer	Geopolymer Solutions, LLC
Address	11200 Cox Road, Texas 77385
Contact details	rodz@geopolymertech.com
Website	http://www.geopolymertech.com

EPD STANDARDS, SCOPE AND VERIFICATION

Program operator	EPD Hub, hub@epdhub.com
Reference standard	ISO 21930:2017 and ISO 14025
PCR	EPD Hub Core PCR version 1.0, 1 Feb 2022
Sector	Construction product
Category of EPD	Third party verified EPD
Scope of the EPD	Cradle-to-Gate with Options, A4, and Modules C1-C4, D
EPD author	David MacLean McMac CX
EPD verification	Independent verification of this EPD and data, according to ISO 14025: ☐ Internal certification ☑ External verification
EPD verifier	Haiha Nguyen, as an authorized verifier acting for EPD Hub Limited

The manufacturer has the sole ownership, liability, and responsibility for the EPD. EPDs within the same product category but from different programs may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804 and if they are not compared in a building context.

PRODUCT

Product name	Sequestered Red Mud Cement
Additional labels	-
Product reference	-
Place of production	United States
Period for data	2023
Averaging in EPD	No averaging
Variation in GWP-fossil for A1-A3	0%

ENVIRONMENTAL DATA SUMMARY

Declared unit	1 metric ton of Red Mud Cold Fusion Cement
Declared unit mass	1000 kg
GWP-fossil, A1-A3 (kgCO2e)	2.29E+02
GWP-total, A1-A3 (kgCO2e)	2.30E+02
Secondary material, inputs (%)	44.2
Secondary material, outputs (%)	80
Total energy use, A1-A3 (kWh)	929
Total water use, A1-A3 (m3e)	2.79

PRODUCT AND MANUFACTURER

ABOUT THE MANUFACTURER

https://www.geopolymertech.com/red-mud/

Alkali Activated Cements "Geopolymers" have been around for thousands of years. During Roman and Egyptian periods cement binders were based upon basic available materials including crushed limestone and wood ash. The resultant cements were low energy but also low strength. Modern construction techniques required the development of higher strength materials. To meet this demand Ordinary Portland Cement (OPC) became the predominant industry solution for horizontal and vertical infrastructures. Ordinary Portland Cement (OPC) however, requires much higher temperature manufacturing than Geopolymers. This extra energy has negatively impacted our communities with the burdens these massive quantities of carbon and other pollutants create. Globally, communities are demanding that the designers and the construction industry find alternative solutions to minimize this burden.

Geopolymer Solutions, LLC. (GPS) has solved the low strength problems associated with Alkali Activated Cements. In the process of our development of our Cold Fusion Cements, GPS has also significantly reduced or eliminated shrinkage (plastic, drying, and autogenous) and set times. GPS accomplished this by abandoning legacy unsafe dry and liquid chemicals, without sacrificing quality and the sustainability of Geopolymers' including ensuring no Portland Cement is used in our mixtures.

GPS has assembled a team of professionals constituting of construction and construction materials experience. The professionals are responsible for navigating the generally coarse path of all new and highly technical materials. The acceptance of our materials has been difficult due to the failure of most academia to solve the problems with the most advanced cement on the planet, and the corresponding disbelief that a private company such as ours has accomplished the task fully. Some of this scepticism has been alleviated by the certification of our production plant and materials by agencies such as Underwriter Laboratories LLC, who have issued three designs to GPS for Spray Applied Fireproofing including certifications for our ASTM C119/UL263 and UL1709 mixtures. Most of our client base consists of return clientele, most of which completed a comprehensive laboratory testing process prior to using our materials.

GPS was incorporated as a Limited Liability Company in February of 2016 and has been serving the North American Continent with acid resistant concrete/cement materials, and spray applied fireproofing. The quality of our materials was exhibited while at Underwriter Laboratories' facility in Chicago, Illinois, where surprise was expressed by observers of the fire testing of our materials when the layers did not fall off the columns. Reportedly, materials falling off the columns during the test is a common characteristic of our competitors' products. The chemical bonding of all our materials to metal substrates occurs at the molecular level and consequently removes the possibility that GPS materials will ever be removed from the metal after application. This suggests that even during explosions such as aircraft collisions, our material will continue to protect structural items on which it is applied.

GPS is proud and excited to serve our community by producing the most advanced building materials on the earth. The fact that the production and use of our materials reduces the carbon footprint of cement production by over 80-percent is an added benefit.

PRODUCT DESCRIPTION

OVERVIEW: http://www.geopolymertech.com

This LCA study represents one (1) cubic meter of a Red Mud Cement product. This product consists of binders, fly ash, minerals, and other components. All components are dry when shipped to the site and then mixed with water during installation. The cement is used in both horizontal and vertical structural applications. The strength class of the concrete is 55 MPa.

A unique characteristic of all Geopolymer Cold Fusion Cements (CFC), including the Red Mud Cold Fusion Cement in this environmental product declaration (EPD), is that they are hydraulically activated, yet contain no water molecules once cured. During the curing process, water is chemically adsorbed through interaction with other constituent ingredients and chemically bonding within the cement. The resultant glass chemistry retains no available water molecules that would interact with aggregate or reinforcement materials, thereby inhibiting rust and corrosion failure issues even in the harshest conditions. The absence of any water molecules also results in virtually no expansion or contraction from freeze thaw or fast temperature changes. This zero-water characteristic protects rebar and steel from degradation, preventing the precursor that leads to cracks and failure of the Ordinary Portland Cement (OPC). This makes Cold Fusion Cement (CFC) much more resilient and longer lasting than legacy OPC.

THE MANUFACTURING PRODUCTION PROCESS:

Cold Fusion Concrete is a silicon dioxide primary chemistry relying upon the glassy components of directly installed silicon dioxide, various minerals, and waste materials to achieve an approximate 70% SiO_2 content, which is extremely similar to glass chemistry. The silicon dioxide, aluminum, and calcium constituents in red mud, or lithium, gold, copper, silver, or other mining waste are either primary or majority constituents in Cold Fusion Concrete. As such, the synergy between Cold Fusion Concrete and mining waste is profound. The Ferrous and other metal components of the waste present no deleterious reactions in the final product and heavy metals are encapsulated safely within.

Legacy Geopolymer materials are produced using a liquid hydroxide and/or liquid silicate as pozzolan activators. Cold Fusion Concrete (CFC) utilizes only dry materials including sodium or potassium metasilicate and/or sodium or potassium metasilicate pentahydrate as an activator. Sodium or potassium metasilicate/pentahydrate are alkali salts, have an elevated pH, and are anhydrous or pentahydrate versions of silicates. Sodium or potassium liquid hydroxides and/or silicates while unnecessary, can be used in conjunction with Cold Fusion Concrete technology and as demonstrated herein, without compromising quality.

Sodium hydroxide that is found in the bauxite residue is corrosive to glass, or SiO_2 materials. However, sodium hydroxide is used in the process of making sodium metasilicate. Sodium metasilicate is the primary activator used in Cold Fusion Concrete and while the sodium hydroxide digested the glassy components to make sodium metasilicate, the reformation of SiO_2 during the reaction with water, calcium, and aluminum in Cold Fusion Concrete results in resistance to further sodium hydroxide corrosion. Accordingly, while sodium hydroxide is typically corrosive to glass, the reformation of the cementitious structure is durable and not susceptible to further degradation in sodium hydroxide; it is beneficial.

Carbon dioxide sequestration has become a primary focus garnering world-wide attention. Unfortunately, the technology surrounding carbon dioxide sequestration is typically fashioned around the most simplistic and technologically basic approach as is possible, including adding carbon dioxide to Portland Concrete and converting calcium hydroxide into carbonates. The process has positives and negatives.

Adding carbon dioxide to concrete materials as curing and sequestering mechanism can occur with long term benefits. With respect to calcium hydroxide carbonation, should the calcium carbonate molecule be attached to a glassy silicon dioxide molecule, the calcium carbonate is refined into a moisture and chemical resistant material. The same is true for metallic oxide molecules that are converted into carbonates from carbon dioxide curing. The silicon dioxide containing long chain molecule that includes calcium, ferrous, magnesium, aluminum, manganese, and other metal carbonates is of significantly higher quality due to the presence of the silica/silicon attachment. This process occurs in abundance in Cold Fusion Concrete technology, which in simplistic terms is just turning short chain molecules into long chain molecules through covalent bonding.

The carbon sequestration into Bauxite Residue Concrete is not limited to the calcium components using our technology. The ferrous, aluminum and magnesium oxides in the sodium hydroxide rich residue experience partial dissolution when subjected to an environmentally benign solution, which converts the oxides to fluid hydroxides and allows carbon dioxide to react and form ferrous, aluminum, and magnesium carbonates. The dissolution is enhanced significantly if the residue is exposed to other currently patent-pending processes. The carbon dioxide in any sequestering process is most effectively introduced in the form of a cellular bubble, by pouring liquid carbon dioxide into the mixture, or by injecting carbon dioxide gas that distributes evenly throughout the mixture.

For producing a dry cement material for delivery to ready mix facilities and incorporation into mineral aggregate and water for concrete mixtures, dry Cold Fusion Concrete materials are combined after the red mud is sequestered, dehydrated, and reduced in size to approximately 1 to 20 microns.

JOBSITE DEPLOYMENT:

After mixing and placing the concrete in the element intended for construction, the feature is cured normally for from one to twenty-eight days, cured with the application of about 140°F heat or infrared, or, cured by passing a direct or alternating current through the concrete for a minimum of 30 seconds. When electrical curing is the chosen option, care should be exercised in applying a very low voltage initially until the material loses cohesion (which typically takes about 5 to 15 seconds), then increasing the voltage until the material reaches an internal temperature of about 190°F.

The resulting concrete achieves a compressive strength of from 4,000 to 10,000 pounds per square inch (psi), similar modulus properties as Portland mixtures, low permeability, and elevated resistance to freeze and thaw cycling and chemical attack.

INGREDIENT QUALITY CONTROL:

Alumina processing facilities have records of where the bauxite originated, and most facilities have information on various constituents of the bauxite including aluminum, calcium, silica, ferrous, magnesium, and other influencing materials. Likewise, most bauxite materials containing elevated NORM have been documented over the years. While the influencing constituents of the various bauxite sources are not variable enough to alter the final concrete recipe, the existence of elevated TENORM and other red mud characteristics must be established prior to retrieval of the red mud. The site study in three efforts is performed consisting of a document review, a field sampling and testing program, and the development of a 3-dimensional model that includes mixing variable materials to achieve low radiation emittance and a consistent concrete/cement product.

VALIDATED TEST DATA: https://www.geopolymertech.com/red-mud

CFC FP250 NFPA 58, Annex H, Procedure for Torch Fire and Hose Stream Testing of Thermal Insulating Systems for LP-Gas Containers (with reference to NFPA 290) https://www.geopolymertech.com/wp-content/uploads/2024/01/TEST-REPORT-Intertek-Hose-Stream-Torch-Test-NFPA-58-CFC-FP250-02-28-2020.pdf

CFC FP250 Jet Fire Resistance 1.89 in. thick on a 12 in. Schedule 80 steel pipe, for compliance with the applicable requirements of the following criteria: ISO 22899-1:2007(E), Determination of the Resistance to Jet Fires of Passive Fire Protection Materials https://www.geopolymertech.com/wp-content/uploads/2024/01/TEST-REPORT-Intertek-Jet-Fire-Testing-CFC-FP250-103688445-sat-003-02-27-2019.pdf

CFC FP250 Jet Fire Resistance 1.86 in. thick on Structural Steel Specimen, for compliance with the applicable requirements of the following criteria: ISO 22899-1:2007(E): Determination of the Resistance to Jet Fires of Passive Fire Protection Materials. https://www.geopolymertech.com/wp-content/uploads/2024/01/TEST-REPORT-Intertek-Jet-Fire-Testing-CFC-FP250-103688445-sat-004-02-28-2019.pdf

CFC FP250 Salt Spray (Fog) Test ASTM B-117 on four steel panels 5000 hours. https://www.geopolymertech.com/wp-content/uploads/2024/01/TEST-REPORT-Corrmet-5000-hr-salt-spray-test-ASTM-B-117-CFC-FP250-05-06-2019.pdf

CFC FP250 Salt Spray (Fog) Test ASTM B-117 on four steel panels 10000 hours. https://www.geopolymertech.com/wp-content/uploads/2024/01/TEST-REPORT-Corrmet-10000-hr-salt-spray-test-ASTM-B-117-CFC-FP250-01-06-2020.pdf

CEMENT PRODUCTS CONTRIBUTE TO CORROSION. GEOPOLYMER CONCRETE INHIBIT IT.

After completion of 10,000 hours of salt spray exposure test, all four insulated steel panels were evaluated for presence of spot rusting, and corrosion attack to the metal substrate protected by insulation. A small area of insulation from each sample was removed to inspect the condition of the metal substrate. Visual examination revealed that the metal substrate under the insulation was virtually free from any spot rusting or corrosion damage due to salt spray exposure testing. Furthermore, it appears that the protection of the metal substrate under the insulation is

For further information contact GPS at info@geopolymertech.com

PRODUCT RAW MATERIAL MAIN COMPOSITION

Raw material category	Amount, mass- %	Material origin
Metals	0	-
Minerals	95.84	North America
Fossil materials	0.77	North America
Bio-based materials	0.31	North America

BIOGENIC CARBON CONTENT

Product’s biogenic carbon content at the factory gate

Biogenic carbon content in product, kg C	-
Biogenic carbon content in packaging, kg C	-

FUNCTIONAL UNIT AND SERVICE LIFE

Declared unit	1 metric ton of sequestered red mud cementitious materials
Mass per declared unit	1000 kg
Functional unit	One (1) Metric Ton
Reference service life	100 years

SUBSTANCES, REACH - VERY HIGH CONCERN

The product does not contain any REACH SVHC substances in amounts greater than 0,1 % (1000 ppm).

PRODUCT LIFE-CYCLE

SYSTEM BOUNDARY

This EPD covers the life-cycle modules listed in the following table.

Product stage			Assembly stage		Use stage							End of life stage				Beyond the system boundaries		
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D		
x	x	x	x	MND	MND	MND	MND	MND	MND	MND	MND	x	x	x	x	x		
Raw materials	Transport	Manufacturing	Transport	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstr./demol.	Transport	Waste processing	Disposal	Reuse	Recovery	Recycling

Modules not declared = MND. Modules not relevant = MNR.

MANUFACTURING AND PACKAGING (A1-A3)

The environmental impacts considered for the product stage cover the manufacturing of raw materials used in the production as well as packaging materials and other ancillary materials. Also, fuels used by machines, and handling of waste formed in the production processes at the manufacturing facilities are included in this stage. The study also considers the material losses occurring during the manufacturing processes as well as losses during electricity transmission.

The manufacturing plant is set up directly next to waste red mud holding ponds. The wet red mud is dried through a grid-connected electric hopper. All dry components are mixed in specific proportions according to the manufacturers listing. Rotating grid-connected electrical rotating motors power standard readily available equipment used throughout the cementitious production industry. Certain ancillary materials are also included. The study considers the losses of the main raw materials from the manufacturing process. The product is shipped unpackaged in large, enclosed hopper trucks. The amount of CO_2 sequestered in the calcium carbonate is 13 kg in the overall product. The sequestered CO_2 comes from the carbonation process performed onsite by converting the calcium hydroxide native to the red mud and slag into calcium carbonate.

TRANSPORT AND INSTALLATION (A4-A5)

Transportation impacts occurred from final products delivery to construction site (A4) cover fuel direct exhaust emissions, environmental impacts of fuel production, as well as related infrastructure emissions.

Transportation distances assume average 100 km distance from production plant to building site. The transportation method is assumed to be lorry. Vehicle capacity utilization volume factor is assumed to be 1 which means full load. In reality, it may vary but as role of transportation emissions in total results is small, the variety in load is assumed to be negligible. To be conservative, empty returns are included in this study as implemented through an average load factor in the Ecoinvent transport datapoints. Transportation does not cause losses as product is packaged properly.

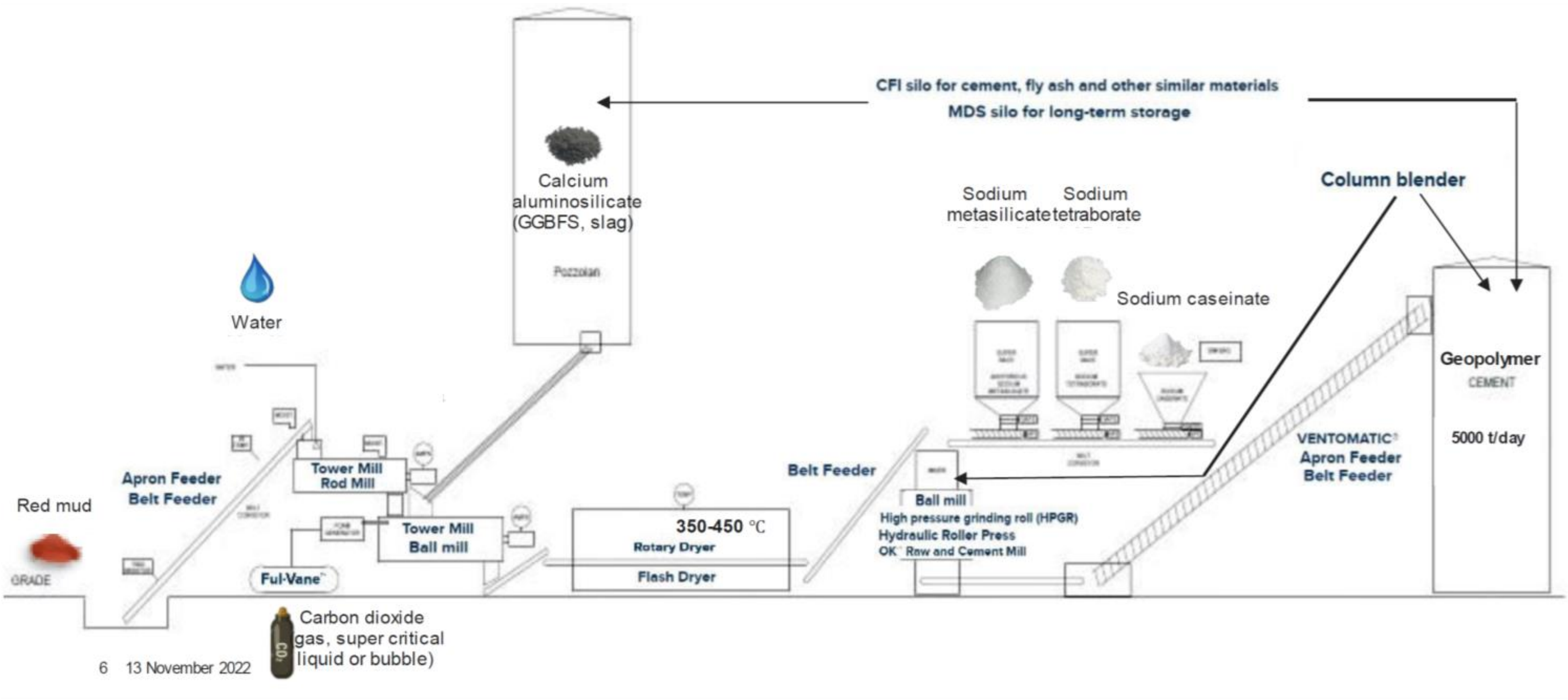
PRODUCT USE AND MAINTENANCE (B1-B7)

This EPD does not cover the use phase.
Air, soil, and water impacts during the use phase have not been studied.

PRODUCT END OF LIFE (C1-C4, D)

The average transportation distance in the model is 300 km. The construction of the waste processing facility and the appropriate equipment are not part of this model. Due to the material and energy recovery potential of parts in the end-of-life product, recycled raw materials lead to avoided virgin material production. The recycling of this concrete is assumed to be per current industry standard crushing process. The EPD model uses current industry standard concrete product recycling rate of 80% and landfilling rate of 20% according to the US EPAs Construction Waste Data from 2018. Diesel usage is considered during the demolition or deconstruction phase of this product.

MANUFACTURING PROCESS



LIFE-CYCLE ASSESSMENT

CUT-OFF CRITERIA

The study does not exclude any modules or processes which are stated mandatory in the reference standard and the applied PCR. The study does not exclude any hazardous materials or substances. The study includes all major raw material and energy consumption. All inputs and outputs of the unit processes, for which data is available for, are included in the calculation. There is no neglected unit process more than 1% of total mass or energy flows. The module specific total neglected input and output flows also do not exceed 5% of energy usage or mass.

ALLOCATION, ESTIMATES AND ASSUMPTIONS

Allocation is required if some material, energy, and waste data cannot be measured separately for the product under investigation. All allocations are done as per the reference standards and the applied PCR. In this study, allocation has been done in the following ways:

Data type	Allocation
Raw materials	No allocation
Packaging materials	Allocated by mass or volume
Ancillary materials	Allocated by mass or volume
Manufacturing energy and waste	Allocated by mass or volume

AVERAGES AND VARIABILITY

Type of average	No averaging
Averaging method	Not applicable
Variation in GWP-fossil for A1-A3	0%

There is no average result considered in this study since EPD refers to one specific product produced in one production plant.

LCA SOFTWARE AND BIBLIOGRAPHY

This EPD has been created using One Click LCA EPD Generator. The LCA and EPD have been prepared according to the reference standards and ISO 14040/14044. Ecoinvent and One Click LCA databases were used as sources of environmental data.

ENVIRONMENTAL IMPACT DATA

CORE ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, PEF

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP – total[1)]	kg CO_2e	2.27E+02	3.22E+00	2.73E-01	2.30E+02	9.39E+00	0.00E+00	MND	MND	MND	MND	MND	MND	MND	8.78E-01	2.82E+01	7.88E+00	1.05E+00	-9.80E-01
GWP – fossil	kg CO_2e	2.26E+02	3.22E+00	2.67E-01	2.29E+02	9.38E+00	0.00E+00	MND	MND	MND	MND	MND	MND	MND	8.78E-01	2.82E+01	7.87E+00	1.05E+00	-9.79E-01
GWP – biogenic	kg CO_2e	-4.34E-03	1.24E-06	4.34E-03	1.24E-06	0.00E+00	0.00E+00	MND	MND	MND	MND	MND	MND	MND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GWP – LULUC	kg CO_2e	1.11E+00	1.19E-03	1.77E-03	1.12E+00	3.46E-03	0.00E+00	MND	MND	MND	MND	MND	MND	MND	4.84E-05	1.04E-02	1.28E-02	9.94E-04	-1.36E-03
Ozone depletion pot.	kg CFC-11e	5.53E-05	7.40E-07	1.71E-08	5.61E-05	2.16E-06	0.00E+00	MND	MND	MND	MND	MND	MND	MND	1.91E-07	6.48E-06	1.32E-06	4.26E-07	-8.23E-08
Acidification potential	mol H^+e	1.33E+00	1.36E-02	9.88E-04	1.34E+00	3.97E-02	0.00E+00	MND	MND	MND	MND	MND	MND	MND	1.24E-02	1.19E-01	6.28E-02	9.90E-03	-6.41E-03
EP-freshwater[2)]	kg Pe	9.47E-03	2.63E-05	1.58E-05	9.51E-03	7.68E-05	0.00E+00	MND	MND	MND	MND	MND	MND	MND	1.18E-06	2.31E-04	1.53E-04	1.10E-05	-5.80E-05
EP-marine	kg Ne	2.32E-01	4.05E-03	2.06E-04	2.36E-01	1.18E-02	0.00E+00	MND	MND	MND	MND	MND	MND	MND	5.55E-03	3.54E-02	2.32E-02	3.43E-03	-1.39E-03
EP-terrestrial	mol Ne	2.58E+00	4.46E-02	2.24E-03	2.63E+00	1.30E-01	0.00E+00	MND	MND	MND	MND	MND	MND	MND	6.08E-02	3.91E-01	2.54E-01	3.77E-02	-1.81E-02
POCP (“smog”)[3)]	kg NMVOCe	6.97E-01	1.43E-02	9.99E-04	7.13E-01	4.17E-02	0.00E+00	MND	MND	MND	MND	MND	MND	MND	1.59E-02	1.25E-01	7.05E-02	1.10E-02	-4.65E-03
ADP-minerals & metals[4)]	kg Sbe	4.13E-02	7.54E-06	5.35E-07	4.13E-02	2.20E-05	0.00E+00	MND	MND	MND	MND	MND	MND	MND	6.22E-07	6.60E-05	1.98E-05	2.42E-06	-9.86E-06
ADP-fossil resources	MJ	3.20E+03	4.83E+01	3.26E+00	3.26E+03	1.41E+02	0.00E+00	MND	MND	MND	MND	MND	MND	MND	1.16E+01	4.23E+02	1.14E+02	2.89E+01	-1.46E+01
Water use[5)]	m^3e depr.	1.17E+02	2.16E-01	6.56E-02	1.17E+02	6.31E-01	0.00E+00	MND	MND	MND	MND	MND	MND	MND	1.60E-02	1.89E+00	9.26E-01	9.16E-02	-1.94E+00

1) GWP = Global Warming Potential; 2) EP = Eutrophication potential. Required characterisation method and data are in kg P-eq. Multiply by 3,07 to get PO4e; 3) POCP = Photochemical ozone formation; 4) ADP = Abiotic depletion potential; 5) EN 15804+A2 disclaimer for Abiotic depletion and Water use and optional indicators except Particulate matter and Ionizing radiation, human health. The results of these environmental impact indicators shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

ADDITIONAL (OPTIONAL) ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, PEF

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Particulate matter	Incidence	1.35E-04	3.71E-07	1.72E-08	1.36E-04	1.08E-06	0.00E+00	MND	MND	MND	MND	MND	MND	MND	1.61E-08	3.24E-06	7.30E-06	1.99E-07	-8.23E-08
Ionizing radiation[6)]	kBq U235e	2.43E+01	2.30E-01	1.96E-02	2.45E+01	6.71E-01	0.00E+00	MND	MND	MND	MND	MND	MND	MND	5.29E-02	2.01E+00	6.31E-01	1.31E-01	-2.32E-01
Ecotoxicity (freshwater)	CTUe	7.26E+03	4.34E+01	5.72E+00	7.31E+03	1.27E+02	0.00E+00	MND	MND	MND	MND	MND	MND	MND	6.40E+00	3.80E+02	1.12E+02	1.88E+01	-1.75E+01
Human toxicity, cancer	CTUh	1.38E-07	1.07E-09	9.61E-10	1.40E-07	3.11E-09	0.00E+00	MND	MND	MND	MND	MND	MND	MND	7.12E-11	9.34E-09	3.49E-09	4.71E-10	-1.02E-09
Human tox. non-cancer	CTUh	3.84E-06	4.30E-08	4.42E-09	3.89E-06	1.25E-07	0.00E+00	MND	MND	MND	MND	MND	MND	MND	9.64E-09	3.76E-07	7.31E-08	1.23E-08	-1.86E-08
SQP[7)]	-	2.80E+03	5.56E+01	4.71E+00	2.86E+03	1.62E+02	0.00E+00	MND	MND	MND	MND	MND	MND	MND	1.47E+00	4.87E+02	9.57E+01	6.18E+01	-1.40E+01

6) EN 15804+A2 disclaimer for Ionizing radiation, human health. 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; 7) SQP = Land use related impacts/soil quality.

USE OF NATURAL RESOURCES

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Renew. PER as energy[8)]	MJ	2.73E+02	5.44E-01	8.06E-01	2.75E+02	1.59E+00	0.00E+00	MND	MND	MND	MND	MND	MND	MND	3.27E-02	4.76E+00	4.46E+00	2.51E-01	-1.36E+00
Renew. PER as material	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	MND	MND	MND	MND	MND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of renew. PER	MJ	2.73E+02	5.44E-01	8.06E-01	2.75E+02	1.59E+00	0.00E+00	MND	MND	MND	MND	MND	MND	MND	3.27E-02	4.76E+00	4.46E+00	2.51E-01	-1.36E+00
Non-re. PER as energy	MJ	3.02E+03	4.83E+01	3.26E+00	3.07E+03	1.41E+02	0.00E+00	MND	MND	MND	MND	MND	MND	MND	1.16E+01	4.23E+02	1.14E+02	2.89E+01	-1.46E+01
Non-re. PER as material	MJ	1.85E+02	0.00E+00	-1.84E-01	1.84E+02	0.00E+00	0.00E+00	MND	MND	MND	MND	MND	MND	MND	0.00E+00	0.00E+00	-1.47E+02	-3.69E+01	0.00E+00
Total use of non-re. PER	MJ	3.20E+03	4.83E+01	3.08E+00	3.26E+03	1.41E+02	0.00E+00	MND	MND	MND	MND	MND	MND	MND	1.16E+01	4.23E+02	-3.38E+01	-7.99E+00	-1.46E+01
Secondary materials	kg	4.42E+02	1.34E-02	2.05E-02	4.43E+02	3.91E-02	0.00E+00	MND	MND	MND	MND	MND	MND	MND	6.68E-04	1.17E-01	3.97E-02	6.07E-03	-1.61E-02
Renew. secondary fuels	MJ	1.85E-02	1.35E-04	1.32E-04	1.87E-02	3.95E-04	0.00E+00	MND	MND	MND	MND	MND	MND	MND	9.88E-06	1.18E-03	4.82E-04	1.59E-04	-1.15E-04
Non-ren. secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	MND	MND	MND	MND	MND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of net fresh water	m^3	2.78E+00	6.26E-03	1.50E-03	2.79E+00	1.83E-02	0.00E+00	MND	MND	MND	MND	MND	MND	MND	4.08E-04	5.48E-02	4.62E-02	3.16E-02	-4.68E-02

8) PER = Primary energy resources.

END OF LIFE – WASTE

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Hazardous waste	kg	1.79E+01	6.40E-02	8.77E-01	1.88E+01	1.87E-01	0.00E+00	MND	MND	MND	MND	MND	MND	MND	4.08E-03	5.61E-01	3.53E-01	0.00E+00	-8.23E-02
Non-hazardous waste	kg	3.85E+02	1.05E+00	8.37E-01	3.87E+02	3.07E+00	0.00E+00	MND	MND	MND	MND	MND	MND	MND	4.68E-02	9.21E+00	1.08E+02	2.00E+02	-2.56E+00
Radioactive waste	kg	8.83E-03	3.23E-04	4.26E-06	9.15E-03	9.43E-04	0.00E+00	MND	MND	MND	MND	MND	MND	MND	8.45E-05	2.83E-03	6.34E-04	0.00E+00	-7.66E-05

END OF LIFE – OUTPUT FLOWS

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	MND	MND	MND	MND	MND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	MND	MND	MND	MND	MND	0.00E+00	0.00E+00	8.00E+02	0.00E+00	0.00E+00
Materials for energy rec	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	MND	MND	MND	MND	MND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	MND	MND	MND	MND	MND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

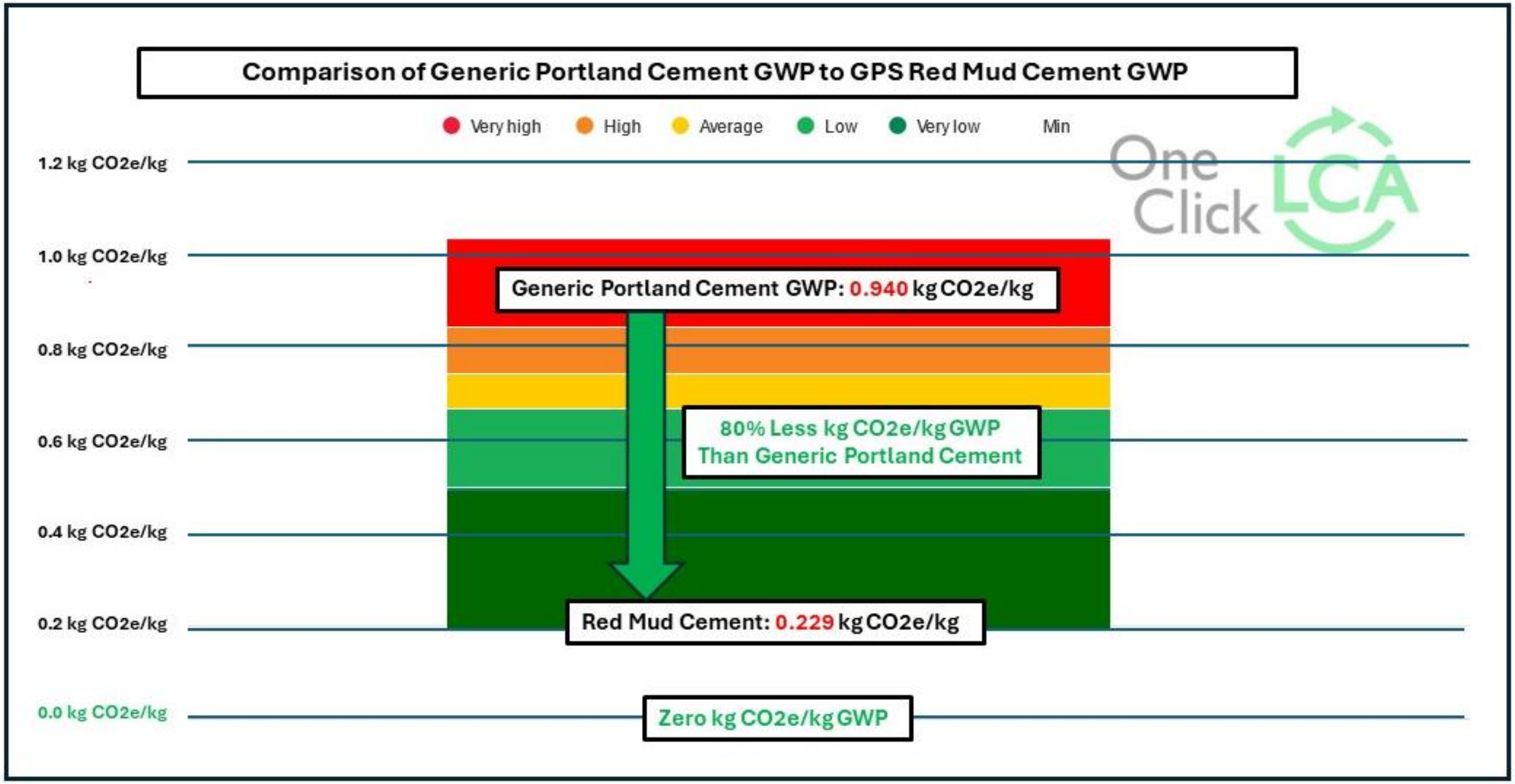
ENVIRONMENTAL IMPACTS – EN 15804+A1, CML / ISO 21930

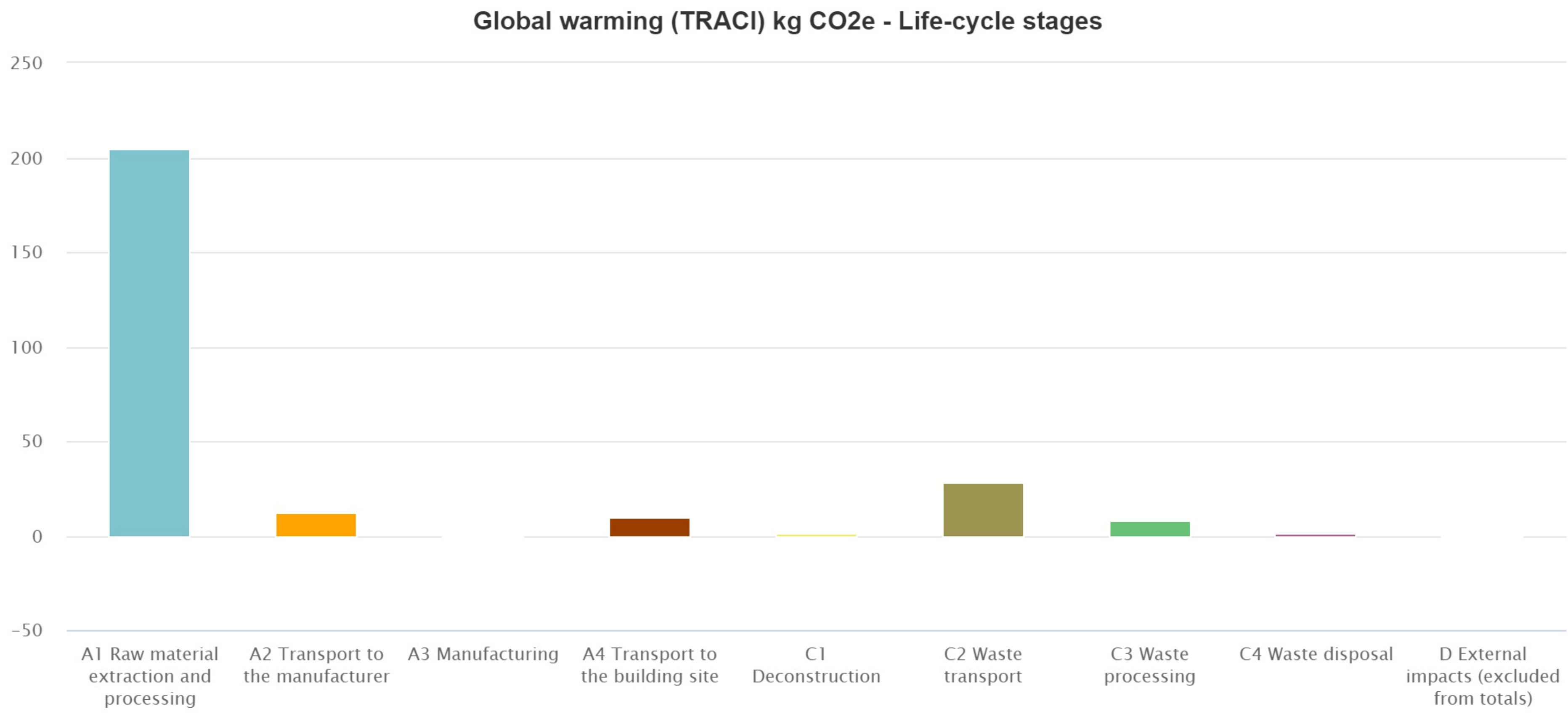
Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Global Warming Pot.	kg CO_2e	2.22E+02	3.18E+00	2.58E-01	2.26E+02	9.29E+00	0.00E+00	MND	MND	MND	MND	MND	MND	MND	8.62E-01	2.79E+01	7.75E+00	1.03E+00	-9.55E-01
Ozone depletion Pot.	kg $CFC_{-11}e$	5.33E-05	5.86E-07	1.56E-08	5.39E-05	1.71E-06	0.00E+00	MND	MND	MND	MND	MND	MND	MND	1.51E-07	5.13E-06	1.05E-06	3.37E-07	-6.83E-08
Acidification	kg SO_2e	1.10E+00	1.06E-02	8.06E-04	1.11E+00	3.09E-02	0.00E+00	MND	MND	MND	MND	MND	MND	MND	8.83E-03	9.26E-02	4.68E-02	7.48E-03	-4.96E-03
Eutrophication	kg $PO_4{}^3e$	3.72E-01	2.41E-03	6.33E-04	3.75E-01	7.03E-03	0.00E+00	MND	MND	MND	MND	MND	MND	MND	1.97E-03	2.11E-02	1.32E-02	1.61E-03	-2.40E-03
POCP ("smog")	kg C_2H_4e	4.97E-02	4.13E-04	1.06E-04	5.02E-02	1.21E-03	0.00E+00	MND	MND	MND	MND	MND	MND	MND	2.62E-04	3.62E-03	1.41E-03	3.14E-04	-3.41E-04
ADP-elements	kg Sbe	3.66E-03	7.30E-06	4.86E-07	3.67E-03	2.13E-05	0.00E+00	MND	MND	MND	MND	MND	MND	MND	6.17E-07	6.39E-05	1.95E-05	2.38E-06	-9.75E-06
ADP-fossil	MJ	3.20E+03	4.83E+01	3.26E+00	3.25E+03	1.41E+02	0.00E+00	MND	MND	MND	MND	MND	MND	MND	1.16E+01	4.23E+02	1.14E+02	2.89E+01	-1.46E+01

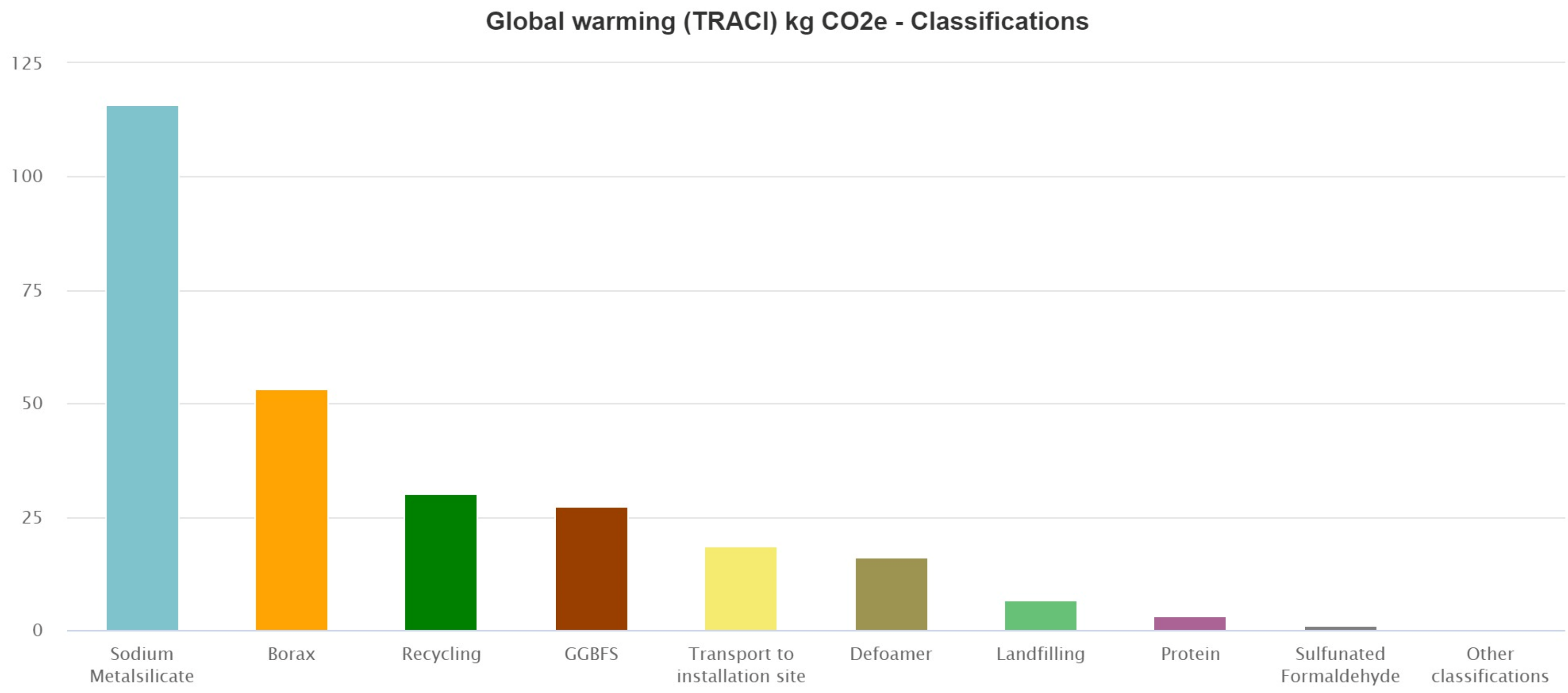
ENVIRONMENTAL IMPACTS – TRACI 2.1. / ISO 21930

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Global Warming Pot.	kg CO_2e	2.05E+02	1.22E+01	2.56E-01	2.17E+02	9.29E+00	0.00E+00	MND	MND	MND	MND	MND	MND	MND	8.73E-01	2.79E+01	7.72E+00	1.03E+00	-9.57E-01
Ozone Depletion	kg $CFC_{11}e$	5.27E-05	2.24E-06	1.55E-08	5.49E-05	1.71E-06	0.00E+00	MND	MND	MND	MND	MND	MND	MND	1.51E-07	5.13E-06	1.05E-06	3.37E-07	-6.77E-08
Acidification	kg SO_2e	4.87E+01	2.48E+00	4.45E-02	5.12E+01	1.89E+00	0.00E+00	MND	MND	MND	MND	MND	MND	MND	6.43E-01	5.67E+00	3.13E+00	4.85E-01	-2.90E-01
Eutrophication	kg Ne	9.24E-02	5.18E-03	4.58E-05	9.76E-02	3.95E-03	0.00E+00	MND	MND	MND	MND	MND	MND	MND	8.59E-04	1.19E-02	4.23E-03	9.06E-04	-2.78E-04
POCP ("smog")	kg O_3e	1.21E+00	4.00E-02	5.55E-04	1.25E+00	3.05E-02	0.00E+00	MND	MND	MND	MND	MND	MND	MND	1.44E-02	9.16E-02	5.97E-02	8.90E-03	-3.59E-03
ADP-fossil	MJ	5.51E+02	2.52E+01	2.46E-01	5.77E+02	1.93E+01	0.00E+00	MND	MND	MND	MND	MND	MND	MND	1.69E+00	5.78E+01	1.34E+01	4.04E+00	-1.09E+00

GRAPHS


Comparison of Generic Portland Cement GWP to GPS Red Mud Cement GWP
Very high
High
Average
Low
Very low
Min
One Click LCA
1.2 kg CO2e/kg
1.0 kg CO2e/kg
0.8 kg CO2e/kg
0.6 kg CO2e/kg
0.4 kg CO2e/kg
0.2 kg CO2e/kg
0.0 kg CO2e/kg
Generic Portland Cement GWP: 0.940 kg CO2e/kg
80% Less kg CO2e/kg GWP
Than Generic Portland Cement
Red Mud Cement: 0.229 kg CO2e/kg
Zero kg CO2e/kg GWP


Global warming (TRACI) kg CO2e - Life-cycle stages
250
200
150
100
50
0
-50
A1 Raw material extraction and processing
A2 Transport to the manufacturer
A3 Manufacturing
A4 Transport to the building site
C1 Deconstruction
C2 Waste transport
C3 Waste processing
C4 Waste disposal
D External impacts (excluded from totals)


Global warming (TRACI) kg CO2e - Classifications
125
100
75
50
25
0
Sodium Metalsilicate
Borax
Recycling
GGBFS
Transport to installation site
Defoamer
Landfilling
Protein
Sulfunated Formaldehyde
Other classifications

VERIFICATION STATEMENT

VERIFICATION PROCESS FOR THIS EPD

This EPD has been verified in accordance with ISO 14025 by an independent, third-party verifier by reviewing results, documents and compliancy with reference standard, ISO 14025 and ISO 14040/14044, following the process and checklists of the program operator for:

- This Environmental Product Declaration
- The Life-Cycle Assessment used in this EPD
- The digital background data for this EPD

Why does verification transparency matter? Read more online
This EPD has been generated by One Click LCA EPD generator, which has been verified and approved by the EPD Hub.

THIRD-PARTY VERIFICATION STATEMENT

I hereby confirm that, following detailed examination, I have not established any relevant deviations by the studied Environmental Product Declaration (EPD), its LCA and project report, in terms of the data collected and used in the LCA calculations, the way the LCA-based calculations have been carried out, the presentation of environmental data in the EPD, and other additional environmental information, as present with respect to the procedural and methodological requirements in ISO 14025:2010 and reference standard.

I confirm that the company-specific data has been examined as regards plausibility and consistency; the declaration owner is responsible for its factual integrity and legal compliance.

I confirm that I have sufficient knowledge and experience of construction products, this specific product category, the construction industry, relevant standards, and the geographical area of the EPD to carry out this verification.

I confirm my independence in my role as verifier; I have not been involved in the execution of the LCA or in the development of the declaration and have no conflicts of interest regarding this verification.

HaiHa Nguyen, as an authorized verifier acting for EPD Hub Limited
14.07.2023

VERIFIED ISO 14025

PATENTS

Pat No. 9,670,096/App No. 15/228,829
High strength, density controlled cold fusion concrete cementitious spray applied fireproofing (CFC FP250).
https://patentcenter.uspto.gov/applications/15228829

Pat No. 9,725,365/App No. 15/474,034 Division of Parent 15/228,829
High strength, density controlled cold fusion concrete cementitious spray applied fireproofing (CFC FP250)
https://patentcenter.uspto.gov/applications/15474034

Pat No. 9,932,269/App No. 15/474,074 Division of Parent App 15/228,829
High strength, density controlled cold fusion concrete cementitious spray applied fireproofing (CFC FP250)
https://patentcenter.uspto.gov/applications/15474074

Pat No. 9,944,560/App No. 15/615,439 Continuation in-part of Parent App 15/228,829 and 15/474,074
Fire Resistant Coating (for CFC FP250)
https://patentcenter.uspto.gov/applications/15615439

Pat No. 10,196,310/App No. 15, 228,781
Cold Fusion Concrete (CFC)
https://patentcenter.uspto.gov/applications/15228781

Pat No. 10,954,162/App No. 16, 580,474
Protective Coating (for CFC)
https://patentcenter.uspto.gov/applications/16580474

Pat No. 11,390,562/App No. 17,696,793
Process for Preparing Cold Fusion Concrete & Cement Compositions from Metal Mining & Production Waste (CFC with Red Mud)
https://patentcenter.uspto.gov/applications/17696793