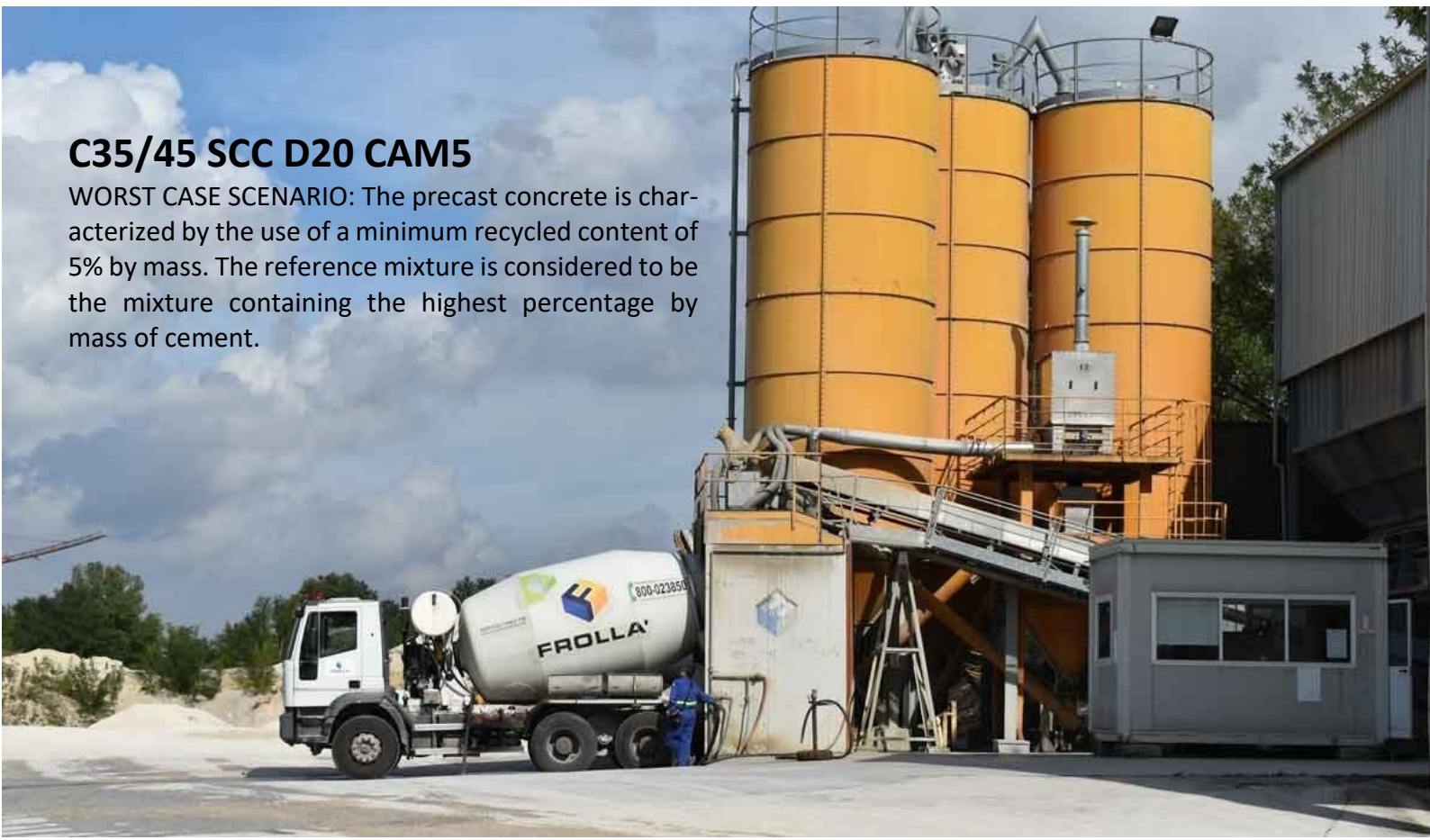
Environmental Product Declaration

as per ISO 14025 and EN 15804

Owner of the declaration:	FROLLA' S.r.l.
Publisher:	Kiwa-Ecobility Experts
Programme operator:	Kiwa-Ecobility Experts
Registration number:	EPD-Kiwa-EE-000402-EN
Issue date:	12.06.2024
Valid to:	12.06.2029



C35/45 SCC D20 CAM5

WORST CASE SCENARIO: The precast concrete is characterized by the use of a minimum recycled content of 5% by mass. The reference mixture is considered to be the mixture containing the highest percentage by mass of cement.

1. General information

FROLLA' S.r.l.

Programme operator:
Kiwa-Ecobility Experts
Kiwa GmbH, Ecobility Experts
Wattstraße 11-13
13355 Berlin
Germany

Registration number:
EPD-Kiwa-EE-000402-EN

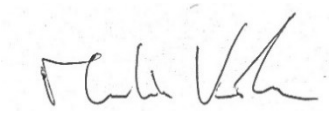
This declaration is based on the Product Category Rules:
PCR A: EPD program Version 2.1, 2022-02-14

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

Issue date:
12.06.2024

Valid to:
12.06.2029

Raoul Mancke
(Head of programme operations, Kiwa-Ecobility Experts)



Martin Koehrer
(Verification body, Kiwa-Ecobility Experts)

C35/45 SCC D20 CAM5

Owner of the declaration:
Frollà S.r.l.
via Castellano 4
63839 Servigliano (FM)
Italy

Declared product / declared unit:
1 m^3 of produced concrete

Scope:
This Environmental Product Declaration describes the environmental impacts related to the production of precast concrete produced during the year 2022. For the purposes of identifying environmental impacts, the reference mixture is considered to be the mixture containing the highest percentage by mass of cement: C35/45 SCC D20 CAM5.
Kiwa-Ecobility Experts assumes no liability for manufacturer's information, LCA data and evidence.

Verification:
The European standard EN 15804+A2:2019 serves as the core PCR.

Independent verification of the declaration and data, according to EN ISO 14025:2010.

☐internal ☒external

Dr.-Ing. Morteza Nikravan
(External verifier of Kiwa GmbH)

2. Product

2.1 Product description

FROLLÀ S.r.l. produces and distributes precast concrete.

The concretes produced are mixtures consisting of aggregates of different sizes, cement, water, and additives. This declaration refers to the family called CAM5 with variable characteristics in terms of compressive strength class, consistency class, and maximum diameter. The family is characterized by the use of the same cement, the same aggregates, and with a minimum recycled content of 5% by mass.

2.2 Reference Service Life (RSL)

Reference service life is not applicable in the absence of modules B1-B7

2.3 Substances of very high concern

No substance of very high concern is included in the manufacturing process. The additive used is not considered dangerous in accordance with CE Regulation 1272/2008 (CLP): No PBT, vPvB, or disruptor endocrine substances present in concentration ≥ 0.1%.[1]

2.4 Base materials / Ancillary materials

Quantity of raw materials for 1 m^3 of concrete

Raw material	Unit	Value
NATURAL SAND	Kg	989
GRAVEL	Kg	335
CRUSHED STONE 12/25	Kg	206
CRUSHED STONE 25/40	Kg	189
RECYCLED AGGREGATE	Kg	0
CEMENT	Kg	420
WATER	Kg	180
ADDITIVE	Kg	3

For some products used by the company, it has been possible to obtain the value of certified EPD.
This EPD calculation is based on BARBETTI cement-certified EPD and MAPEI additives-certified EPD.

2.5 Manufacturing

The production plant consists of 5 hoppers for loading aggregates, n. 3 silos for loading cement, n. 2 tanks for the loading of the mixing water, and n. 2 tanks for the loading of additives. The aggregates used for the production of concrete are produced by the same company and are stored in the yard and in the loading hoppers divided by particle size class. The aggregates are taken from the heaps in the yard by means of a shovel motor and placed in the dosing hoppers. The weighing system is managed by loading software. The cementitious binder, transported from the cement plant to the plant, using tankers, is pneumatically loaded into the storage silos. Aggregates, cementitious binders, and any additives, once dosed, are adequately mixed homogeneously inside the truck mixer with the addition of water.

[1] Safety Data Sheet “DYNAMON XTEND W 300 R“

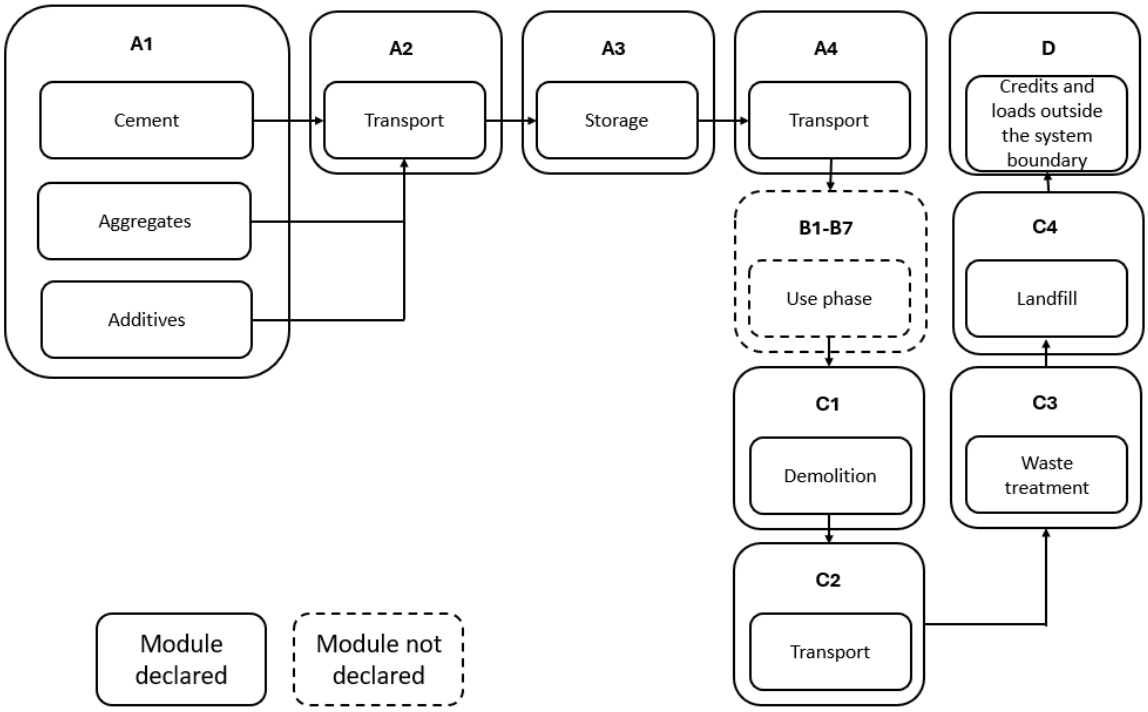


Figure 1: Graphic schematic process flow diagram for life cycle, a more detailed representation of production, individual processes must show which module they are assigned to and whether the module has been declared in the EPD.

2.6 Other Information

The recycled content of the mixtures in question is obtained by applying the formula given in paragraph 7.8.4 of EN ISO 14021:2021:

$$X\ (\%) = \frac{A}{P} \times 100$$

where:

- X is the recycled content expressed as a percentage
- A is the mass of recycled material
- P is the mass of the product

Performance indicator: Percentage (%) of recovered and/or recycled material content specified, in accordance with EN ISO 14021:2021, as:

- % Pre-consumer recycled content
- % Post-consumer recycled content

where:

- **"Pre-consumer" material**: Material removed from the waste stream during a manufacturing process. The reuse of reworked, reground materials or residues generated in a process and capable of being recovered in the same process that generated them is excluded.
- **"Post-consumer" material**: Material generated by domestic settlements or commercial, industrial, and institutional installations in their role as end-users of the product, which can no longer be used for its intended purpose. This includes the return of material from the supply chain.

In our case, from the EPD of cement we know that the % of recycled material in the cement is equal to 64.61%: considering the amount of cement used in our product, equal to 420 kg, we calculate a quantity of recycled material equal to 270 kg. This value in relation to the total quantity of the product, 2322 kg, will allow you to evaluate a content of 11%

Content of recovered and/or re-cycled material	Pre-consumer	Post-consumer	Total Content
C25/30 S4 D32 CAM5	8%	0%	8%
C28/35 S4 D32 CAM5	9%	0%	9%
C30/37 S4 D32 CAM5	10%	0%	10%
C32/40 S4 D32 CAM5	10%	0%	10%
C35/45 S4 D32 CAM5	11%	0%	11%
C25/30 SCC D20 CAM5	8%	0%	8%
C28/35 SCC D20 CAM5	9%	0%	9%
C30/37 SCC D20 CAM5	10%	0%	10%
C32/40 SCC D20 CAM5	10%	0%	10%
C35/45 SCC D20 CAM5	11%	0%	11%

3. LCA: Calculation rules

3.1 Declared unit

The declared unit is 1 m^3 of produced concrete.

3.2 Scope of declaration and system boundaries

The environmental product declaration is a cradle-to-grave ‘‘with modules A4 and module D‘‘. Depending on the option chosen, the boundaries of the system include:

- the production and supply of raw materials (A1),
- the transport of raw materials to the production site (A2),
- the process of making the product (A3),
- Transport to the construction site (A4),
- Demolition at the end of life (C1),
- transport of the final waste to the treatment site (C2),
- The processes of the final treatments (C3),
- Disposal of residual waste (C4).

In addition, the study also assesses the presence of any benefits beyond the boundaries of the system (D).

Description of the system boundary																
Product stage			Construction process stage		Use stage							End of life stage				Benefits and loads beyond the system boundaries
Raw material supply	Transport	Manu-facturing	Transport from manu-facturer to	Construction-installation	Use	Main-tenance	Repair	Replacement	Refur-bishmen	Operational energy use	Operational water use	De-construction / demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
X	X	X	X	ND	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
X=Module declared | ND= Module not declared																

3.3 Geographical reference area

Geographical validity: Italy (Products manufactured and marketed in Italy)

3.4 Cut-off Criteria

The cut-off rules set out in EN 15804:2019 have been applied: the cut-offs applied do not exceed 1% of the mass and energy flows entering the system.

3.5 Allocation

For raw materials of virgin origin, both the impacts associated with the materials, as well as those associated with the related production processes. Some impacts of the production plant (e.g. electricity, water, and diesel consumption) have been allocated among the products of the 2022 production.

3.6 Data collection and reference time period

This EPD is based on primary data for the aspects considered fundamental, such as the composition of the products examined, the distances between the suppliers of raw materials and the production site, and the energy consumption of the plant. For all processes for which no primary data is available, secondary data from the database has been referenced LCA Ecoinvent v3.8, Allocation, Cut-off by Classification.

3.7 Estimates and assumptions

Module A1 includes all the impacts associated with the production of the raw materials and the impacts related to the extraction and processing of energy resources used in the plant's production processes (electricity and diesel for mixing concrete in concrete mixers). With regard to raw materials of virgin origin, both the impacts associated with the materials themselves and those associated with the related production processes were considered.

Module A2 includes the external transport of raw materials from suppliers to the production plant and internal transport for the handling of raw materials with diesel-powered vehicles.

Module A3 includes the impacts related to the production of the mixtures at the production plant. Within the A3 stage, the following were considered:

- The production and treatment of waste from the plant and its transport to the operator's site;
- The emissions to air and water produced by the concrete batching plant and wastewater treatment;
- The production of auxiliary materials.

3.8 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, 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. A 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).

4. LCA: Scenarios and additional technical information

Module A4 includes the impacts related to the transport of concrete from the production site to the construction site by a concrete mixer truck.
Module C1 includes the processes of demolition and dismantling of products from the site of use.
Module C2 includes the transport of products from the demolition site to the disposal or recovery facilities, considering a distance equal to 53,1 km.
Module C3 includes the sorting and treatment processes of the products for the start of recovery, taking into account rock-crushing activity. According to Eurostat statistics on demolition waste in the construction sector in Italy, about 98% of End-of-life concrete is sent for recycling. For the calculation of the absorption of CO_2 from the atmosphere during the C3 phase, reference was made to EN 16757:2022 as indicated in the PCR EPDItaly028. CO_2 uptake: 0,49 $kgCO_2/m^3$.
Module C4 includes impacts related to the disposal of the product in landfills at the End of life. According to Eurostat statistics on demolition waste in the construction sector in Italy, about 2% of End-of-life concrete is destined for landfill storage. In this phase, the phenomenon of carbonation during the long-term storage of concrete in landfills was considered. The calculation of the absorption of the CO2 from the atmosphere during phase C4 has been referred to EN 16757:2022.
Module D includes the impacts and benefits outside the boundaries of the system due to the use of recycled materials.

5. LCA: Results

The following tables show the results of the impact assessment indicators, resource use, waste, and other output streams. The results presented here refer to the declared average product.

Disclaimer on ADP-e, ADP-f, WDP, ETP-fw, HTP-c, HTP-nc, SQP: The results of these environmental impact indicators must be used with caution, as the uncertainties in these results are high or as there is limited experience with the indicator.

Disclaimer on IR: This impact category mainly addresses the potential effect of low dose ionizing radiation on human health in the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents and occupational exposures, nor does it consider radioactive waste disposal in underground facilities. Potential ionizing radiation from soil, radon, and some building materials is also not measured by this indicator.

	LCA results - Indicators describing environmental impacts based on the impact assessment (LCIA): 1 m^3 C35/45 SCC D20 CAM5 (EN 15804+A2)							
Parameter	**Unit**	**A1 – A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
	Core environmental impact indicators (EN 15804+A2)							
GWP-total	kg CO2 eqv.	1,95E+02	8,30E+00	8,04E-01	1,10E+00	3,62E-01	9,70E-02	-2,20E-01
GWP-f	kg CO2 eqv.	1,94E+02	8,29E+00	7,99E-01	1,10E+00	3,60E-01	9,64E-02	-2,20E-01
GWP-b	kg CO2 eqv.	8,93E-01	8,06E-03	3,05E-03	6,59E-03	1,35E-03	3,16E-04	-5,15E-04
GWP-luluc	kg CO2 eqv.	1,67E-02	2,98E-03	1,16E-03	1,51E-03	5,23E-04	2,48E-04	-1,53E-04
ODP	kg CFC 11 eqv.	1,95E-05	1,98E-06	1,41E-07	1,84E-07	6,38E-08	3,61E-09	-2,29E-15
AP	mol H+ eqv.	6,22E-01	3,46E-02	6,47E-03	8,57E-03	2,91E-03	7,10E-04	-3,07E-04
EP-fw	kg P eqv.	1,25E-02	5,16E-04	1,62E-04	2,10E-04	7,31E-05	4,27E-06	-2,82E-07
EP-m	kg N eqv.	1,63E-01	1,06E-02	2,42E-03	3,22E-03	1,09E-03	2,02E-04	-7,95E-05
EP-T	mol N eqv.	1,73E+00	1,15E-01	2,63E-02	3,50E-02	1,18E-02	2,21E-03	-8,50E-04
POCP	kg NMVOC eqv.	4,90E-01	3,72E-02	7,31E-03	9,63E-03	3,29E-03	6,10E-04	-2,28E-04
ADP-mm	kg Sb-eqv.	3,95E-04	1,90E-05	2,05E-06	2,67E-06	9,27E-07	5,92E-08	-3,60E-08
ADP-f	MJ	1,85E+03	1,29E+02	1,22E+01	1,66E+01	5,49E+00	1,31E+00	-3,72E+00
WDP	m3 world eqv.	7,59E+02	4,45E-01	1,81E-01	2,36E-01	8,19E-02	1,26E-02	-2,27E-02
	Additional environmental impact indicators (EN 15804+A2)							
PM	disease incidence	3,48E-06	9,75E-07	7,41E-07	9,63E-07	3,35E-07	1,89E-08	0
IR	kBq U235 eqv.	9,260472	6,54E-01	7,53E-02	9,78E-02	3,40E-02	1,92E-03	0
ETP-fw	CTUe	1232,539	1,01E+02	1,07E+01	1,39E+01	4,81E+00	2,72E-01	0
HTP-c	CTUh	2,38E-08	2,79E-09	3,60E-10	4,67E-10	1,62E-10	9,18E-12	0
HTP-nc	CTUh	6,29E-07	1,10E-07	7,26E-09	9,44E-09	3,28E-09	1,85E-10	0
SQP	Pt	762,0583	1,48E+02	1,07E+01	1,39E+01	4,81E+00	2,72E-01	0

ADP-mm= Abiotic depletion potential for non-fossil resources | **ADP-f**=Abiotic depletion for fossil resources potential | **AP**= Acidification potential, Accumulated Exceedance | **EP-fw** = Eutrophication potential, fraction of nutrients reaching freshwater end compartment | **EP-m**= Eutrophication potential, fraction of nutrients reaching marine end compartment| **EP-T**= Eutrophication potential, Accumulated Exceedance | **GWP-b**=Global Warming Potential biogenic | **GWP-f**=Global Warming Potential fossil fuels | **GWP-luluc**=Global Warming Potential land use and land use change |**GWP-total**=Global Warming Potential total| **ODP**=Depletion potential of the stratospheric ozone layer |**POCP**=Formation potential of tropospheric ozone | **WDP**=Water (user) deprivation potential, deprivation- weighted water consumption | **ETP-fw**=Potential Comparative Toxic Unit for ecosystems | **HTP-c**=Potential Toxic Unit for Humans toxicity, cancer | **HTP-nc**= Potential Toxic Unit for humans, non-cancer | **IRP**=Potential Human exposure efficiency relative to U235, human health | **PM**=Potential incidence of disease due to Particulate Matter emissions | **SQP**=Potential soil quality index

	LCA results - Indicators describing resource use and environmental information derived from life cycle inventory (LCI): 1 m^3 C35/45 SCC D20 CAM5 (EN 15804+A2)							
Parameter	**Unit**	**A1 -A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	4,27E+01	3,75E-01	5,99E-02	4,58E-01	1,74E+00	1,35E-01	-8,10E-01
PERM*	MJ	3,51E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	MJ	4,33E+01	3,75E-01	5,99E-02	4,58E-01	1,74E+00	1,35E-01	-8,10E-01
PENRE	MJ	1,91E+03	1,37E+02	9,50E+00	7,30E+01	2,76E+02	1,71E+00	-3,72E+00
PENRM*	MJ	1,73E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PENRT	MJ	1,94E+03	1,37E+02	9,50E+00	7,30E+01	2,76E+02	1,71E+00	-3,72E+00
SM	Kg	3,43E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RSF	MJ	1,36E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF	MJ	1,94E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
FW	m^3	1,86E-01	6,99E-03	2,32E-03	3,39E-02	6,10E-02	7,42E-03	-9,40E-04
HWD	Kg	1,47E-02	4,30E-04	4,90E-04	1,60E-03	1,10E-04	1,52E-08	-5,98E-04
NHWD	Kg	7,61E+01	2,10E-01	2,51E-01	7,27E+00	7,14E-02	9,99E-02	-1,97E+00
RWD	Kg	2,18E-03	1,08E-03	1,23E-03	4,05E-03	2,75E-04	9,25E-08	-6,71E-04
CRU	Kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MFR	Kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MER	Kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EET	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EEE	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

PERE=Use of renewable primary energy excluding renewable primary energy resources used as raw materials | **PERM**= Use of renewable primary energy resources used as raw materials | **PERT**=Total use of renewable primary energy resources | **PENRE**= Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials | **PENRM**= Use of non-renewable primary energy resources used as raw materials | **PENRT**= Total use of non-renewable primary energy resources | **SM**=Use of secondary material | **RSF**=Use of renewable secondary fuels | **NRSF**=Use of non-renewable secondary fuels | **FW**=Use of fresh water | **HWD**=Hazardous waste disposed | **NHWD**=Non-hazardous waste disposed | **RWD**=Radioactive waste disposed | **CRU**=Components for re-use | **MFR**=Materials for recycling | **MER**=Materials for energy recovery | **EET**=Exported energy, thermical | **EE**=Exported energy, electrical

*Since this EPD calculation is based on MAPEI additives-certified EPD, this module accounts also for the calorific value of the packaging considered as an output and therefore with a negative value. This influences PENRM, non-renewable energy content by plastic packaging, and PERM, renewable energy content by wood packaging.[2]

[2] MAPEI Declaration number EPD-EFC-20210198-IBG1-EN (6. LCA: Interpretation)

6. LCA: Interpretation

The graph below shows how the various process steps affect the core environmental impact indicators.

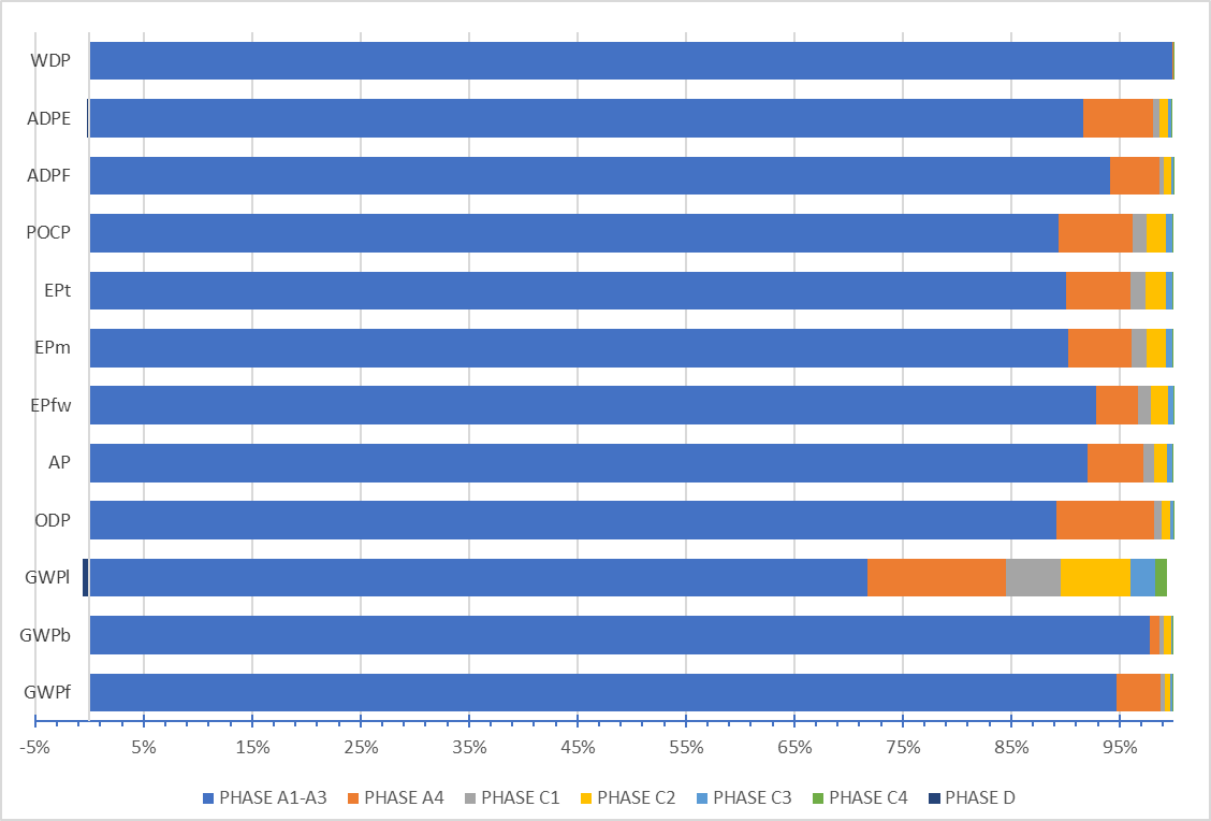


Figure 2: Influence of the modules on the environmental core indicators

It is possible to see how impactful the A1 – A3 phase is, considering all the indicators involved, especially concerning water consumption (WDP) due to the treatment of raw materials and the mixture preparation.
Subsequently, phase A4 also has an impact, albeit to a lesser extent, with a significant contribution from the impact of the item "global rewelding potential referred to land consumption" (GWPl) related to the transport of concrete from the production site to the construction site.
For the latter indicator, phase D makes a positive contribution, declaring a quantity of global warming potential avoided, thanks to the use of recycled material outside the boundaries of the system.

7. References

Ecoinvent 2021	Ecoinvent Datenbank Version 3.8 (2021)
EN 15804	EN 15804:2012+A2:2019: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products
ISO 14025	ISO 14025:2010 Environmental labels and declarations — Type III environmental declarations — Principles and procedures
ISO 14040	ISO 14040:2006 Environmental management - Life cycle assessment - Principles and framework
ISO 14044	ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines
NMD 2019	NMD STICHTING NATIONAL ENVIRONMENTAL DATABASE: Environmental Performance Assessment Method for Construction; 1.1 (March 2022); Rijswijk
PCR A	Kiwa-Ecobility Experts, Berlin, 2022: PCR A – General Program Category Rules for Construction Products from the EPD programme of Kiwa-Ecobility Experts; Version 2.1
c-PCR	EN 16757:2022 Sustainability of construction works - Environmental product declarations - Product Category Rules for concrete and concrete elements
R<THiNK 2023	R<THiNK; Online-EPD-Tool by NIBE B.V.
SimaPro Software	Industry data LCA library; website: https://simapro.com/databases/industry-data-lca-library/
BARBETTI cement EPD	https://barbetti.it/wp-content/uploads/EPDCEMENTERIA2019.pdf valid until 09.05.2026
MAPEI additives EPD	https://cdnmedia.mapei.com/docs/librariesprovider2/products-documents/7_dynamon-xtend-w302r_c_6d94bcd610b24a10b5496cb81a2bc5b5.pdf?sfvrsn=109a44d5_0 valid until 15.12.2026

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