Statement of Verification

BREG EN EPD No.:000232 Issue 02

This is to verify that the

Environmental Product Declaration

provided by:

Cupa Pizarras

BRE Global Verified EPD

is in accordance with the requirements of:

EN 15804:2012+A2:2019

and

BRE Global Scheme Document SD207

This declaration is for:

The Functional Unit is 1 m^2 of roof covered with CUPA 12 with an average weight of 36.90 kg/m^2 over 75 years study period

Company Address

Cupa Pizarras
Grosvenor Gardens, London
London, SW1W 0AU

CUPA PIZARRAS
The world leader in natural slate

Signed for BRE Global Ltd	Hayley Thomson Operator	20 February 2026 Date of this Issue
31 January 2019 Date of First Issue		19 February 2031 Expiry Date

BRE Global Verified EPD

BRE Global Ltd., Garston, Watford WD25 9XX.
T: +44 (0)333 321 8811 F: +44 (0)1923 664603 E: Enquiries@breglobal.com

ECO PLATFORM

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Environmental Product Declaration

EPD Number: **000232**

General Information

EPD Programme Operator	Applicable Product Category Rules
BRE Global Watford, Herts WD25 9XX United Kingdom	BRE Environmental Profiles 2023 Product Category Rules for Type III environmental product declaration of construction products to EN 15804+A2 PN 514 Rev 3.1
Commissioner of LCA study	**LCA consultant/Tool**
Cupa Pizarras Grosvenor Gardens, London London, SW1W 0AU T: +44 20 3318 4455 E: UK@cupapizarras.com W: www.cupapizarras.com/uk	María Lago Lorenzo Cupa Innovación SLU Calle Macal nº 32 36213 Vigo Tool: Simapro 9.4
Declared/Functional Unit	**Applicability/Coverage**
The Functional Unit is 1 m^2 of roof covered with CUPA 12 with an average weight of 36.90 kg/m^2 over 75years study period	Product Average.
EPD Type	**Background database**
Cradle to Grave	Ecoinvent 3.8

Demonstration of Verification
CEN standard EN 15804 serves as the core PCR [a]
Independent verification of the declaration and data according to EN ISO 14025:2010 ☒Internal ☐ External
(Where appropriate [b])Third party verifier: Bala Subramanian
a: Product category rules b: Optional for business-to-business communication; mandatory for business-to-consumer communication (see EN ISO 14025:2010, 9.4)

Comparability
Environmental product declarations from different programmes may not be comparable if not compliant with EN 15804:2012+A2:2019. Comparability is further dependent on the specific product category rules, system boundaries and allocations, and background data sources. See Clause 5.3 of EN 15804:2012+A2:2019 for further guidance

Information modules covered

Product			Construction		Use stage							End-of-life					Benefits and loads beyond the system boundary
					Related to the building fabric					Related to the building							
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4		D
Raw materials supply	Transport	Manufacturing	Transport to site	Construction – Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal		Reuse, Recovery and/or Recycling potential
☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑		☑

Note: Ticks indicate the Information Modules declared.

Manufacturing site(s)

CUPA PIZARRAS S.A.
Folgoso do Courel (27325), Lugo
Spain

Construction Product:

Product Description

The products covered in this study are **natural roofing slate** (Cupa 12) extracted from slate quarries located in Folgoso do Courel, Lugo, provinces in the north-western region of Spain, with extraction and manufacturing activities carried out at the same location. Moulded by nature for over 500 million years, natural slate is a metamorphic rock that, unlike artificial products, maintains its colour and properties unalterable through time, are capable of enduring extreme temperatures, difficult snow formation, fire-resistance as well as being fully waterproof.

Slate is the most resistant material used for roofing without the need of maintenance. By being 100% natural, slate is the roofing material with less environmental impact, which guarantees a perfect performance in any weather condition. Its unparalleled character and durability make this material ideal to preserve the aesthetics appearance and personality of any architectural project.

CUPA12 are dark grey slate with a smooth matt surface coming from La Campa Quarry in Folgoso do Courel (Lugo).

This is an average EPD for the product. The declared considers an average of the following formats: 500x250 mm, 400x250 mm, 600x300 mm, 400x200 mm, and 500x300 mm, all with a thickness of 5 mm.

Table 1. Description of the product average used in the LCA, Cupa 12.

Cupa 12			
Slate format (mm)	**Weight (kg/m^2)**	**Wastage allowance, 5% (kg/m^2)**	**Quantity of slate for the functional unit (kg/m^2)**
500 mm x 250 mm x 5 mm	35.00	1.75	36.75
400 mm x 250 mm x 5 mm	36.40	1.82	38.22
600 mm x 300 mm x 5 mm	32.76	1.64	34.40
400 mm x 200 mm x 5 mm	35.84	1.79	37.63
500 mm x 300 mm x 5 mm	35.70	1.79	37.49
Average	**35.14**	**1.76**	**36.90**

The installation guide recommends the addition of 5% wastage allowance. This waste has been considered for the functional unit. The following table shows the calculations considered to determine the quantity of slate for the functional unit. In conclusion, the quantity of slate needed to cover 1 m^2 of roofing with Cupa 12 is 36.90 kg.

The results of the individual products can be found in the section description of the variance respecting to the average of the results of the LCIA.

Technical Information

Property	Value, Unit	Applied standard
Water absorption	0.17% Code: W1 (< 0.4%)	UNE EN 12326-1
Contents of carbonate non-carbonated	0.30% Complies: (< 1.5%)	UNE EN 12326-1
More characteristic	Longitudinal 52 MPA Transverse 49 MPA	UNE EN 12326-1
SO2 exposure test	S1	UNE EN 12326-1
Thermal cycle test	T1	UNE EN 12326-1
Freeze thaw test	Fulfill: < 0.6%	UNE EN 12326-1
Size (mm)	500x250x5 400x250x5 400x200x5 600x300x5 500x300x5	UNE EN 12326-1

For more detailed information on the technical properties of this product, please refer to the product datasheet or contact the manufacturer directly

Main Product Contents

The product is 100% natural slate

Material/Chemical Input	%
Slate, from ground	100

Manufacturing Process

The production phase includes both quarry operations and the processing of the slate in the factory. The manufacturing consisted of various steps:

Extraction

Cupa 12 is operated as an underground mine. Unlike open-pit quarries, no overburden removal is required, as access to the slate seams is achieved through underground galleries. Block extraction is carried out using diamond wire technology, allowing for precise and efficient cutting. This process relies on both electricity, to power the cutting equipment, and diesel fuel for the operation of support machinery and transportation within the mine.

Water is used in a closed-loop system for cooling and dust suppression, minimizing environmental impact.

The slate waste generated during the cutting process is stored within the mine itself and used as backfill material in abandoned galleries, contributing to the structural stability of the excavation.

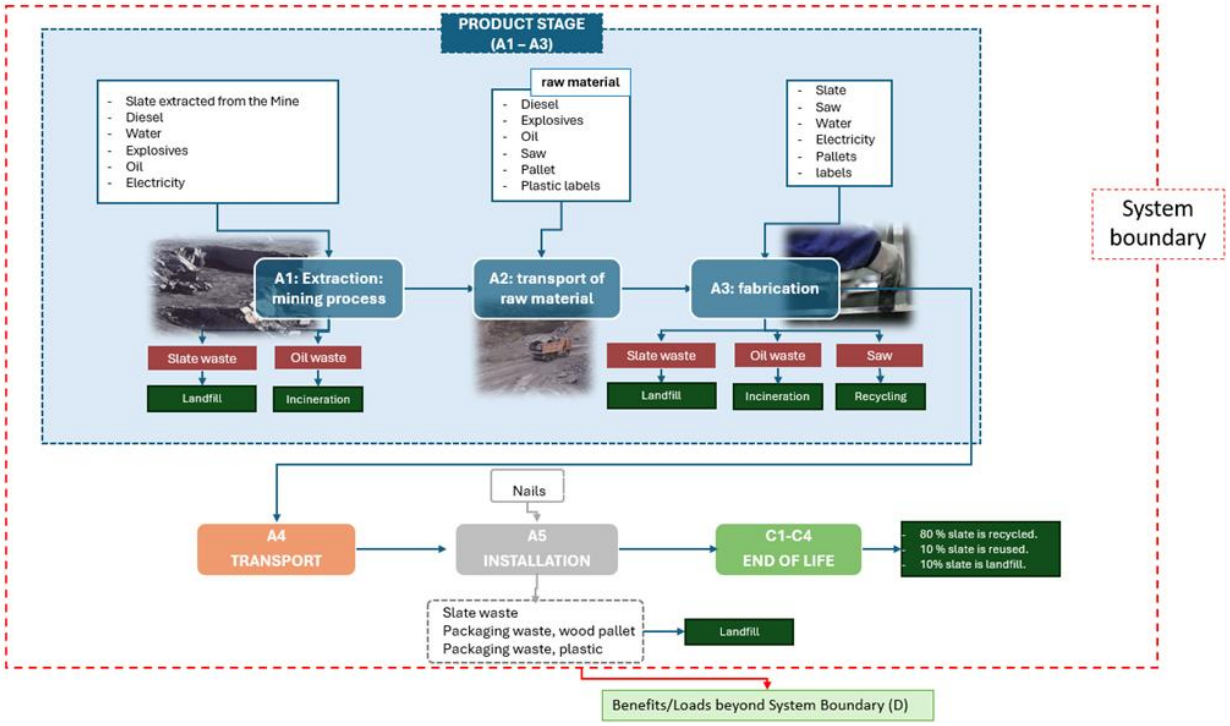
Manufacturing

In the factory, the slate undergoes the following stages:

- Primary exfoliation: The slate reaches the transformation centres in the form of slate blocks. Blocks are then divided into smaller ones, which do not exceed 30 - 35 cm in thickness, using pneumatic hammers mounted into machinery and taking advantage of the schistosity plans.

- Sawing: Next, the slate blocks of adequate thickness are carried by the overhead cranes or hoists toward saws with diamond blades, where they are cut into blocks, with dimensions slightly superior to the commercial sizes that are intended to be manufactured. Once the blocks have been sawn, they are deposited either in containers filled with water, of approximately 1.5 m3 to avoid drying and the consequent loss of ease of splitting, or on roller roads, to be transported directly to the working area.
- Final exfoliation: This stage consists of the exfoliation of the blocks to the commercial thicknesses, carrying out the work on the so-called splitting benches. First, they are divided into slabs of about 20 to 30 mm thick and then they are exfoliated to 3-5mm. Finally, workers size them according to standard forms and measures for commercialization. This operation is carried out by means of specialized scissor, guillotines, and punching machines.
- Selection: Once the shaping process has finished, the natural slates are subjected to final inspection and are sorted based on their quality
- Packaging: After classification, the slates are counted and placed in wooden pallets for storage and future delivery.

Process flow diagram



Construction Installation

A4. Transport

This module includes the road and sea transportation of the slate from the manufacturing sites in Spain to construction site in the UK, including two means: the first one being lorry, from manufacturing site to ports and ports to final clients; the second one being container ships between ports.

A5. intallation

For this study, a manual installation of the slate has been considered.

It has been established that traditional slate installation requires steel nails at a rate of 2 nails per slate installed. This amounts to 170 g/m^2 of steel.

The installation also takes into account 5% of slate rejection due to breakage and defects that occur during distribution. This rejected slate is sent to landfill being an inert material.

The packaging waste including wooden pallet and wrapping plastic are sent to landfill.

Use Information

This stage is made up of B1 Use, B2 Maintenance, B3 Repair, B4 Substitution, B5 Rehabilitation, B6 Use of energy in service and B7 Use of water in service.

- Use of the products in building: the environmental impacts in this module are negligible since the use of roof slate as covering materials does not require any energy nor material consumption.
- Waste management during use: no waste derives from the slate during the use phase.
- Maintenance: under normal conditions of use, roofing slates may require occasional inspections, replacement of plates due to damage, for example, due to extreme weather events. The impacts due to natural catastrophes are considered negligible.
- Repair: under normal conditions of use (Except extreme weather events), the slates do not require repairs during the use phase.
- Replacement: the products have a comparable long service life in building and do not require material replacement. The environmental impacts of this module are considered irrelevant.
- Rehabilitation: the products have a comparable long service life in building and do not require material replacement. Therefore, the environmental impacts of this module are not contemplated.

Once the installation is completed, no technical actions nor operations are required during the use stages until end of life. Therefore, CUPA roofing slates have no impact at this stage.

End of Life

This stage includes the following modules: C1 Deconstruction/ demolition; C2 Transport; C3 Waste processing and C4 Final disposal.

C1. Deconstruction/Demolition

This phase includes all the activities related to the dismantling of the site. The slates are dismantled manually and, therefore, it has been considered that there is no relevant energy consumption in the dismantling operation. **100% of the product waste is recovered from the demolition site** and transported for further treatment.

C2. Waste Transportation

This stage of the life cycle includes the transport of slates and screws after deconstruction of the site to the place of their treatment or deposit. Also, the transport of the recovered slates is included in this step.

Transport to final disposal is by heavy truck and 30 km is considered.

C3 Waste Treatment

Thanks to its high durability, slates can be removed during demolition or remain in the structure during rehabilitation or reconstruction. For this analysis, approximately 10 % of the slate is considered reusable in a new location. The end-of-waste status for reuse is achieved once the slate has been reconditioned for use in another project. This recondition includes cleaning the slate with water.

The remaining slate, about 80 % , is recycled into aggregates. To reach its final waste state, this portion is coarse-crushed, allowing its reuse as recycled aggregate.

End-of-life disposal is modelled according to the scenarios defined in the BRE Global Product Category Rules (PCR) for Type III Environmental Product Declarations of Construction Products, in accordance with EN 15804+A2 PN 514 Rev 3.1, Appendix D.

C4 Final Disposal

The waste generated is inert, non-toxic waste, which is normally deposited in landfills. It has been assumed for this study that 10 % of the material is taken to landfill and treated as inert.

Life Cycle Assessment Calculation Rules

Declared / Functional unit description

The functional unit is chosen to be 1 m² of roof covered with Cupa 12 with an average weight of 36.90 kg/m2 over 75 years.

The determination of the Reference Service Life (RSL) of the evaluated material is based on the results obtained from tests conducted in accordance with ASTM C406.

The functional unit is declared for a group of similar products, different formats of slates: 500X250, 400x250, 600x300, 400x200, 500x300 mm with a thickness of 5 mm. For each of the products, the calculation has considered the amount of product needed to cover 1 m² of roof, meaning the size of the slate (thickness x width x length), the weight of each reference and the number of slates necessary to cover 1 m² of roof including the recommended overlapping spaces. This average results in 35.14 kg of product necessary to cover 1 m² of roof. The installation guide recommends the addition of 5% wastage allowance. This waste has been considered for the functional unit. In conclusion, **the quantity of slate needed to cover 1 m² of roofing with Cupa 12 is 36.90 kg.**

System boundary

This is a cradle-to-grave Life Cycle Assessment (LCA) that covers all life cycle stages in accordance with EN 15804:2012+A2:2019 and BRE 2021 Product Category Rules (PN 514 Rev 3.1). It includes the extraction, transportation, and fabrication of slates (A1–A3), construction and installation (A4–A5), the use stage (B1–B7), end-of-life processes (C1–C4), and benefits and loads beyond the system boundaries (Module D).

Data sources, quality and allocation

Specific data has been taken on the amounts of matter and energy used during the life cycle of the products. These data have been supplied by CUPA PIZARRA, referring to the period since 01.01.2022 to 31.12.2022 and come from direct factory and mining data. The production data has been obtained through a survey that the company has accomplished. Data related to raw material and energy consumption was obtained from invoices provided by CUPA and production data was obtained from SAP software.

For Cupa 12, there are no co-products during the extraction of products therefore no allocation in the mining process. The data have been obtained from the La Campa mine and the production facility, located in Folgoso do Courel (Lugo) Spain, in northern Spain. Neither co-production nor allocation occur at Cupa 12. On the other hand, for generic data, for which no direct data could be obtained, the Ecoinvent 3.8 database was used, choosing the "cut-off by classification" system. This database has been developed through a joint initiative of the Swiss Research Institute ETH and various Federal Offices of Switzerland. These data have been compiled by teams of experts and are representative industry data. Modelling of life cycle of slate was performed using the software SimaPro 9.4.0.2.

At processing plant (CUPA PIZARRAS S.A), multiple slate formats are produced, which share the same extraction and transformation stages. The different formats are not considered co-products in the strict LCA sense, as they perform the same primary function and share a common market. To ensure consistency and comparability of LCA results, a common base unit of 1 kg of slate produced is applied to all formats. A conversion factor relating mass to surface area (kg/m²) is then applied, allowing the results to be transformed into the final functional unit of 1 m² of installed slate. This approach allows maintaining a transparent and traceable inventory of material, energy, and emissions flows.

The main energy source during the extraction and manufacturing process at CUPA PIZARRAS S.A of Cupa 12 slate is electricity. Electricity data considered for mining and manufacturing process are based on the Spanish grid mix, using representative datasets from the Ecoinvent v3.8 LCI (compiled in 2021), with a good level of temporal and technological representativeness. Therefore, the most appropriate LCA data have been used. The

global warming potential (GWP) of the dataset considered is 1 kWh ES electricity = 0.426 kg CO_2 eq (scope 2, mandatory GHG).

Waste generated during extraction is accounted for using data provided by the company. At mine, the slate waste generated during the cutting process is stored within the mine itself and used as backfill material in abandoned galleries, contributing to the structural stability of the excavation. Other ancillary materials like Oils, diamond wires and saws handled by authorized waste managers for recycling or safe disposal. At the manufacturing facility, the disposal of the production waste is similar to what happens in the mine, in the slate transformation plant, slate waste, which is inert material, is also produced. These waste materials are deposited in slag heaps, which are located on the mountain slopes, near the production facilities or quarries

The LCA carried out by CUPA PIZARRA has been done following the requirements regarding data quality set by EN 15804:2012+A2:2020. This ensures that the evaluation of the results is reliable, consistent and transparent. All generic data comes from reliable sources and thus has been checked for plausibility.

- **Geographical relevance -** The data we have collected is based as close as possible to manufacturing site. All data refers to European technology.
- **Technological relevance -** All the technological data gathered is current and for most materials it is generally industry averages.
- **Temporal relevance -** Our datasets are updated as often as possible to ensure they are at least within the last 10 years for generic data and within the last 5 years for producer specific data. The databases Ecoinvent v.3.8 has been updated earlier of the same year that this study took place.

Cut-off criteria

The application of the cut-off criteria was carried out according to the indications of standard in clause 6.3.6 of the EN 15804+A2. Only diffuse emissions and those inputs and outputs which represent less than 1% of the consumption of renewable and non-renewable primary energy and less than 1% of the total input mass of the processes elementary was excluded, due to uncertainty and lack of data. Specifically, the excluded inputs include the diamond wire and the maintenance activities.

LCA Results

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts									
			GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater
			kg CO_2 eq	kg CO_2 eq	kg CO_2 eq	kg CO_2 eq	kg CFC11 eq	mol H^+ eq	kg $(PO_4)^{3-}$ eq
Product stage	Raw material supply	A1	AGG	AGG	AGG	AGG	AGG	AGG	AGG
	Transport	A2	AGG	AGG	AGG	AGG	AGG	AGG	AGG
	Manufacturing	A3	AGG	AGG	AGG	AGG	AGG	AGG	AGG
	Total (of product stage)	A1-3	6.20E+00	6.95E+00	-7.95E-01	4.09E-02	2.02E-06	6.16E-02	2.28E-04
Construction process stage	Transport	A4	1.98E+00	1.98E+00	6.39E-04	1.98E-05	4.72E-07	1.70E-02	1.06E-06
	Construction	A5	4.72E-01	3.50E-01	1.21E-01	2.33E-04	2.04E-08	1.57E-03	1.59E-05
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Operational energy use	B6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Operational water use	B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
End of life									
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.46E-01	1.46E-01	4.80E-05	1.18E-06	3.47E-08	5.08E-04	7.49E-08
	Waste processing	C3	1.03E-02	1.00E-02	2.76E-04	2.10E-05	5.32E-10	4.75E-05	8.76E-07
	Disposal	C4	8.84E-03	8.80E-03	3.30E-05	4.17E-07	1.97E-09	9.32E-05	8.03E-09
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-7.93E-01	-7.84E-01	-4.34E-03	-4.12E-03	-2.10E-07	-6.80E-03	-2.53E-05

GWP-total = Global warming potential, total;
GWP-fossil = Global warming potential, fossil;
GWP-biogenic = Global warming potential, biogenic;
GWP-luluc = Global warming potential, land use and land use change;

ODP = Depletion potential of the stratospheric ozone layer;
AP = Acidification potential, accumulated exceedance; and
EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment

LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts									
			EP-marine	EP-terrestrial	POCP	ADP-mineral &metals	ADP-fossil	WDP	PM
			kg N eq	mol N eq	kg NMVOC eq	kg Sb eq	MJ, net calorific value	m^3 world eq deprived	disease incidence
Product stage	Raw material supply	A1	AGG	AGG	AGG	AGG	AGG	AGG	AGG
	Transport	A2	AGG	AGG	AGG	AGG	AGG	AGG	AGG
	Manufacturing	A3	AGG	AGG	AGG	AGG	AGG	AGG	AGG
	Total (of product stage)	A1-3	1.23E-02	1.36E-01	4.17E-02	9.08E-07	2.23E+02	6.25E+00	2.68E-05
Construction process stage	Transport	A4	3.93E-03	4.37E-02	1.17E-02	7.55E-08	2.84E+01	-4.82E-03	1.63E-07
	Construction	A5	4.22E-04	3.92E-03	1.65E-03	3.43E-06	3.69E+00	7.85E-02	3.13E-08
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Operational energy use	B6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Operational water use	B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
End of life									
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.63E-04	1.79E-03	4.88E-04	6.35E-09	2.07E+00	-3.47E-04	1.09E-08
	Waste processing	C3	6.81E-06	7.86E-05	2.18E-05	6.21E-10	2.26E-01	8.17E-03	1.40E-10
	Disposal	C4	4.17E-05	4.57E-04	1.25E-04	4.51E-10	1.22E-01	3.26E-05	2.58E-09
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.43E-03	-1.59E-02	-4.79E-03	-9.08E-08	-2.33E+01	-2.38E+00	-2.69E-06

EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment;
EP-terrestrial = Eutrophication potential, accumulated exceedance;
POCP = Formation potential of tropospheric ozone;
ADP-mineral&metals = Abiotic depletion potential for non-fossil resources;
ADP-fossil = Depletion potential of the stratospheric ozone layer;
WDP = Water (user) deprivation potential, deprivation-weighted water consumption; and
PM = Particulate matter.

LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts							
			IRP	ETP-fw	HTP-c	HTP-nc	SQP
			kBq U^{235} eq	CTUe	CTUh	CTUh	dimensionless
Product stage	Raw material supply	A1	AGG	AGG	AGG	AGG	AGG
	Transport	A2	AGG	AGG	AGG	AGG	AGG
	Manufacturing	A3	AGG	AGG	AGG	AGG	AGG
	Total (of product stage)	A1-3	1.70E+00	8.88E+01	2.80E-09	6.37E-08	1.02E+02
Construction process stage	Transport	A4	1.23E-01	1.19E+01	1.98E-10	2.02E-08	7.59E-02
	Construction	A5	8.52E-03	9.37E+00	2.71E-09	1.13E-08	1.03E+00
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Operational energy use	B6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Operational water use	B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
End of life							
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	9.01E-03	8.41E-01	1.18E-11	1.37E-09	5.57E-03
	Waste processing	C3	3.33E-03	1.21E-01	9.61E-12	2.01E-10	5.00E-02
	Disposal	C4	5.36E-04	4.53E-02	5.64E-13	4.56E-11	1.56E-01
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.62E-01	-1.48E+01	-2.69E-10	-8.52E-09	-6.84E+00

IRP = Potential human exposure efficiency relative to U235;
ETP-fw = Potential comparative toxic unit for ecosystems;
HTP-c = Potential comparative toxic unit for humans;
HTP-nc = Potential comparative toxic unit for humans; and
SQP = Potential soil quality index.

LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing resource use, primary energy								
			PERE	PERM	PERT	PENRE	PENRM	PENRT
			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	AGG	AGG	AGG	AGG	AGG	AGG
	Transport	A2	AGG	AGG	AGG	AGG	AGG	AGG
	Manufacturing	A3	AGG	AGG	AGG	AGG	AGG	AGG
	Total (of product stage)	A1-3	4.07E+01	0.00E+00	4.07E+01	2.34E+02	0.00E+00	2.34E+02
Construction process stage	Transport	A4	4.25E-02	0.00E+00	4.25E-02	3.01E+01	0.00E+00	3.01E+01
	Construction	A5	3.03E-01	0.00E+00	3.03E-01	3.91E+00	0.00E+00	3.91E+00
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Operational energy use	B6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Operational water use	B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
End of life								
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	3.18E-03	0.00E+00	3.18E-03	2.20E+00	0.00E+00	2.20E+00
	Waste processing	C3	3.97E-02	0.00E+00	3.97E-02	2.37E-01	0.00E+00	2.37E-01
	Disposal	C4	3.35E-03	0.00E+00	3.35E-03	1.29E-01	0.00E+00	1.29E-01
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-2.70E+00	0.00E+00	-2.70E+00	-2.31E+01	0.00E+00	-2.31E+01

PERE = Use of renewable primary energy excluding renewable primary energy 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 resource

LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing resource use, secondary materials and fuels, use of water						
			SM	RSF	NRSF	FW
			kg	MJ net calorific value	MJ net calorific value	m^3
Product stage	Raw material supply	A1	AGG	AGG	AGG	AGG
	Transport	A2	AGG	AGG	AGG	AGG
	Manufacturing	A3	AGG	AGG	AGG	AGG
	Total (of product stage)	A1-3	0.00E+00	0.00E+00	0.00E+00	9.87E-02
Construction process stage	Transport	A4	0.00E+00	0.00E+00	0.00E+00	5.40E-04
	Construction	A5	0.00E+00	0.00E+00	0.00E+00	2.57E-03
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Operational energy use	B6	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Operational water use	B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00
End of life						
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	4.15E-05
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	1.95E-03
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	3.99E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	-1.07E-02

SM = Use of secondary material;
RSF = Use of renewable secondary fuels;
NRSF = Use of non-renewable secondary fuels;
FW = Net use of fresh water

LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Other environmental information describing waste categories					
			HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	AGG	AGG	AGG
	Transport	A2	AGG	AGG	AGG
	Manufacturing	A3	AGG	AGG	AGG
	Total (of product stage)	A1-3	1.07E-04	8.64E+02	1.64E-03
Construction process stage	Transport	A4	6.41E-05	1.20E-03	2.03E-04
	Construction	A5	2.10E-05	3.07E+00	9.13E-06
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00
	Operational energy use	B6	0.00E+00	0.00E+00	0.00E+00
	Operational water use	B7	0.00E+00	0.00E+00	0.00E+00
End of life					
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	5.45E-06	8.55E-05	1.48E-05
	Waste processing	C3	9,40E-08	3,25E-04	1,74E-06
	Disposal	C4	3.17E-07	3.69E+00	8.74E-07
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1,77E-04	-7,77E+02	-1,26E-03

HWD = Hazardous waste disposed;
NHWD = Non-hazardous waste disposed;
RWD = Radioactive waste disposed

LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Other environmental information describing output flows – at end of life								
			CRU	MFR	MER	EE	Biogenic carbon (product)	Biogenic carbon (packaging)
			kg	kg	kg	MJ per energy carrier	kg C	kg C
Product stage	Raw material supply	A1	AGG	AGG	AGG	AGG	AGG	AGG
	Transport	A2	AGG	AGG	AGG	AGG	AGG	AGG
	Manufacturing	A3	AGG	AGG	AGG	AGG	AGG	AGG
	Total (of product stage)	A1-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Construction process stage	Transport	A4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Construction	A5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Operational energy use	B6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Operational water use	B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
End of life								
End of life	Deconstruction, demolition	C1	3.69E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	3.69E+00	2.95E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

CRU = Components for reuse;
MFR = Materials for recycling

MER = Materials for energy recovery;
EE = Exported Energy

Scenarios and additional technical information

Scenarios and additional technical information			
Scenario	Parameter	Units	Results
A4 – Transport to the building site	This module includes the road and sea transportation of the slate from the manufacturing sites in Spain to construction site in the UK, including two means: the first one being lorry, from manufacturing site to ports and ports to final clients; the second one being container ships between ports		
	Vehicle type: Lorry	Freight, lorry >32 metric ton, EURO6	Diesel
	Vehicle type: Ship	Freight, sea, container ship	Heavy fuel oil
	Distance:	km	608 km by road 1198 km by sea
	Capacity utilisation (incl. empty returns)	%	% assumption from Ecoinvent database. The average freight load factor of a >32 metric ton lorry is 15.96 tonnes with a gross vehicle weight (GVW) of 29.96 tonnes.
	Bulk density of transported products	kg/m3	2800
A5 – Installation in the building	This module includes all materials used for the installation of the product. For this study, a manual installation of the slate has been considered. It has been established that traditional slate installation requires steel nails at a rate of 2 nails per slate installed. This amounts to 170 g/m^2 of steel. The installation also considers 5% of slate rejection due to breakage and defects that occur during distribution. This rejected slate is sent to landfill being an inert material. The packaging waste including wooden pallet and wrapping plastic are sent to a local waste manager. The packaging waste treatment scenario is assumed to be the most recent UK's, including open burning, municipal incineration, and sanitary landfill.		
	Steel nails	Kg/m^2	0.17
	Packaging waste: wooden pallet	Kg/m^2	1.2
	Packaging waste: packaging film	Kg/m^2	0.006
	Slate waste materials from installation wastage	Kg/m^2	1.76
B2 – Maintenance	Under normal conditions of use, roofing slates may require occasional inspections, replacement of plates due to damage, for example, due to extreme weather events. The impacts due to natural catastrophes are considered negligible.		
B3 – Repair	Under normal conditions of use (except extreme weather events), the slates do not require repairs during the use phase.		

Scenarios and additional technical information			
Scenario	Parameter	Units	Results
B4 – Replacement	The products have a comparable long service life in building and do not require material replacement. The environmental impacts of this module are considered irrelevant.		
B5 – Refurbishment	The products have a comparable long service life in building and do not require material replacement. Therefore, the environmental impacts of this module are not contemplated.		
Reference service life	75 years. The determination of the Reference Service Life (RSL) of the evaluated material is based on the results obtained from tests conducted in accordance with ASTM C406.		
B6 – Use of energy; B7 – Use of water	The environmental impacts in this module are negligible since the use of roof slate as covering materials does not require any energy nor water consumption.		
C1 – Deconstruction	The slates are dismantled manually and, therefore, it has been considered that there is no relevant energy consumption in the dismantling operation. 100% of the product waste is recovered from the demolition site and transported for further treatment.		
C2 – Transportation	Distance from the dismantling site to a disposal site will be no more than 30 km. The transport mode is a 13-32 lorry.		
	Transport, freight, lorry 16-32 metric ton. EURO5 {RER}| transport, freight, lorry 16-32 metric ton. EURO5 | Cut-off. U	km	30
C3 – waste processing	Thanks to its high durability, slates can be removed during demolition or remain in the structure during rehabilitation or reconstruction. For this analysis, approximately 10 % of the slate is considered reusable in a new location. The end-of-waste status for reuse is achieved once the slate has been reconditioned for use in another project. This recondition includes cleaning the slate with water. The remaining slate, about 80 %, is recycled into aggregates. To reach its final waste state, this portion is coarse-crushed, allowing its reuse as recycled aggregate. End-of-life disposal is modelled according to the scenarios defined in the BRE Global Product Category Rules (PCR) for Type III Environmental Product Declarations of Construction Products, in accordance with EN 15804+A2 PN 514 Rev 3.1, Appendix D.		
	Slate for reuse -10%	Kg/m^2	3.69
	Slate to recycle- 80%	Kg/m^2	29.52
C4 – Disposal	The waste generated is inert, non-toxic waste, which is normally deposited in landfills. It has been assumed for this study that 10 % of the material is taken to landfill and treated as inert		
	Slate to landfill-10%	Kg/m2	3.69

Scenarios and additional technical information			
Scenario	Parameter	Units	Results
Module D	Module D reports the existence of environmental loads and impacts outside the system boundaries due to the reuse and recycling of some of the system's output streams. Module D reports on 'potential' benefit –not the actual or ultimate benefits. The net impacts resulting from counting the impacts of the reuse process and subtracting the production impacts of the materials substituted for the reused materials, considering the difference in quality between the primary and secondary material, are reported. Module D covers the net benefits and loads arising from the reuse of the slate from end-of-waste state materials resulting from the end-of-life stage (C1 – C4). For this study, it is assumed that 10% of the slates are reused, replacing virgin slates and thereby avoiding energy consumption, emissions, and resource use. In addition, 80% of the slates are recycled as aggregate, preventing the production of an equivalent amount of natural aggregates.		

Summary, comments and additional information

Results interpretation

The bulk of the environmental impacts and primary energy demand are attributed to the production phase, covered by information modules A1-A3 of EN 15804+A2.
The most significant contributions to production phase impacts are the upstream production of raw materials used in the slate manufacturing process, generation/supply of electricity, the production/use of fuels on site., and the disposal of slate waste generated.

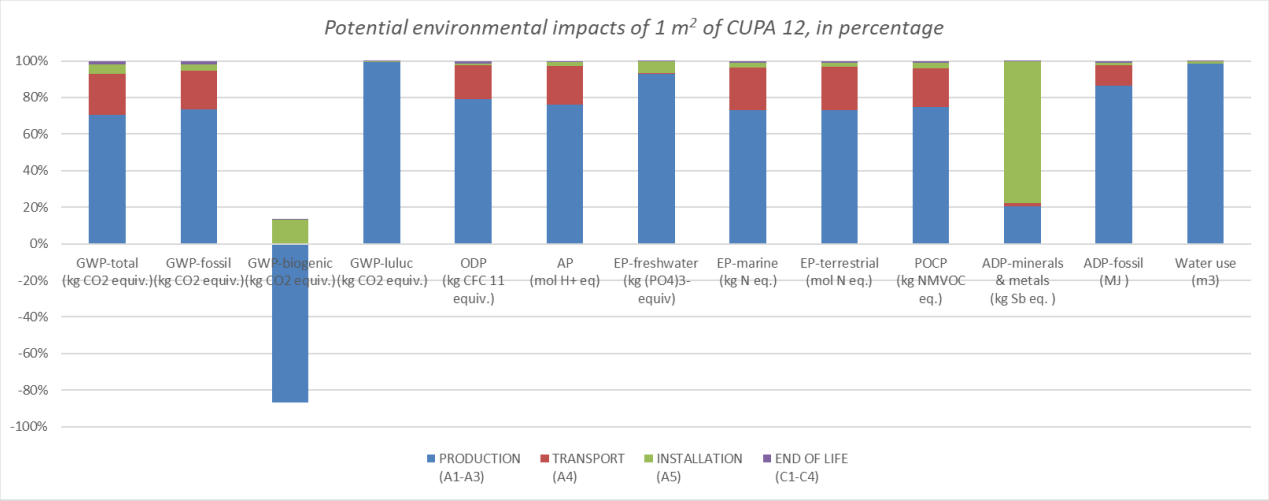


Figure 1. Representation of environmental impacts, in percentage.

Description of the variance respecting to the average of the results of the LCIA

The functional unit is declared for a group of similar products, different formats of slates: 500X250, 400x250, 600x300, 400x200, 500x300 mm with a thickness of 5 mm. For each of the products, the calculation has considered the amount of product needed to cover 1 m² of roof, meaning the size of the slate (thickness x width x length), the weight of each reference and the number of slates necessary to cover 1 m² of roof including the recommended overlapping spaces. The installation guide recommends the addition of 5% wastage allowance. This waste has been considered for the functional unit. The calculations made for each of the products can be seen in the table below:

Cupa 12								
A	**B**	**C**	**D**	**E=A*B*C*D**	**F**	**G=E*F**	**H=G*0.05**	**I=G+H**
Thickness (m)	**Length (m)**	**Width (m)**	**Density of Slate (kg/m3)**	**Weight a slate (Kg)**	**Number slate/m²**	**Quantity of slate, without wastage allowance 1 m² [kg]**	**Quantity of slate, wastage allowance [kg]**	**Quantity of slate for the functional unit (kg/m²)**
0.005	0.5	0.25	2800	1.75	20	35.00	1.75	36.75
0.005	0.4	0.25	2800	1.4	26	36.40	1.82	38.22
0.005	0.6	0.3	2800	2.52	13	32.76	1.64	34.40
0.005	0.4	0.2	2800	1.12	32	35.84	1.79	37.63
0.005	0.5	0.3	2800	2.1	17	35.7	1.79	37.49
Average						**35.14**	**1.76**	**36.90**

Next, the variance of the results in the main indicators of the different sizes with respect to the average considered is shown in the table below:

Variance of data with respect to the mean of CUPA 12

Impact Category	Unit	Average	500x250	400x250	600x300	400x200	500x300
		36.90 kg/m2	36.75 kg/m2	38.22 kg/m2	34.40 kg/m2	37.63 kg/m2	37.49 kg/m2
Climate change	kg CO2 eq	8.81E+00	8.78E+00	9.11E+00	8.24E+00	8.98E+00	8.95E+00
Climate change - Fossil	kg CO2 eq	9.44E+00	9.41E+00	9.77E+00	8.82E+00	9.62E+00	9.59E+00
Climate change - Biogenic	kg CO2 eq	-6.73E-01	-6.70E-01	-6.97E-01	-6.27E-01	-6.86E-01	-6.84E-01
Climate change - Land use and LU change	kg CO2 eq	4.12E-02	4.10E-02	4.26E-02	3.84E-02	4.20E-02	4.18E-02
Ozone depletion	kg CFC11 eq	2.55E-06	2.54E-06	2.64E-06	2.38E-06	2.60E-06	2.59E-06
Acidification	mol H+ eq	8.08E-02	8.05E-02	8.37E-02	7.54E-02	8.24E-02	8.21E-02
Eutrophication, freshwater	kg P eq	2.46E-04	2.45E-04	2.55E-04	2.31E-04	2.51E-04	2.50E-04
Eutrophication, marine	kg N eq	1.68E-02	1.68E-02	1.74E-02	1.57E-02	1.71E-02	1.71E-02
Eutrophication, terrestrial	mol N eq	1.86E-01	1.85E-01	1.93E-01	1.74E-01	1.90E-01	1.89E-01
Photochemical ozone formation	kg NMVOC eq	5.57E-02	5.55E-02	5.76E-02	5.20E-02	5.68E-02	5.65E-02
Resource use, minerals and metals	kg Sb eq	4.42E-06	4.42E-06	4.45E-06	4.35E-06	4.44E-06	4.43E-06
Resource use, fossils	MJ	2.58E+02	2.57E+02	2.67E+02	2.40E+02	2.63E+02	2.62E+02
Water use	m3 depriv.	6.33E+00	6.30E+00	6.55E+00	5.91E+00	6.45E+00	6.43E+00
Particulate matter	disease inc.	2.70E-05	2.69E-05	2.80E-05	2.52E-05	2.76E-05	2.74E-05
Ionising radiation	kBq U-235 eq	1.84E+00	1.83E+00	1.91E+00	1.72E+00	1.88E+00	1.87E+00
Ecotoxicity, freshwater	CTUe	1.11E+02	1.11E+02	1.15E+02	1.04E+02	1.13E+02	1.13E+02
Human toxicity, cancer	CTUh	5.73E-09	5.71E-09	5.84E-09	5.52E-09	5.79E-09	5.78E-09
Human toxicity, non-cancer	CTUh	9.68E-08	9.64E-08	9.98E-08	9.09E-08	9.84E-08	9.81E-08
Land use	Pt	1.04E+02	1.03E+02	1.07E+02	9.65E+01	1.06E+02	1.05E+02

The following graph represents the results of the variance of the data with respect to the mean in percentage.

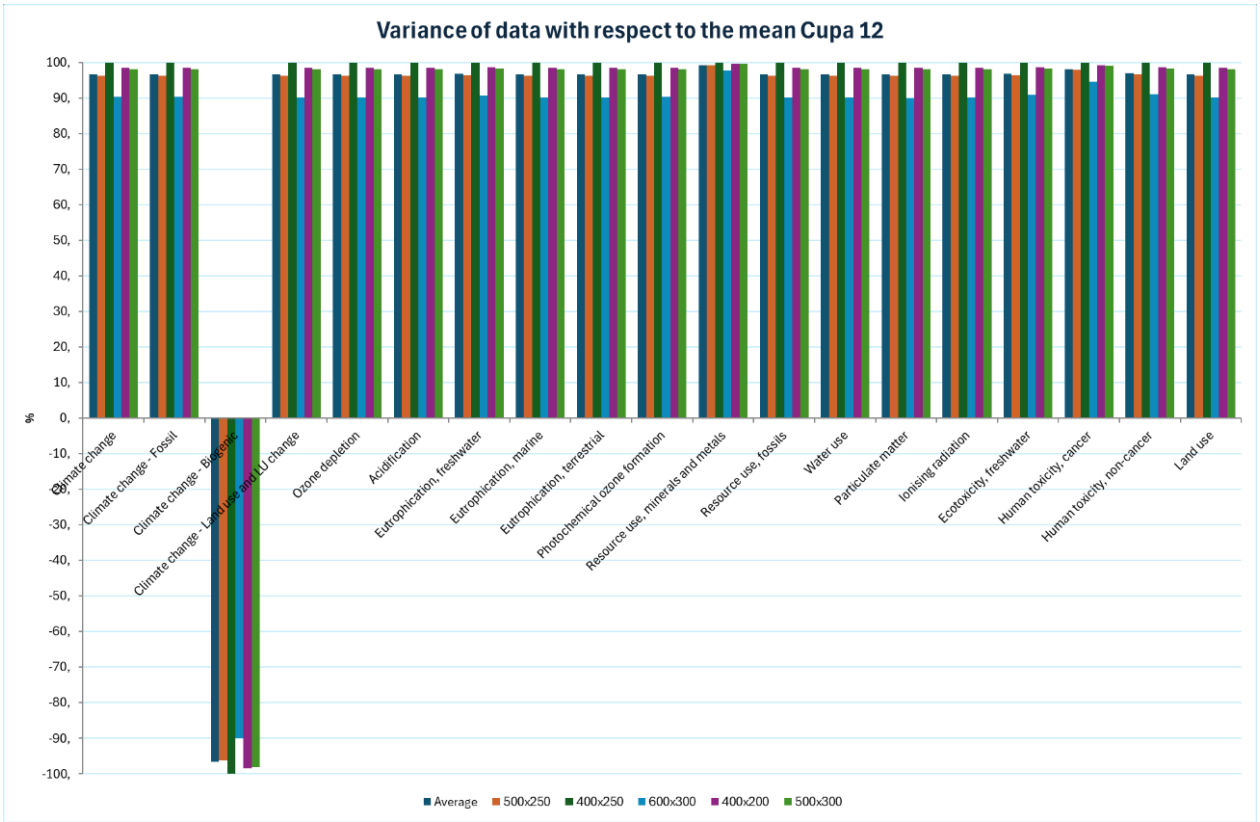


Figure 2. Variance of data with respect to the mean of CUPA 12, in percentage.

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