

GlobalEPD

A VERIFIED ENVIRONMENTAL DECLARATION



Environmental Product Declaration

EN ISO 14025:2010

EN 15804:2012+A2:2019

EN 15804:2012+A2:2019/AC:2021

AENOR

Steel guardrails

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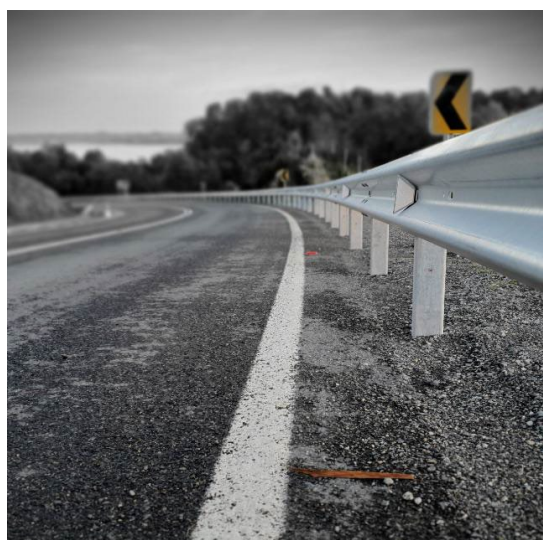
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Gonvarri
Asturias



Road Steel
Gonvarri Industries



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AENOR is a founding member of ECO Platform, the European Association of Environmental Product Declaration Verification Programs

The European Standard EN 15804:2012+A2:2019 serves as PCR
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1. General Information

1.1 The organisation

Road Steel is the road safety division of Gonvarri Industries, a leading company in the transformation of flat steel and aluminium, with more than 60 years of experience. Gonvarri Asturias is one of the production centres where road safety product can be manufactured. Gonvarri Industries has 45 factories in the flat steel and aluminium transformation sector, 20 distribution centres and offices in 19 countries.

Road Steel has a technical team of experts in the design of vehicle restraint systems, with the most modern analysis tools, which allows them to conduct research and development to improve their products. They offer a wide range of products that are designed to improve road safety, including barriers, guardrails, and crash cushions. These products are designed to protect drivers and passengers in the event of an accident, while also minimizing damage to vehicles and infrastructure. From the company's website, it is possible to consult the product catalogues within which the technical characteristics of the same are described in an exhaustive manner.

Gonvarri Industries satisfies the metal needs of their clients through their four business units: Service Centres, Metal Structures, Material Handling, and Precision Tubes. They are committed to environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment.

1.2 Scope of the declaration

This Environmental Product Declaration describes environmental information relating to the life cycle analysis from cradle to grave with options (A1-A3 + A4-A5 + C1-C4 + D), of the Single Steel Guardrails BMS1L-H2, BMS4BR-H1 and BMS4PR-N2, manufactured by Gonvarri Asturias in 2022, at its production plan in Cancienes (Asturias, Spain).

1.3 Lifecycle and compliance.

This EPD has been developed and verified in accordance with the UNE-EN ISO 14025:2010, UNE-EN 15804:2012+A2, as well as:

PRODUCT CATEGORY RULE INFORMATION

Descriptive title	Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products
Registration code and version	EN 15804:2012 + A2:2019
Date of issue	2019
Program Operator	AENOR

1.4 Differences compared to previous versions of this EDP

This version is issued to include the information on energy use in section 3.5 Other calculation rules and assumptions.

This Environmental declaration includes the following stages of the life cycle:

System limits. Information modules considered

Product stage	A1	Raw material supply	X
	A2	Transport to factory	X
	A3	Manufacture	X
Construction	A4	Transport to construction site	X
	A5	Installation/construction	X
Stage d use	B1	Use	NR
	B2	Maintenance	NR
	B3	Repair	NR
	B4	Replacement	NR
	B5	Refurbishment	NR
	B6	Operational energy use	NR
	B7	Operational water use	NR
End of life	C1	Deconstruction/demolition	X
	C2	Transport	X
	C3	Waste processing	X
	C4	Waste disposal	X
	D	Potential for reuse, recovery and/or recycling	X
X = Module included in the LCA; NR = Not relevant module; MNA = Module not assessed			

This EPD may not be comparable with those developed in other Programs or in accordance with different reference documents, specifically it may not be comparable with EPDs not prepared in accordance with the UNE-EN 15804+A2 Standard.

Similarly, this EPD may not be comparable if the source of the data is different (eg databases), not all relevant information modules are included or are not based on the same scenarios.

The comparison of construction products must be made on the same function, applying the same functional unit and at the level of the building (or architectural or engineering work), that is, including the behaviour of the product throughout its entire life cycle, as well as the specifications of section 6.7.2 of the UNE-EN ISO 14025 Standard.

2. The product

2.1 Identification of the product

The metal barriers included in this study are vehicle containment systems designed to be installed at the highway margins or median. This study includes 3 types, all of them composed by a bi-wave longitudinal rail and inclined posts with different spacing between them.

The products have successfully passed the full-scale crash-tests according to the European Standard EN 1317-2 and were certified according to the EN 1317-5.

The manufacturer declares the following information on the technical specifications of the product:

Product features

Parameter	BMS1L-H2	BMS4BR-L1	BMS4PR-N2
Containment level	H2	H1	N2
Working width	W4	W3	W3
Dynamic deflection	1.2m	0.9m	1.0m
Impact severity class	A	A	A

2.2 Product composition

The composition declared by the manufacturer, for 1 linear meter is as follows:

Product composition

Substance /Component	Contents BMS1L-H2	Contents BMS4BR-H1	Contents BMS4PR-N2	Units
Processed steel	97.77	97.23	97.19	%
Steel forging parts	2.23	2.77	2.81	%

The weight declared by the manufacturer, for 1 linear meter is as follows:

Product weight

BMS1L-H2	BMS4BR-L1	BMS4PR-N2	Units
21.56	13.72	13.49	Kg/m

3.LCA Information

3.1 Life cycle Analysis

The LCA has been performed with the support of My Professional Database EN and Extension database III: iron and steel 2023, integrated in the GaBi software. The characterization factors used are those included in the UNE EN 15804:2012+A2:2020 standard.

3.2 Declared unit

The declared unit of the present study is 1 linear meter of safety barrier.

3.3 Assignment criteria

The manufacturing processes of the product under study do not generate any co-products, so no load allocations have been made.

The cut-off criteria enable to model a product system without considering the totality of inputs and outputs. These criteria should be consistent with the objective and scope of the system. The rules set out in the 6.3.6. section of EN 15804 have been applied:

- The mass of intermediate flows not considered are less than or equal to 1 % of the mass of the elements of the reference product corresponding to the functional unit.
- The energy flows not considered are less than or equal to 1 % of the total use of primary energy during the life cycle of the product corresponding to the functional unit.
- The environmental impacts not considered are less than or equal to 5 % of the total environmental impacts generated during the life cycle of the product corresponding to the functional unit.

3.4 Representativeness, quality and selection of data

All unit processes included in the system boundaries, the quality of primary and secondary data are addressed in the LCA report. This is done according to ISO 14044 standards, where the following categories of data quality were addressed:

- Time coverage: the data collected in the study pertain to the year 2022.
- Geographical coverage: the data is representative of the region in which the product is distributed.
- Technological coverage: the data collected to develop the life cycle model of the product refer to the technology currently used by the company, its suppliers, and its employees, and is considered representative of the actual life cycle of the product.
- Precision: data collection has been carried out internally by the plant team and whenever possible, primary data has been used.

- **Completeness:** the data gathered is representative of the product system.
 - Differences in data quality along a product system life cycle and between different product systems is consistent with the goal and scope of the study.
 - Regional and temporal coverage is consistent with the scope of the study.
 - Allocation rules have been consistently applied to all product systems.
 - Elements of impact assessment have been consistently applied.
- **Consistency:** the data is representative of the current typical performance of the product under study. All, the technological, time and geographical coverage, are representative of the goal and scope of the study, as it is detailed along this report.
- **Coherence:** the assessment methodology is applied uniformly to all components of the analysis.
- **Reproducibility:** LCA calculation method has been processed, so that data gathering, and processing follows the defined assessment method. All definitions, assumptions, and calculations for all the aspects within the study are gathered and described in this report, as well as in the calculation tool.

- **Source of data:** the data is contained in the company's internal management systems.
- **Uncertainty:** assessment uncertainty has been analysed and gathered. Moreover, if data gaps are filled by estimations, a sensibility analysis is carried out so that the uncertainty level is determined.

All the data in the study are considered primary - those collected first-hand from the resources, such as weighing, invoices, records, etc. - except those regarding the downstream processes, which are secondary.

3.5 Other calculation rules and assumptions

Information on energy use:

- **Electricity:** To model the electricity mix of Gonvarri Asturias plant, CUP redemption data has been employed, which uses GoO with 100% wind power renewable electricity. The GWP of the electricity mix applied for A1-A3 is 1,41E-02 CO₂e/kWh.
- **Natural gas:** The GWP of the gas mix applied for A1-A3 is 7,23E-02 CO₂e/MJ.

4. System limits, scenarios and additional technical information

The “cradle to grave with options (A1-A3 + A4-A5 + C1-C4 + D)”,. At this scope level, all relevant inputs, and outputs at all stages of the life cycle, except the use phase, are considered.

The life cycle stages range from the extraction of all types of raw materials, through the transport, processing, manufacturing of the equipment, distribution, installation phase, to the end of life of each aspect involved in the system.

Product stage (A1-A3): includes everything from the extraction of raw materials (A1) and the manufacturing of the parts (A3), the transport (A2) from the suppliers to the plant of Gonvarri Asturias in Cancienes (Asturias, Spain), the assembly of the different sections of the safety barriers and the packaging of the product. This stage also includes in-plant consumption during the manufacturing of the product, such as energy, water or waste generated and its distribution to the end-of-life manager.

Construction process stage (A4-A5): includes transport from the Gonvarri Asturias plant in Cancienes to the place where the products are used (A4) and the consumables in the installation of the safety barriers at the customer's site, including the packaging waste generated (A5).

End of life stage (C1-C4): includes consumables in the deconstruction of the safety barriers at the customer's site (C1), transport to the waste manager from the customer's site (C2), together with the corresponding treatment by type of material, being waste processing (C3) and waste disposal (C4).

Benefits and loads beyond the system boundary (D): considers the recovery and recycling potential of the materials deriving from end-of-life processes: the calculation of the environmental benefits deriving from steel recovery is based on the indications provided in the document “Product Category Rules for Type III environmental product declaration of construction products to EN 15804: 2012”.

4.1 Pre-manufacturing processes (upstream). A1-A2

This stage includes the raw material extraction process and the transport of the materials from the suppliers' site to Gonvarri Asturias' manufacturing plant, where the product is assembled and fabricated.

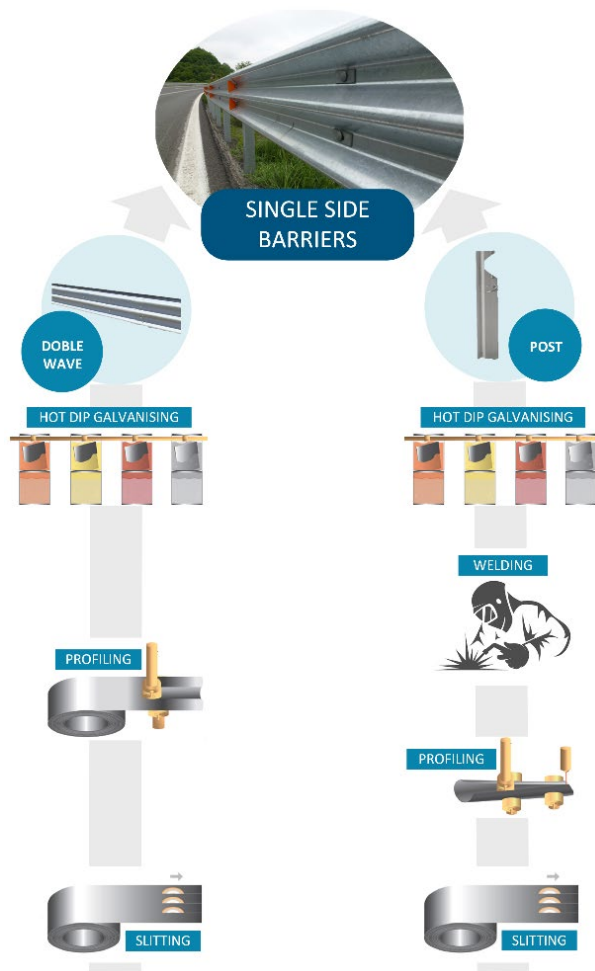
Electricity, natural gas and diesel has been included, which are allocated based on processed steel to produce the safety barrier

To model the electricity mix of the Gonvarri Asturias plant, GoO redemption system has been employed.

4.2 Product manufacturing. A3

This stage includes the description of manufacturing processes, up to the factory gate. Electricity, natural gas, diesel, and water consumption as well as the waste generated during the manufacturing stage of the product, in Gonvarri Asturias' facilities, has been included, which are allocated based on processed steel to produce the safety barrier.

During the manufacturing/assembly, waste is generated in the plant, which has also been included. This waste is then sent to material recovery or disposal, statistics for EoL of each material have been defined according to the recommended material specific values for the parameters to be used for the Circular Footprint Formula, proposed by the European Commission. A default distance of 300 km by truck is defined for the transport to the waste collector,



4.3 Installation process. A4-A5

This stage covers the transport from Gonvarri Asturias fabrication plant in Cancienes (Asturias, Spain) to the final customers and the description of the installation process.

To do this, a distribution scenario is modelled weighing the land and sea distance of final customers with the sales per country of the product during 2022.

The installation of the safety barriers requires diesel consumption assigned to the construction machine used by the post driver.

The end of life of the packaging used for the distribution of the product is also accounted for. This waste is then sent to material recovery or disposal, statistics for EoL of each material have been defined according to the recommended material specific values for the parameters to be used for the Circular Footprint Formula, proposed by the European Commission. A default distance of 300 km by truck is defined for the transport to the waste collector.

4.4 End of life (C1-C4)

For deconstruction module (C1), considering that no better data is available, consumable inputs estimated in A5 are used for the calculation.

Since the products does not return to the manufacturing plant at its end of life and the lack of information on the final waste treatment, statistics for EoL of each material have been defined according to the recommended material specific values for the parameters to be used for the Circular Footprint Formula, proposed by the European Commission.

4.5 Benefits and charges beyond the system boundary. D

This stage corresponds to the potential for reuse, recovery and/or recycling, expressed as net benefits and impacts. The inputs and outputs with the following aspects have been included in the benefits and loads beyond the system boundaries stage:

- Loads and benefits related to the export of secondary materials
- Loads and benefits related to the export of secondary fuels
- Loads and benefits related to the export of energy as a result of waste incineration
- Loads and benefits related to landfill energy export

The system boundary of the building product system at its end-of-life stage is established at the point where the outputs of the system under study, e.g., building materials, products, or elements, reach the end of waste condition. Therefore, the treatment of waste material streams (e.g., undergoing recovery or recycling processes) during any of the product system modules (e.g., during the production stage, the use stage, or the end-of-life stage) are included up to the system boundaries of the corresponding module defined above.

Parameter	Steel
% recycled	36.59 %
% to be recycled	95.00 %
% to landfill	5.00 %

5. Declaration of the environmental parameters of the ACV and the ICV for BMS1L-H2.

Environmental impacts.

The estimated impact results are relative and do not indicate the final value of the impact categories, nor do they refer to threshold values, safety margins or risks.

Parameter	Units	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP-total	kg CO2 eq	4,02E+01	1,68E+00	1,57E-02	NR	NR	NR	NR	NR	NR	NR	7,26E-02	5,84E-01	0,00E+00	4,98E-02	-1.65E+01
GWP-fossil	kg CO2 eq	3,95E+01	1,68E+00	2,44E-02	NR	NR	NR	NR	NR	NR	NR	1,14E-01	5,55E-01	0,00E+00	5,04E-02	-1.65E+01
GWP-biogenic	kg CO2 eq	7,15E-01	-1,35E-02	-1,03E-02	NR	NR	NR	NR	NR	NR	NR	-4,88E-02	2,89E-02	0,00E+00	-6,24E-04	3.49E-02
GWP-luluc	kg CO2 eq	2,12E-02	8,92E-03	1,61E-03	NR	NR	NR	NR	NR	NR	NR	7,59E-03	0,00E+00	0,00E+00	5,12E-05	-6.29E-03
GWP-total-IPCC	kg CO2 eq	3,95E+01	1,69E+00	2,48E-02	NR	NR	NR	NR	NR	NR	NR	1,16E-01	5,55E-01	0,00E+00	5,05E-02	-1.65E+01
ODP	kg CFC11 eq	5,93E-11	1,74E-13	1,52E-14	NR	NR	NR	NR	NR	NR	NR	7,17E-14	0,00E+00	0,00E+00	8,32E-14	-4.92E-07
AP	mol H+ eq	8,84E-02	1,55E-02	1,10E-04	NR	NR	NR	NR	NR	NR	NR	5,18E-04	5,17E-04	0,00E+00	1,62E-04	-6.97E-02
EP-freshwater	kg PO4 eq	3,73E-05	3,68E-06	6,34E-07	NR	NR	NR	NR	NR	NR	NR	2,99E-06	0,00E+00	0,00E+00	4,56E-08	-1.01E-03
EP-marine	kg N eq	2,39E-02	6,48E-03	2,27E-05	NR	NR	NR	NR	NR	NR	NR	1,07E-04	2,56E-04	0,00E+00	4,06E-05	-1.47E-02
EP-terrestrial	mol N eq	2,59E-01	7,15E-02	3,04E-04	NR	NR	NR	NR	NR	NR	NR	1,43E-03	2,91E-03	0,00E+00	4,46E-04	-1.71E-01
POCP	Kg NMVOC eq	7,79E-02	1,75E-02	8,51E-05	NR	NR	NR	NR	NR	NR	NR	4,00E-04	4,96E-04	0,00E+00	1,27E-04	-1.01E-01
ADP-minerals& metals ²	kg Sb eq	1,74E-06	7,04E-08	1,13E-08	NR	NR	NR	NR	NR	NR	NR	5,32E-08	0,00E+00	0,00E+00	1,38E-09	-1.08E-05
ADP-fossil ²	MJ	3,76E+02	2,19E+01	2,36E+00	NR	NR	NR	NR	NR	NR	NR	1,11E+01	0,00E+00	0,00E+00	7,53E-01	-1.60E+02
WDP ²	m ³	6,40E-01	1,28E-02	2,02E-03	NR	NR	NR	NR	NR	NR	NR	9,44E-03	0,00E+00	0,00E+00	-6,85E-04	-1.82E-01

GWP - Total: Global Warming Potential; **GWP - fossil:** Global warming potential of fossil fuels; **GWP - biogenic:** Biogenic Global Warming Potential; **GWP - luluc :** Global warming potential of land use and land use change; **ODP:** Stratospheric Ozone Depletion Potential; **AP:** Acidification potential, accumulated surplus; **EP-freshwater:** Eutrophication potential, fraction of nutrients that reach the final freshwater compartment; **EP-marine:** Eutrophication potential, fraction of nutrients that reach the final compartment of seawater; **EP-terrestrial:** Eutrophication potential, cumulative surplus; **POCP:** tropospheric ozone formation potential; **ADP-minerals&metals** Abiotic resource depletion potential for non-fossil resources; **ADP-fossil:** Abiotic Resource Depletion Potential for fossil resources; **WDP:** Water deprivation potential (user), weighted water deprivation consumption. **NR:** Not relevant

Additional environmental impacts

Parameter	Units	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PM	disease incidence	1,31E-06	3,83E-07	7,90E-10	NR	NR	NR	NR	NR	NR	NR	3,71E-09	4,52E-09	0,00E+00	1,74E-09	-1.42E-06
IRP ¹	kBq U235 eq	3,56E-01	5,15E-03	4,43E-04	NR	NR	NR	NR	NR	NR	NR	2,08E-03	0,00E+00	0,00E+00	1,30E-03	3.40E-01
ETP-fw ²	CTUe	7,26E+01	1,56E+01	1,66E+00	NR	NR	NR	NR	NR	NR	NR	7,84E+00	1,24E-03	0,00E+00	2,24E-01	-6.12E+01
HTP-c ²	CTUh	4,57E-08	3,04E-10	3,35E-11	NR	NR	NR	NR	NR	NR	NR	1,58E-10	6,02E-14	0,00E+00	2,65E-11	-1.12E-07
HTP-nc ²	CTUh	1,80E-07	1,21E-08	1,48E-09	NR	NR	NR	NR	NR	NR	NR	6,98E-09	1,36E-12	0,00E+00	2,53E-09	-3.80E-07
SQP ²	-															

PM: Potential incidence of diseases due to particulate matter (PM) emissions; **IRP** : Human Potential Exposure Efficiency Relative to U235; **ETP-fw** : Comparative Ecosystem Toxic Unit Potential - Freshwater; **HTP-c** : **Comparative Ecosystem Toxic Unit Potential - Carcinogenic Effects**; **HTP-nc** : Comparative Ecosystem Toxic Unit Potential - Non-Carcinogenic Effects; **SQP** : Soil quality potential index.; **NR**: Not relevant

Notice 1: This impact category deals mainly with the eventual impacts of low doses of ionizing radiation on human health, from the nuclear fuel cycle. It does not consider the effects due to possible nuclear accidents or occupational exposure due to the disposal of radioactive waste in underground facilities. The ionizing radiation potential of the ground, due to radon or from some construction materials, is not measured with this parameter either.

Warning 2: The results of this indicator of environmental impact should be used with caution, since the uncertainties of the results are high and the experience with this parameter is limited.

Use of resources

Parameter	Units	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PERE	MJ	3,54E+01	9,92E-01	1,67E-01	NR	NR	NR	NR	NR	NR	NR	7,88E-01	0,00E+00	0,00E+00	6,77E-02	3.34E+01
PERM	MJ	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0.00E+00
PERT	MJ	3,54E+01	9,92E-01	1,67E-01	NR	NR	NR	NR	NR	NR	NR	7,88E-01	0,00E+00	0,00E+00	6,77E-02	3.34E+01
PENRE	MJ	3,79E+02	2,20E+01	2,37E+00	NR	NR	NR	NR	NR	NR	NR	1,12E+01	0,00E+00	0,00E+00	7,54E-01	5.32E+01
PENRM	MJ	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0.00E+00
PENRT	MJ	3,79E+02	2,20E+01	2,37E+00	NR	NR	NR	NR	NR	NR	NR	1,12E+01	0,00E+00	0,00E+00	7,54E-01	-1.72E+02
SM	kg	8,40E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0.00E+00
RSF	MJ	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0.00E+00
NRSF	MJ	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0.00E+00
FW	m3	3,73E-02	1,10E-03	1,85E-04	NR	NR	NR	NR	NR	NR	NR	8,69E-04	0,00E+00	0,00E+00	8,49E-06	1.42E-03

PERE : Use of renewable primary energy excluding primary renewable energy resources used as raw material; **PERM**: Use of primary renewable energy used as raw material; **PERT**: Total use of primary renewable energy; **PENRE**: Use of non-renewable primary energy, excluding non-renewable primary energy resources used as raw materials; **PENRM**: Use of non-renewable primary energy used as raw material; **PENRT**: Total use of non-renewable primary energy; **SM**: Use of secondary materials; **RSF**: Use of renewable secondary fuels; **NRSF**: Use of non-renewable secondary fuels; **FW**: Net use of running water resources; **NR**: Not relevant

Waste categories

Parameter	Units	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HWD	kg	-1,09E-09	6,85E-11	8,77E-12	NR	NR	NR	NR	NR	NR	NR	4,13E-11	0,00E+00	0,00E+00	6,22E-11	-2.28E-03
NHWD	kg	5,87E-01	2,81E-03	3,55E-04	NR	NR	NR	NR	NR	NR	NR	1,61E-03	0,00E+00	0,00E+00	1,08E+00	-1.34E+00
RWD	kg	3,57E-03	3,50E-05	3,07E-06	NR	NR	NR	NR	NR	NR	NR	1,44E-05	0,00E+00	0,00E+00	8,76E-06	3.89E-03

HWD: Hazardous Waste Disposed; **NHWD:** Non-hazardous waste disposed of; **RWD:** Radioactive waste disposed of; **NR:** Not relevant

Output streams

Parameter	Units	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
CRU	kg	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MFR	kg	1,59E+00	0,00E+00	1,09E-04	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	1,73E+01	0,00E+00	0,00E+00
MER	kg	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EE	MJ	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	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; **NR:** Not relevant

Information on biogenic carbon content

Biogenic carbon content	Units	Result by declared functional unit
Product biogenic carbon content - KgC	Kg C	0
Biogenic carbon content packaging - KgC	Kg C	6.68E-02

6. Declaration of the environmental parameters of the ACV and the ICV for BMS4BR-L1.

Environmental impacts.

The estimated impact results are relative and do not indicate the final value of the impact categories, nor do they refer to threshold values, safety margins or risks.

Parameter	Units	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP-total	kg CO2 eq	2,59E+01	1,07E+00	1,57E-02	NR	NR	NR	NR	NR	NR	NR	5,18E-02	3,71E-01	0,00E+00	3,17E-02	-1.05E+01
GWP-fossil	kg CO2 eq	2,55E+01	1,07E+00	2,44E-02	NR	NR	NR	NR	NR	NR	NR	8,12E-02	3,53E-01	0,00E+00	3,21E-02	-1.05E+01
GWP-biogenic	kg CO2 eq	4,53E-01	-8,60E-03	-1,03E-02	NR	NR	NR	NR	NR	NR	NR	-3,48E-02	1,84E-02	0,00E+00	-3,97E-04	2.21E-02
GWP-luluc	kg CO2 eq	1,39E-02	5,68E-03	1,61E-03	NR	NR	NR	NR	NR	NR	NR	5,41E-03	0,00E+00	0,00E+00	3,26E-05	-3.98E-03
GWP-total-IPCC	kg CO2 eq	2,55E+01	1,07E+00	2,49E-02	NR	NR	NR	NR	NR	NR	NR	8,27E-02	3,53E-01	0,00E+00	3,21E-02	-1.05E+01
ODP	kg CFC11 eq	3,94E-11	1,11E-13	1,53E-14	NR	NR	NR	NR	NR	NR	NR	5,12E-14	0,00E+00	0,00E+00	5,29E-14	-3.11E-07
AP	mol H+ eq	5,77E-02	9,88E-03	1,10E-04	NR	NR	NR	NR	NR	NR	NR	3,70E-04	3,29E-04	0,00E+00	1,03E-04	-4.41E-02
EP-freshwater	kg PO4 eq	2,45E-05	2,34E-06	6,35E-07	NR	NR	NR	NR	NR	NR	NR	2,13E-06	0,00E+00	0,00E+00	2,90E-08	-6.37E-04
EP-marine	kg N eq	1,55E-02	4,12E-03	2,28E-05	NR	NR	NR	NR	NR	NR	NR	7,61E-05	1,63E-04	0,00E+00	2,58E-05	-9.32E-03
EP-terrestrial	mol N eq	1,68E-01	4,55E-02	3,05E-04	NR	NR	NR	NR	NR	NR	NR	1,02E-03	1,85E-03	0,00E+00	2,84E-04	-1.08E-01
POCP	Kg NMVOC eq	5,06E-02	1,11E-02	8,52E-05	NR	NR	NR	NR	NR	NR	NR	2,85E-04	3,15E-04	0,00E+00	8,09E-05	-6.39E-02
ADP-minerals& metals ²	kg Sb eq	1,14E-06	4,48E-08	1,13E-08	NR	NR	NR	NR	NR	NR	NR	3,80E-08	0,00E+00	0,00E+00	8,79E-10	-6.81E-06
ADP-fossil ²	MJ	2,41E+02	1,39E+01	2,37E+00	NR	NR	NR	NR	NR	NR	NR	7,95E+00	0,00E+00	0,00E+00	4,79E-01	-1.01E+02
WDP ²	m ³	4,31E-01	8,16E-03	2,03E-03	NR	NR	NR	NR	NR	NR	NR	6,74E-03	0,00E+00	0,00E+00	-4,36E-04	-1.15E-01

GWP - Total: Global Warming Potential; **GWP - fossil:** Global warming potential of fossil fuels; **GWP - biogenic:** Biogenic Global Warming Potential; **GWP - luluc :** Global warming potential of land use and land use change; **ODP:** Stratospheric Ozone Depletion Potential; **AP:** Acidification potential, accumulated surplus; **EP-freshwater:** Eutrophication potential, fraction of nutrients that reach the final freshwater compartment; **EP-marine:** Eutrophication potential, fraction of nutrients that reach the final compartment of seawater; **EP-terrestrial:** Eutrophication potential, cumulative surplus; **POCP:** tropospheric ozone formation potential; **ADP-minerals&metals** Abiotic resource depletion potential for non-fossil resources; **APD-fossil:** Abiotic Resource Depletion Potential for fossil resources; **WDP:** Water deprivation potential (user), weighted water deprivation consumption. **NR:** Not relevant

Additional environmental impacts

Parameter	Units	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PM	disease incidence	8,52E-07	2,44E-07	7,91E-10	NR	NR	NR	NR	NR	NR	NR	5,63E-01	2,88E-09	0,00E+00	1,11E-09	-9.00E-07
IRP ¹	kBq U235 eq	2,69E-01	3,28E-03	4,43E-04	NR	NR	NR	NR	NR	NR	NR	1,49E-03	0,00E+00	0,00E+00	8,24E-04	2.15E-01
ETP-fw ²	CTUe	4,77E+01	9,92E+00	1,67E+00	NR	NR	NR	NR	NR	NR	NR	5,60E+00	7,89E-04	0,00E+00	1,42E-01	-3.88E+01
HTP-c ²	CTUh	3,00E-08	1,93E-10	3,36E-11	NR	NR	NR	NR	NR	NR	NR	1,13E-10	3,83E-14	0,00E+00	1,69E-11	-7.08E-08
HTP-nc ²	CTUh	1,16E-07	7,69E-09	1,48E-09	NR	NR	NR	NR	NR	NR	NR	4,98E-09	8,63E-13	0,00E+00	1,61E-09	-2.40E-07
SQP ²	-															

PM: Potential incidence of diseases due to particulate matter (PM) emissions; **IRP** : Human Potential Exposure Efficiency Relative to U235; **ETP-fw** : Comparative Ecosystem Toxic Unit Potential - Freshwater; **HTP-c** : **Comparative Ecosystem Toxic Unit Potential - Carcinogenic Effects**; **HTP-nc** : Comparative Ecosystem Toxic Unit Potential - Non-Carcinogenic Effects; **SQP** : Soil quality potential index.; **NR**: Not relevant

Notice 1: This impact category deals mainly with the eventual impacts of low doses of ionizing radiation on human health, from the nuclear fuel cycle. It does not consider the effects due to possible nuclear accidents or occupational exposure due to the disposal of radioactive waste in underground facilities. The ionizing radiation potential of the ground, due to radon or from some construction materials, is not measured with this parameter either.

Warning 2: The results of this indicator of environmental impact should be used with caution, since the uncertainties of the results are high and the experience with this parameter is limited.

Use of resources

Parameter	Units	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PERE	MJ	2,37E+01	6,31E-01	1,68E-01	NR	NR	NR	NR	NR	NR	NR	5,63E-01	0,00E+00	0,00E+00	4,31E-02	2.11E+01
PERM	MJ	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0.00E+00
PERT	MJ	2,37E+01	6,31E-01	1,68E-01	NR	NR	NR	NR	NR	NR	NR	5,63E-01	0,00E+00	0,00E+00	4,31E-02	2.11E+01
PENRE	MJ	2,42E+02	1,40E+01	2,37E+00	NR	NR	NR	NR	NR	NR	NR	7,97E+00	0,00E+00	0,00E+00	4,80E-01	3.36E+01
PENRM	MJ	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0.00E+00
PENRT	MJ	2,42E+02	1,40E+01	2,37E+00	NR	NR	NR	NR	NR	NR	NR	7,97E+00	0,00E+00	0,00E+00	4,80E-01	-1.09E+02
SM	kg	5,32E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0.00E+00
RSF	MJ	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0.00E+00
NRSF	MJ	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0.00E+00
FW	m ³	2,53E-02	6,97E-04	1,85E-04	NR	NR	NR	NR	NR	NR	NR	6,20E-04	0,00E+00	0,00E+00	5,40E-06	8.97E-04

PERE : Use of renewable primary energy excluding primary renewable energy resources used as raw material; **PERM**: Use of primary renewable energy used as raw material; **PERT**: Total use of primary renewable energy; **PENRE**: Use of non-renewable primary energy, excluding non-renewable primary energy resources used as raw materials; **PENRM**: Use of non-renewable primary energy used as raw material; **PENRT**: Total use of non-renewable primary energy; **SM**: Use of secondary materials; **RSF**: Use of renewable secondary fuels; **NRSF**: Use of non-renewable secondary fuels; **FW**: Net use of running water resources; **NR**: Not relevant

Waste categories

Parameter	Units	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HWD	kg	-1,58E-09	4,36E-11	8,78E-12	NR	NR	NR	NR	NR	NR	NR	2,95E-11	0,00E+00	0,00E+00	3,96E-11	-1.44E-03
NHWD	kg	3,81E-01	1,79E-03	3,56E-04	NR	NR	NR	NR	NR	NR	NR	1,15E-03	0,00E+00	0,00E+00	6,87E-01	-8.49E-01
RWD	kg	2,54E-03	2,23E-05	3,07E-06	NR	NR	NR	NR	NR	NR	NR	1,03E-05	0,00E+00	0,00E+00	5,57E-06	2.46E-03

HWD: Hazardous Waste Disposed; **NHWD:** Non-hazardous waste disposed of; **RWD:** Radioactive waste disposed of; **NR:** Not relevant

Output streams

Parameter	Units	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
CRU	kg	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MFR	kg	1,01E+00	0,00E+00	1,39E-04	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	1,10E+01	0,00E+00	0,00E+00
MER	kg	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EE	MJ	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	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; **NR:** Not relevant

Information on biogenic carbon content

Biogenic carbon content	Units	Result by declared functional unit
Product biogenic carbon content - KgC	Kg C	0
Biogenic carbon content packaging - KgC	Kg C	4.23E-02

7. Declaration of the environmental parameters of the ACV and the ICV for BMS4PR-N2.

Environmental impacts.

The estimated impact results are relative and do not indicate the final value of the impact categories, nor do they refer to threshold values, safety margins or risks.

Parameter	units	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP-total	kg CO2 eq	2,55E+01	1,05E+00	1,57E-02	NR	NR	NR	NR	NR	NR	NR	3,58E-02	3,65E-01	0,00E+00	3,12E-02	-1.03E+01
GWP-fossil	kg CO2 eq	2,51E+01	1,05E+00	2,44E-02	NR	NR	NR	NR	NR	NR	NR	5,61E-02	3,47E-01	0,00E+00	3,16E-02	-1.03E+01
GWP-biogenic	kg CO2 eq	4,45E-01	-8,45E-03	-1,03E-02	NR	NR	NR	NR	NR	NR	NR	-2,40E-02	1,81E-02	0,00E+00	-3,91E-04	2.17E-02
GWP-luluc	kg CO2 eq	1,37E-02	5,58E-03	1,61E-03	NR	NR	NR	NR	NR	NR	NR	3,74E-03	0,00E+00	0,00E+00	3,21E-05	-3.91E-03
GWP-total-IPCC	kg CO2 eq	2,51E+01	1,06E+00	2,48E-02	NR	NR	NR	NR	NR	NR	NR	5,71E-02	3,47E-01	0,00E+00	3,16E-02	-1.03E+01
ODP	kg CFC11 eq	3,87E-11	1,09E-13	1,52E-14	NR	NR	NR	NR	NR	NR	NR	3,53E-14	0,00E+00	0,00E+00	5,21E-14	-3.06E-07
AP	mol H+ eq	5,68E-02	9,71E-03	1,10E-04	NR	NR	NR	NR	NR	NR	NR	2,55E-04	3,23E-04	0,00E+00	4,24E-02	-4.34E-02
EP-freshwater	kg PO4 eq	2,41E-05	2,30E-06	6,34E-07	NR	NR	NR	NR	NR	NR	NR	1,47E-06	0,00E+00	0,00E+00	4,72E-01	-6.26E-04
EP-marine	kg N eq	1,53E-02	4,06E-03	2,27E-05	NR	NR	NR	NR	NR	NR	NR	5,26E-05	1,60E-04	0,00E+00	0,00E+00	-9.16E-03
EP-terrestrial	mol N eq	1,65E-01	4,47E-02	3,04E-04	NR	NR	NR	NR	NR	NR	NR	7,04E-04	1,82E-03	0,00E+00	5,31E-06	-1.06E-01
POCP	Kg NMVOC eq	4,99E-02	1,10E-02	8,51E-05	NR	NR	NR	NR	NR	NR	NR	1,97E-04	3,10E-04	0,00E+00	0,00E+00	-6.28E-02
ADP-minerals& metals ²	kg Sb eq	1,12E-06	4,40E-08	1,13E-08	NR	NR	NR	NR	NR	NR	NR	2,62E-08	0,00E+00	0,00E+00	3,90E-11	-6.69E-06
ADP-fossil ²	MJ	2,37E+02	1,37E+01	2,36E+00	NR	NR	NR	NR	NR	NR	NR	5,49E+00	0,00E+00	0,00E+00	0,00E+00	-9.97E+01
WDP ²	m ³	4,24E-01	8,02E-03	2,02E-03	NR	NR	NR	NR	NR	NR	NR	4,65E-03	0,00E+00	0,00E+00	5,48E-06	-1.13E-01

GWP - Total: Global Warming Potential; **GWP - fossil:** Global warming potential of fossil fuels; **GWP - biogenic:** Biogenic Global Warming Potential; **GWP - luluc :** Global warming potential of land use and land use change; **ODP:** Stratospheric Ozone Depletion Potential; **AP:** Acidification potential, accumulated surplus; **EP-freshwater:** Eutrophication potential, fraction of nutrients that reach the final freshwater compartment; **EP-marine:** Eutrophication potential, fraction of nutrients that reach the final compartment of seawater; **EP-terrestrial:** Eutrophication potential, cumulative surplus; **POCP:** tropospheric ozone formation potential; **ADP-minerals&metals** Abiotic resource depletion potential for non-fossil resources; **APD-fossil:** Abiotic Resource Depletion Potential for fossil resources; **WDP:** Water deprivation potential (user), weighted water deprivation consumption. **NR:** Not relevant

Additional environmental impacts

Parameter	Units	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PM	disease incidence	8,40E-07	2,40E-07	7,90E-10	NR	NR	NR	NR	NR	NR	NR	3,89E-01	2,83E-09	0,00E+00	1,09E-09	-8.85E-07
IRP ¹	kBq U235 eq	2,65E-01	3,22E-03	4,43E-04	NR	NR	NR	NR	NR	NR	NR	1,03E-03	0,00E+00	0,00E+00	8,11E-04	2.12E-01
ETP-fw ²	CTUe	4,69E+01	9,76E+00	1,66E+00	NR	NR	NR	NR	NR	NR	NR	3,87E+00	7,75E-04	0,00E+00	1,40E-01	-3.81E+01
HTP-c ²	CTUh	2,95E-08	1,90E-10	3,35E-11	NR	NR	NR	NR	NR	NR	NR	7,79E-11	3,76E-14	0,00E+00	1,66E-11	-6.96E-08
HTP-nc ²	CTUh	1,14E-07	7,56E-09	1,48E-09	NR	NR	NR	NR	NR	NR	NR	3,44E-09	8,48E-13	0,00E+00	1,59E-09	-2.36E-07
SQP ²	-															

PM: Potential incidence of diseases due to particulate matter (PM) emissions; **IRP** : Human Potential Exposure Efficiency Relative to U235; **ETP-fw** : Comparative Ecosystem Toxic Unit Potential - Freshwater; **HTP-c** : **Comparative Ecosystem Toxic Unit Potential - Carcinogenic Effects**; **HTP-nc** : Comparative Ecosystem Toxic Unit Potential - Non-Carcinogenic Effects; **SQP** : Soil quality potential index.; **NR**: Not relevant

Notice 1: This impact category deals mainly with the eventual impacts of low doses of ionizing radiation on human health, from the nuclear fuel cycle. It does not consider the effects due to possible nuclear accidents or occupational exposure due to the disposal of radioactive waste in underground facilities. The ionizing radiation potential of the ground, due to radon or from some construction materials, is not measured with this parameter either.

Warning 2: The results of this indicator of environmental impact should be used with caution, since the uncertainties of the results are high and the experience with this parameter is limited.

Use of resources

Parameter	Units	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PERE	MJ	2,33E+01	6,21E-01	1,67E-01	NR	NR	NR	NR	NR	NR	NR	3,89E-01	0,00E+00	0,00E+00	4,24E-02	2.08E+01
PERM	MJ	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0.00E+00
PERT	MJ	2,33E+01	6,21E-01	1,67E-01	NR	NR	NR	NR	NR	NR	NR	3,89E-01	0,00E+00	0,00E+00	4,24E-02	2.08E+01
PENRE	MJ	2,38E+02	1,37E+01	2,37E+00	NR	NR	NR	NR	NR	NR	NR	5,50E+00	2,29E-03	0,00E+00	4,72E-01	3.31E+01
PENRM	MJ	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0.00E+00
PENRT	MJ	2,38E+02	1,37E+01	2,37E+00	NR	NR	NR	NR	NR	NR	NR	5,50E+00	0,00E+00	0,00E+00	4,72E-01	-1.07E+02
SM	kg	5,23E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0.00E+00
RSF	MJ	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0.00E+00
NRSF	MJ	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0.00E+00
FW	m ³	2,49E-02	6,85E-04	1,85E-04	NR	NR	NR	NR	NR	NR	NR	4,28E-04	0,00E+00	0,00E+00	5,31E-06	8.82E-04

PERE : Use of renewable primary energy excluding primary renewable energy resources used as raw material; **PERM**: Use of primary renewable energy used as raw material; **PERT**: Total use of primary renewable energy; **PENRE**: Use of non-renewable primary energy, excluding non-renewable primary energy resources used as raw materials; **PENRM**: Use of non-renewable primary energy used as raw material; **PENRT**: Total use of non-renewable primary energy; **SM**: Use of secondary materials; **RSF**: Use of renewable secondary fuels; **NRSF**: Use of non-renewable secondary fuels; **FW**: Net use of running water resources; **NR**: Not relevant

Waste categories

Parameter	Units	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HWD	kg	-1,56E-09	4,28E-11	8,77E-12	NR	NR	NR	NR	NR	NR	NR	2,04E-11	0,00E+00	0,00E+00	3,90E-11	-1.42E-03
NHWD	kg	3,75E-01	1,76E-03	3,56E-04	NR	NR	NR	NR	NR	NR	NR	7,93E-04	0,00E+00	0,00E+00	6,76E-01	-8.34E-01
RWD	kg	2,50E-03	2,19E-05	3,07E-06	NR	NR	NR	NR	NR	NR	NR	7,12E-06	0,00E+00	0,00E+00	5,48E-06	2.42E-03

HWD: Hazardous Waste Disposed; **NHWD:** Non-hazardous waste disposed of; **RWD:** Radioactive waste disposed of; **NR:** Not relevant

Output streams

Parameter	Units	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
CRU	kg	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MFR	kg	1,64E-01	0,00E+00	1,36E-04	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	1,08E+01	0,00E+00	0,00E+00
MER	kg	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EE	MJ	0,00E+00	0,00E+00	0,00E+00	NR	NR	NR	NR	NR	NR	NR	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; **NR:** Not relevant

Information on biogenic carbon content

Biogenic carbon content	Units	Result by declared functional unit
Product biogenic carbon content - KgC	Kg C	0
Biogenic carbon content packaging - KgC	Kg C	4.16E-02

References

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