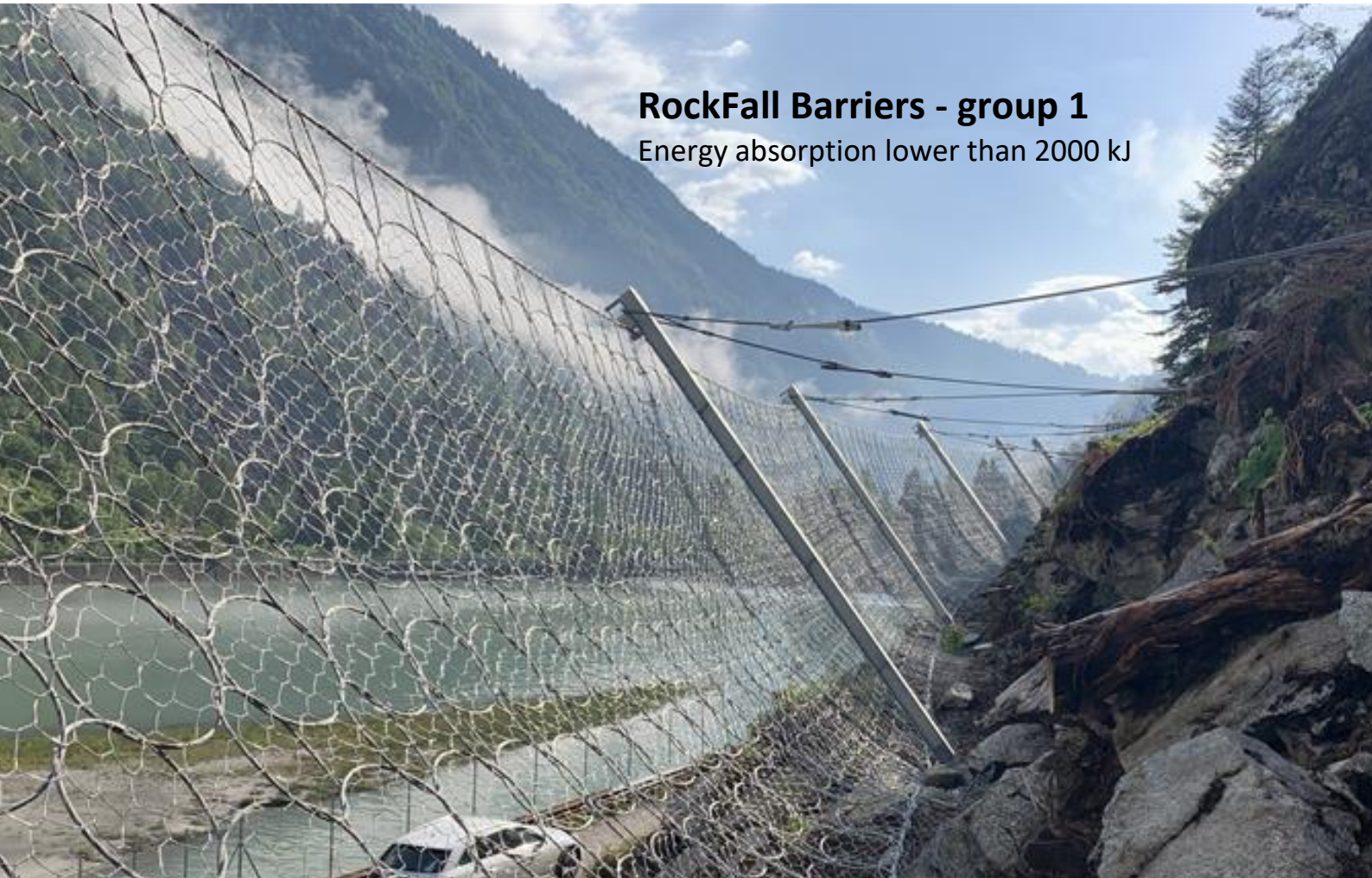
Environmental Product Declaration

as per ISO 14025 and EN 15804

Owner of the declaration:	Officine Maccaferri S.p.A.
Publisher:	Kiwa-Ecobility Experts
Programme operator:	Kiwa-Ecobility Experts
Registration number:	EPD-Kiwa-EE-000436-EN
Issue date:	27.06.2025
Valid to:	27.06.2030



1. General information

Officine Maccaferri S.p.A.

RockFall Barriers - group 1
Energy absorption lower than 2000 kJ

Programme operator:
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Kiwa GmbH, Ecobility Experts
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Owner of the declaration:
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20122 Milano (MI)
Italy

Registration number:
EPD-Kiwa-EE-000436-EN

Declared product / declared unit:
1 m^2 RockFall Barriers

This declaration is based on the Product Category Rules:
PCR B – Product Category Rules for steel construction products, Requirements on the Environmental Product Declarations for steel construction products; Version 2020-03-13

Scope:
The EPD is based on the composition of RB35, RB35H2, RB70, RB100 UAF, RB750, RB1000, RB1500. The average product EPD type is Cradle to gate with option module A4 from manufacturer to place of installation, modules C1-C4, and module D.
Kiwa-Ecobility Experts assumes no liability for manufacturer's information, LCA data and evidence.

Issue date:
27.06.2025

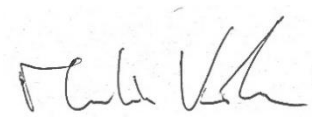
Valid to:
27.06.2030

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

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



Martin Koehrer
(Verification body, Kiwa-Ecobility Experts)

Morteza Nikravan
(Third party verifier)

2. Product

2.1 Product description

Rockfall barriers are key elements in the security and safety of infrastructure, mine works, buildings or people. Even small rockfalls or debris flows events can block infrastructure and can have far-reaching economic effects beyond the immediate disruption. This also applies to buildings or other installations at risk of damage from rockfalls. Rockfall barriers group 1 (Energy absorption lower than 2000 kJ) hybrid and attenuators are specifically developed to mitigate hazards coming from low to medium energy rockfall impacts. These structures consist of main components: interception structures made of galvanized steel mesh, supporting elements made of hot deep galvanized metallic posts and base plates and connecting elements including energy dissipating devices, made mostly of galvanized steel wire ropes.

2.2 Application (Intended Use of the product)

The main goal of these structures is to stop the falling boulders or drastically reducing their impacting speed, by dissipating the energy through deformation of the structures' components.
Rockfall barriers group 1 (Energy absorption lower than 2000 kJ) were tested and manufactured in compliance with ETAG 027 (EAD 340059-00-0106 or EAD 340089-00-0106).

2.3 Reference Service Life (RSL)

The typical service life is up to 50 years depending on protective coating of the components and the environmental site condition.
In addition to international standard testing requirements for mechanical performance of the overall system, the raw materials and main components of Maccaferri Rockfall Barriers undergo dedicated aging tests, to ensure their reliability from the moment of installation to the end of their working life.

2.4 Technical data

Characteristics (*)	Value	Unit
Energy absorption	From 0 to 1500	kJ
Available Nominal Height (**)	Up to 5	m
Durability	Depending on environmental conditions	

(*) Further Performances are detailed in Declaration of Performance according to Regulation (EU) 305/2011.

(**) Nominal height and reference height in accordance with ETAs issued in accordance to EAD 340059-00-0106 and EAD 340089-00-0106.

2.5 Substances of very high concern

Rockfall barriers group 1 (Energy absorption lower than 2000 kJ) do not contain SVHC.

2.6 Base materials / Ancillary materials

The composition with scrap for 1 m^2 of the reference products is reported in Table below. The products are implemented with galvanized steel (interception structures made of galvanized steel mesh, supporting elements made of hot deep galvanized metallic posts and base plates, and connecting elements made mostly of galvanized steel ropes) an Aluminum (connecting components and energy dissipating devices)

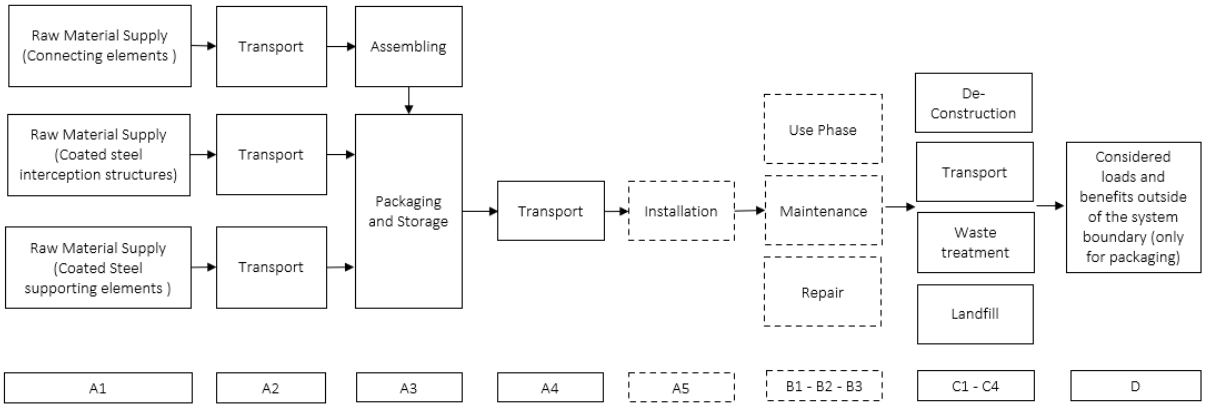
Raw material	Unit	Value
Steel (galvanized steel)	kg	9.109
Aluminium	kg	0.100

The reference CPC code is 412 “Products of iron or steel”.

2.7 Manufacturing

The manufacturing is carried out in Trento plant (Italy).

The production process includes the assembling of connection components and collection of coated steel interception structure together with steel supporting elements.



2.8 Other Information

Further technical characteristics and information of the Rockfall barriers (Energy absorption lower than 2000 kJ) are detailed and available on the Maccaferri website (https://www.maccaferri.com/).

According to Construction Product Regulation (EU) 305/2011 the essential technical characteristics are reported in the ETAs and Declaration of Performances (DOP).

In terms of recycled contents, the analyzed Rockfall barriers group 1 (Energy absorption lower than 2000 kJ) has the following characteristics:

Steel produced through Electric arc furnace (EAF), with minimum recycled contents of 75%

Steel produced through Blast oxygen furnace (BOF) with minimum recycled contents of 16.5%

Rockfall barriers group 1 (Energy absorption lower than 2000 kJ)	% of recycled material*	%EAF	%BOF
Steel	56.5	75	16.5

*Based on the available suppliers' declarations.

3. LCA: Calculation rules

3.1 Declared unit

In accordance with the PCR B, 1 m^2 of Rockfall barriers group 1 (Energy absorption lower than 2000 kJ) is chosen as the declared unit.

3.2 Conversion factors

Product	Unit weight (kg/m^2)	Conversion factor per 1 kg
Rockfall barriers group 1 average product (Energy absorption lower than 2000 kJ)	**9.210**	**0.109**

3.3 Scope of declaration and system boundaries

This a cradle to gate with module A4, modules C1-C4 and module D. Module A5 has not been considered since it is highly dependent on the context in which the opera fits. More precisely, the following processes were accounted for each module:

A1 - Production of raw materials used in the products, as well as the production of energy carriers used in the production process.

A2 - Transport of raw materials to the manufacturing site and internal handling

A3 - Manufacturing of the Rockfall barriers group 1 (Energy absorption lower than 2000 kJ) which includes the manufacturing steps reported in section 2.7 as well as the production of the distribution packaging and of the ancillary material. In addition, the treatment of waste generated from the manufacturing processes are accounted for.

A4 - Transport from the manufacturer to the place of use (Module A4 is declared for a distance of 1000 km to give the possibility to adjust the results depending on the specific distance)

C1 - Disassembly of the packaging and of the steel interceptions nettings and panels was considered to be both manual operations and equal to zero.

C2 - Transport from collection point to waste processing and disposal site.

C3 - Shredding and sorting of fractions for recycling.

C4 - Landfill of material fractions not recycled.

D - benefit due to the avoided production of electrical and thermal energy resulting from the incineration of the wood distribution packaging and the avoided production of steel from recycled steel panels and nettings.

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	Manufacturing	Transport from manufacturer to place of use	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishment	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	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	X
X=Module declared | MND=Module not declared																

3.4 Geographical reference area

All process-specific data was collected for the operating year 2024. Geographical reference area is global.

3.5 Cut-uff Criteria

The cut-off applied are related to the packaging of chemicals products and lubricating oil used in the production process.

3.6 Allocation

A mass allocation based on the weight of the production volumes has been applied for energy consumption and general waste of the manufacturing process.

3.7 Data collection and reference time period

Specific data were collected at Trento plant (Italy) considering an annual average referred to 2024, whereas the most updated selected generic datasets available in the LCI databases were used for the other modules. Thus, in line with PCR A requirements, manufacturer-specific data is not older than 5 years and generic data is not older than 10 years.

3.8 Estimates and assumptions

The main assumptions are related to distances of inbound and background transportations. It was also assumed that liquid and gas auxiliaries are unpacked and supplied in tanker trucks.

3.9 Power Mix

With regard to electricity modelling, the market based approach is applied. Since Trento plant uses only electricity from hydropower and has a contract covered by a guarantee of origin with the supplier, the electricity mix was modelled accordingly. The GWP value of the electricity used is 0.006 kg CO2 eq./kWh.

3.10 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+A2. 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), end of life 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

Rockfall Barriers are composed of different parts, some of them removable such as the interception nettings and panels, and others that would be unnecessary to remove both economically and environmentally, such as supporting elements (posts). The dismantling of the steel netting and panel is performed manually, since it consists of the release of some bolts and sleeves. For this reason, C1 is considered equal to zero. The removed panels and nettings are then sent for shredding on a truck EURO 5 (module C2) and, after shredding operation (module C3), with a loss of 5% sent to landfill, the remaining treated steel is sent for recycling (module D). Hence, it is important to emphasise that there is no total correspondence in the input-output mass balance of the system product as part of the rockfall barriers remain in the installation site. No environmental loads or credits from these components have been accounted for. For RB1500 the total amount of steel removed is 4.72 kg while 6.59 kg remains in the installation site.

Processes	Unit (expressed per FU or DU of components, products or materials and by type of material)	RB1500
Collection process specified by type	Kg collected separately	Steel: 4.72 kg
		Wood: 0.47 kg
Recovery system specified by type	Kg for recycling	Steel: 4.49 kg
	Kg for recycling	Wood: 0.14 kg
	Kg for energy recovery	Wood: 0.17 kg
Disposal specified by type	Kg product or material for final deposition	Landfill (Steel): 0.24 kg
		Landfill (Wood): 0.15 kg

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. Due to the variation in the interception panels used and the different weights in production volumes among barriers of the group, some impact categories of the most impactful rockfall barrier in this group have a deviation greater than 10% from the average impacts calculated on the average profile.

	LCA results - Indicators describing environmental impacts based on the impact assessment (LCIA): 1 m² Energy absorption lower to 2000 kJ average profile (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.	1.78E+01	7.81E-01	0.00E+00	3.12E-03	3.14E-01	2.36E-01	-3.04E-01
GWP-f	kg CO2 eqv.	1.77E+01	7.72E-01	0.00E+00	3.14E-03	9.27E-02	8.60E-03	-3.04E-01
GWP-b	kg CO2 eqv.	6.10E-02	1.78E-03	0.00E+00	-4.59E-05	2.22E-01	2.27E-01	1.49E-04
GWP-luc	kg CO2 eqv.	2.08E-02	7.30E-03	0.00E+00	2.90E-05	1.51E-05	7.28E-06	-1.10E-04
ODP	kg CFC 11 eqv.	1.22E-10	1.03E-13	0.00E+00	2.74E-16	2.46E-12	1.48E-14	3.23E-13
AP	mol H+ eqv.	6.51E-02	5.06E-03	0.00E+00	1.65E-05	1.73E-04	5.43E-05	-6.44E-04
EPfr	kg P eqv.	4.01E-05	2.88E-06	0.00E+00	1.14E-08	5.40E-07	3.69E-07	-1.07E-07
EPmar	kg N eqv.	2.02E-02	2.48E-03	0.00E+00	7.96E-06	5.53E-05	7.99E-05	-1.59E-04
EPter	mol N eqv.	2.20E-01	2.75E-02	0.00E+00	8.86E-05	6.14E-04	2.13E-04	-1.72E-03
POCP	kg NMVOC eqv.	5.63E-02	4.79E-03	0.00E+00	1.56E-05	1.36E-04	1.33E-04	-5.16E-04
ADP-e	kg Sb-eqv.	4.69E-04	5.23E-08	0.00E+00	2.04E-10	1.65E-08	2.30E-10	-6.49E-09
ADP-f	MJ	2.24E+02	1.07E+01	0.00E+00	4.26E-02	1.31E+00	1.27E-01	-2.89E+00
WU	m3 world eqv.	2.06E+00	9.53E-03	0.00E+00	3.61E-05	2.72E-02	1.47E-03	-8.81E-03
	Additional environmental impact indicators (EN 15804+A2)							
PM	disease incidence	1.03E-06	1.88E-08	0.00E+00	7.70E-11	1.32E-09	5.17E-10	-9.10E-09
IR	kBq U235 eqv.	1.62E+00	3.01E-03	0.00E+00	7.97E-06	1.35E-02	2.30E-04	-8.85E-03
ETP-fw	CTUe	7.76E+01	7.69E+00	0.00E+00	3.00E-02	5.01E-01	2.48E-01	-4.31E-01
HTP-c	CTUh	1.32E-08	1.56E-10	0.00E+00	6.06E-13	7.87E-11	5.61E-12	-3.99E-10
HTP-nc	CTUh	1.98E-07	6.95E-09	0.00E+00	2.67E-11	4.74E-10	7.37E-10	-3.19E-11
SQP	Pt	2.35E+02	4.49E+00	0.00E+00	1.78E-02	8.39E-01	1.15E-02	-1.70E-02
	ADP-e= Abiotic depletion potential for non-fossil resources | **ADP-f**=Abiotic depletion for fossil resources potential | **AP**= Acidification potential, Accumulated Exceedance | **EPfr** = Eutrophication potential, fraction of nutrients reaching freshwater end compartment | **EPmar**= Eutrophication potential, fraction of nutrients reaching marine end compartment| **EPter**= Eutrophication potential, Accumulated Exceedance | **GWP-b**=Global Warming Potential biogenic | **GWP-f**=Global Warming Potential fossil fuels | **GWP-luc**=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 | **WU**=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							

Disclaimer on ADP-e, ADP-f, WU, ETP-fr, 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.

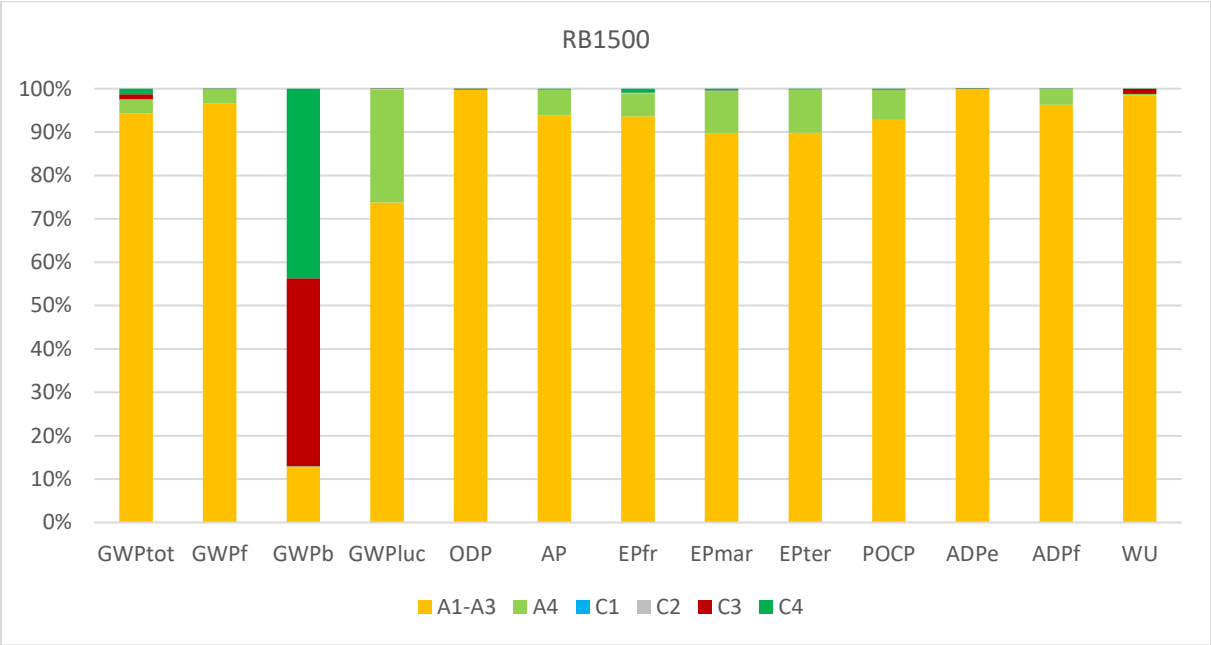
Disclaimer on IR: This impact category mainly addresses the potential effect of low dose ionizing radiation on human health in the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents and occupational exposures, nor does it consider radioactive waste disposal in underground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

	LCA results - Indicators describing resource use and environmental information derived from life cycle inventory (LCI): 1 m² Energy absorption lower to 2000 kJ average profile (EN 15804+A2)							
Parameter	**Unit**	**A1-A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	9.60E+01	7.82E-01	0.00E+00	3.02E-03	1.20E+00	1.18E-02	1.78E-02
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	9.60E+01	7.82E-01	0.00E+00	3.02E-03	1.20E+00	1.18E-02	1.78E-02
PENRE	MJ	2.25E+02	1.08E+01	0.00E+00	4.27E-02	1.31E+00	1.27E-01	-2.91E+00
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	2.25E+02	1.08E+01	0.00E+00	4.27E-02	1.31E+00	1.27E-01	-2.91E+00
SM	Kg	6.40E+00	0.00E+00	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	M3	8.93E-02	8.56E-04	0.00E+00	3.32E-06	9.95E-04	3.84E-05	-3.97E-04
HWD	Kg	5.93E-06	3.34E-11	0.00E+00	1.58E-13	-2.45E-10	1.05E-11	-6.22E-11
NHWD	Kg	2.37E+00	1.64E-03	0.00E+00	6.16E-06	5.57E-03	8.10E-02	-4.23E-03
RWD	Kg	1.18E-02	2.02E-05	0.00E+00	5.52E-08	1.26E-04	1.55E-06	-4.21E-05
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	2.48E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.17E+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, thermal | EE=Exported energy, electrical							

LCA results - information on biogenic carbon content at the factory gate: 1 m² Energy absorption lower to 2000 kJ average profile (EN 15804+A2)		
Parameter	**Unit**	**Value**
biogenic carbon content in product	kg C	0
biogenic carbon content in accompanying packaging	kg C	0.151
NOTE 1 kg biogenic carbon is equivalent to 44/12 kg CO2		

6. LCA: Interpretation

The analysis of the contribution of each module to the impacts of the heaviest Rockfall barrier in group 1 (RB1500) is shown in the graph below. It can be observed that the impacts are driven by modules A1-A3, while the contribution of the other modules is less than 10% for all impact categories analyzed except for biogenic GWP (87%), whose impact is driven by the disposal of wood packaging, as it is the only material with biogenic GWP content in the analyzed product system. The contribution of module D is negligible (<1%) compared to modules A1-A3.



7. References

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
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
PCR B	Kiwa-Ecobility Experts, Berlin, 2020: PCR B – Product Category Rules for steel construction products, Requirements on the Environmental Product Declarations for steel construction products; Version 2020-03-13 (draft)
Ecoinnovazione; 2024.	Technical report: LCA study of Rockfall barrier products for Geoengineering works.

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