ZAG EPD

Environmental Product Declaration

According to ISO 14025 and EN 15804

Product families Randdrahtgabione, Ösengabione and Hakengabione

EPD number	EPD-24/0003
EPD owner	Rothfuss Best Gabion GmbH & Co. KG Dr.-Oetker-Straße 30 DE-54516 Wittlich / Germany
EPD Program operator	ZAG EPD
Issue date	26. 09. 2024
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ECO PLATFORM EPD VERIFIED

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General information	Product families of welded wire panels for gabions Randdrahtgabione, Ösengabione and Hakengabione – average EPD
Program holder: Slovenian National Building And Civil Engineering Institute - ZAG Dimičeva ulica 12 1000 Ljubljana http://www.zag.si	**Owner of the Environmental Product Declaration:** Rothfuss Best Gabion GmbH & Co. KG Dr.-Oetker-Straße 30 DE-54516 Wittlich / Germany www.rothfuss-bestgabion.de
Number of the Environmental Product Declaration: EPD-24/0003	**Declared unit:** 1 kg of steel parts of gabions
This Environmental Product Declaration is based on the Product Category Rules (PCR): Product Category Rules for Building-Related Products and Services - Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report according to EN 15804+A2:2019 version 1.4, and EPD International Product category rules (PCR) for Construction products (2019:14, version 1.3.1) valid until 20. 12. 2024	**Scope:** A1-A3, C and D
Issue date: 26. 09. 2024 **Valid until:** 26. 09. 2029 **Production plant:** Rothfuss Best Gabion GmbH & Co. KG Dr.-Oetker-Straße 30 DE-54516 Wittlich / Germany	**Verification:** The CEN standard SIST EN 15804 serves as the core Product Category Rule (PCR) Independent verification of the EPD according to EN ISO 14025 ☐ external ☒ internal **Title and the handwritten signature of verificator:** *Janez Turk, PhD* Slovenian National Building And Civil Engineering Institute – ZAG
Title and the handwritten signature issuer: *Franc Capuder, MSc* Slovenian National Building And Civil Engineering Institute – ZAG	**Title and handwritten signature of leading expert:** *Anja Lešek, MSc env. civ. eng.* Slovenian National Building And Civil Engineering Institute – ZAG

1 Product

1.1 Product description

Product families Randdrahtgabione, Ösengabione and Hakengabione are all welded wire panels for gabions.

Product family **Randdrahtgabione**: Welded wire panels with square edges (flush cut) made from steel wire connected with spiral binder (helical rod), cramp, clamp or C-ring and stiffened by stiffeners (distance rod).

Product family **Ösengabione**: Welded wire panels with welded eyelets made from steel wire connected with locking rod and stiffened by stiffeners (distance rod). Locking system also with minimum risk of injury.

Product family **Hakengabione**: Welded wire panels with hooks made from steel wire, connected by hooking up to each other and stiffened by stiffeners (distance rod).

1.2 Technical Data

All included products have their technical specifications listed in ETA-21/0448 dated 8th of March 2024, based on EAD 200020-00-0102 Weldmesh gabion boxes and mattresses, March 2017.

The basic materials for the production of Product families Randdrahtgabione, Ösengabione and Hakengabione is a hot dip coated steel wire according to EN 16120-2, tolerance according to EN 10218-2 T1, with Zinc-aluminium alloy Zn 95%/Al 5% or Zn 90%/Al 10% coating and minimum thickness according to EN 10244-2 (accuracy class A). The coating process can apply various thicknesses of the ZnAl coatings which are described in defined values of EN 10244-2. Product families differ from each other mostly by shape which does not affect the LCA calculations per mass of product (1 kg).

The properties and pictures of Product families Randdrahtgabione, Ösengabione and Hakengabione are presented in Table 1.

1.3 Application

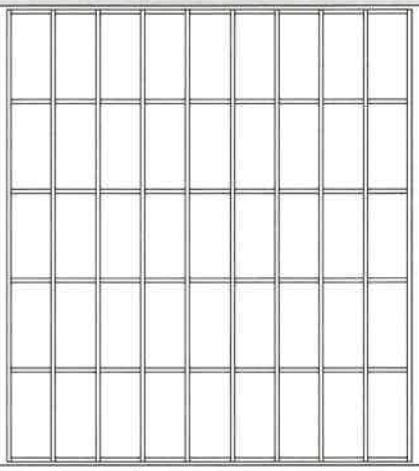
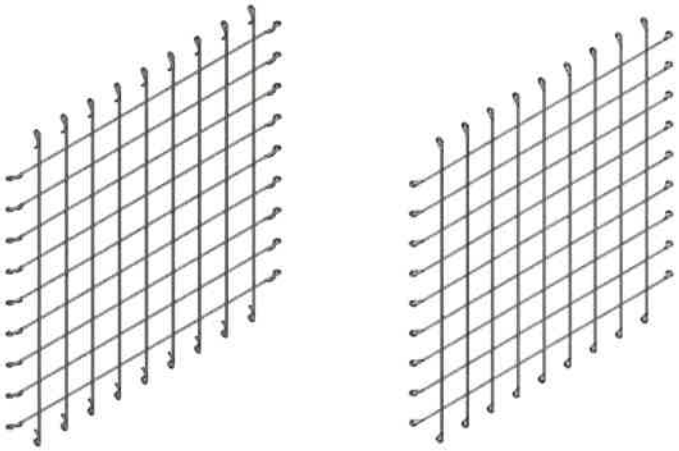
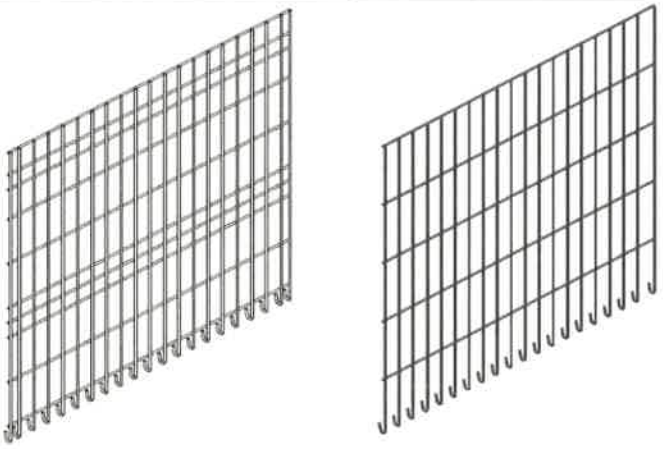
Product families Randdrahtgabione, Ösengabione and Hakengabione are electro-spot-welded steel wire panels used for slope stabilization, earth retention, river training, erosion control purposes, slope protection, landscaping, free-standing walls, noise protection constructions and for architectural claddings and fencing.

1.4 Base materials

The basic material for the production of Product families Randdrahtgabione, Ösengabione and Hakengabione is:

- Hot-Dip coated steel wire (100 %)

Table 1: Overview of the products and their properties

Product's technical characteristics	Picture of the product
Randdrahtgabione: Welded panel from hot dip coated steel wire - Zinc-aluminium alloy coating.	
Ösengabione: Welded panel from hot dip coated steel wire - Zinc-aluminium alloy coating.	
Hakengabione: Welded panel from hot dip coated steel wire - Zinc-aluminium alloy coating.	

1.5 Manufacturing process

The production process for welded wire panels begins with the straightening and cutting of wire into the required lengths for longitudinal and cross wires. Accessories, such as staying rods and locking rods, are then bent using a wire bending machine.

The wires are welded fully automatically using the electro-spot-welding process, operated by hydraulic or pneumatic welding heads. Once welded, the grids are stacked fully automatically on pallets.

Finally, the pallets are strapped and transported to the picking warehouse for further distribution. The flow chart of the production process can be seen in Figure 1.

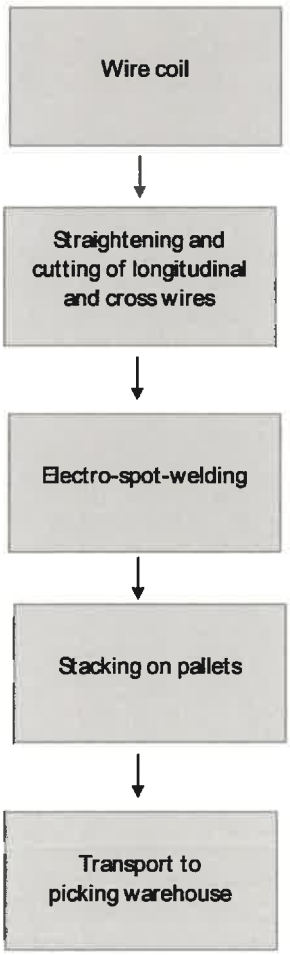


Figure 1: Manufacturing process diagram

1.6 Packaging

Product families Randdrahtgabione, Ösengabione and Hakengabione are bundled up, loaded onto pallets and fixed using a recycled PET strapping tape.

1.7 Environment and health during manufacturing

Rothfuss Best Gabion GmbH & Co. KG maintains a comprehensive quality, environmental, and safety management system, ensuring product quality, employee safety, and environmental care. Regular risk assessments and training are conducted to uphold safety standards, and employees are provided with necessary protective gear. The company prioritizes environmental protection by preventing the release of hazardous substances, recycling excess oils, and implementing waste separation and energy-efficient practices, including LED lighting and renewable energy generation. Additionally, rainwater collection supports local wildlife on the premises.

1.8 Further information

Further information is available on the website www.rothfuss-bestgabion.de.

2 LCA: Calculation rules

2.1 Declared unit

The declared unit has been defined in accordance with the Product Category Rules (PCR): *Product Category Rules for Building-Related Products and Services - Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report according to EN 15804:2012+A2:2019 version 1.4,* and *EPD International Product category rules (PCR) for Construction products (2019:14, version 1.3.1)* valid until 20. 12. 2024.

The following declared unit has been applied for Product families Randdrahtgabione, Ösengabione and Hakengabione:

1 kg of steel parts of gabions.

2.2 System boundary

The system boundary was defined according to the standard EN 15804:2012+A2:2019 (hereafter EN 15804). The system boundaries determine the unit processes that are included in LCA analysis.

This LCA study is based on the Cradle to gate with modules C1-C4 and module D principle. This means, that in this LCA, the following life cycle stages have been assessed: Product stage, which includes raw material supply (A1), transport to the manufacturer (A2) and production (A3); End of life stage, which includes de-construction/demolition (C1), transport to waste processing (C2), waste processing for reuse, recovery and/or recycling (C3) and disposal (C4); and Benefits and burdens beyond the system boundary, that includes recycling, reusing an recovery (D). The schematic representation of system boundaries can be seen in Figure 2.

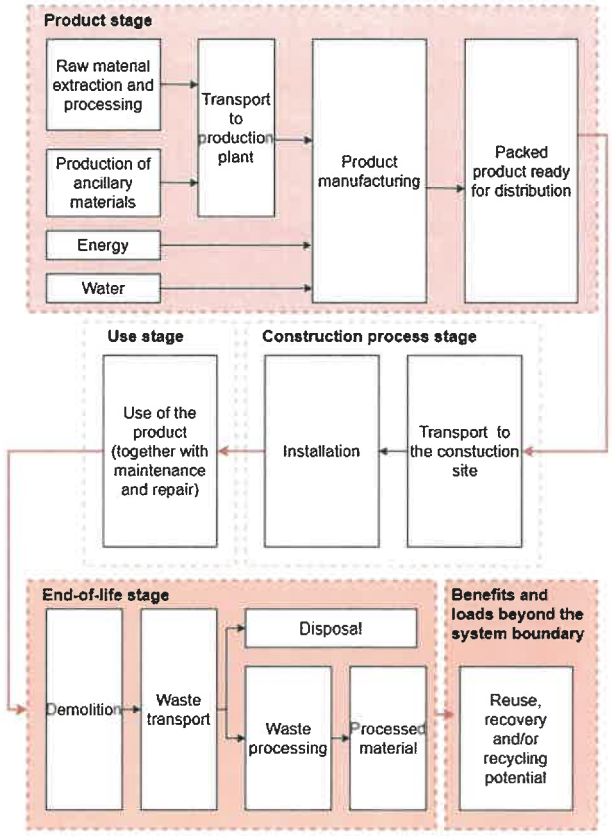


Figure 2: Schematic representation of system boundaries

2.3 Averaging

The environmental impact for the product families Randdrahtgabione, Ösengabione, and Hakengabione is calculated as an average across these groups. Per the PCR, similar products from the same company and manufacturing sites with identical core processes can be grouped in a single EPD. The average results for each indicator are weighted by production volumes and declared accordingly. All products use 100% steel wire from two suppliers, with the average ratio based on company-wide mass. Since the declared unit is 1 kg, there are no LCA differences between the product groups as they differ only in shape, not

input/output mass. All products are made at the manufacturer's plant in Germany.

2.4 Cut-off rules

The cut-off rules, defined in EN 15804 have been followed, therefore all inputs and outputs to/from the studied system have been included in the calculation, for which data are available. A data gap for a unit process "oil for welding" has been made with less than 1% of the total mass input of the unit process and with the total of neglected input flows per module less than 5% of mass.

2.5 Data quality

The data used in the LCA analysis meets EN 15804 standards. Generic data is checked for plausibility, and data sets are complete within defined system boundaries. The data is as current as possible, data sets used for calculations are valid for the current year and represent a reference year within 10 years for generic data and 5 years for producer specific data. All datasets are based on 1-year averages, and inputs/outputs are accounted for over a 100-year period from the representative year.

2.6 Background data

The LCA analysis of Product families Randdrahtgabione, Ösengabione and Hakengabione has been conducted with the LCA for Experts modelling software, developed by Thinkstep (Sphera Solutions GmbH) in collaboration with the University of Stuttgart. All processes have been modelled on the inventory data given in the MLC database (last update: 2024) and from two public valid EPDs (see [7] and [8]).

2.7 Period under review

Product data are based on average production information collected for the year 2023.

2.8 Allocation

In this specific LCA analysis, no allocation procedure is required.

2.9 Comparability

Comparison of the environmental performance of construction products using the EPD information has to be based on the product's use and its impacts on the building. Comparisons are possible in the sub-building level if the conditions, listed in EN 15804 are met.

2.10 List of substances

Product families Randdrahtgabione, Ösengabione and Hakengabione do not contain substances listed in the »Candidate List of Substances of Very High Concern for authorisation« (http://echa.europa.eu/candidate-list-table).
Absence of these substances is declared by the producer.

3 LCA: Scenarios and additional technical information

3.1 Information about biogenic carbon content

Biogenic carbon is present only in the packing materials. Values are presented in Table 2.

Table 2: Biogenic carbon content

Name	Value	Unit
Biogenic Carbon Content in product	0	kg C
Biogenic Carbon Content in accompanying packaging	0,06	kg C

1kg biogenic carbon is equivalent to 44/12 kg of CO_2.

3.2 Technical information

The following technical information for the declared modules past the product stage (see Table 3) can be used for the development of specific scenarios in the context of a building assessment:

Table 3: Selected phases of the LCA

3.2.1 End of life (C1-C4)

The modelling of the end-of-life stage starts with manual demolition of Product families Randdrahtgabione, Ösengabione and Hakengabione (i.e., module C1, without environmental burdens). In the module C2 transport to the local recycling site is included. The transport has been modelled based on the transport distances for the end-of-life stage and waste quantities (1 kg, 30 km). No waste goes to landfill (C4, without environmental burdens).

3.2.2 Reuse, recovery and recycling potential (D)

Module D includes the reuse, recovery and/or recycling potentials, expressed as net impacts and benefits. 100 % of demolished steel parts for gabions gets recycled into new steel, substituting Pig Iron as virgin input material to steel production.

SYSTEM BOUNDARY																
PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY
Raw material supply	Transport	Production	Transport from the gate to the site	Assembly	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
☒	☒	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒

4 LCA: Results

4.1 Indicators of environmental impacts

According to the standard EN 15804, the environmental impacts are presented with thirteen Core environmental impact indicators (Table 4), ten Parameters describing resource use (Table 5), three parameters in Other environmental information describing waste categories (Table 6), four indicators in Environmental information describing output flows (Table 7) and six impact categories in Additional environmental impact indicators (Table 8).

Table 4: Abbreviations and units of Core environmental impact indicators

Core environmental impact indicators	Abbreviation	Unit
Global warming potential total	GWP-total	kg CO_2 eq.
Global warming potential fossil fuels	GWP-fossil	kg CO_2 eq.
Global warming potential biogenic	GWP-biogenic	kg CO_2 eq.
Global warming potential land use and land use change	GWP-luluc	kg CO_2 eq.
Depletion potential of the stratospheric ozone layer	ODP	kg CFC 11 eq.
Acidification potential, accumulated exceedance	AP	mol H^+ eq.
Eutrophication potential, fraction of nutrients reaching freshwater end compartment	EP-freshwater	kg PO_4^- eq.
Eutrophication potential, fraction of nutrients reaching marine end compartment	EP-marine	kg N eq.
Eutrophication potential, accumulated exceedance	EP-terrestrial	kg N eq.
Formation potential of tropospheric ozone	POCP	kg NMVOC eq.
Abiotic depletion potential for non-fossil resources	ADP-minerals&metals	kg Sb eq.
Abiotic depletion for fossil resources potential	ADP-fossil	MJ, net calorific value
Water (user)m deprivation potential, deprivation-weighted water consumption	WDP	m3 world eq.deprived

Table 5: Abbreviations and units of Parameters describing resource use

Parameters describing resource use	Abbreviation	Unit
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	MJ, net calorific value
Use of renewable primary energy resources used as raw materials	PERM	MJ, net calorific value
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	PERT	MJ, net calorific value
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	MJ, net calorific value

Use of non-renewable primary energy sources used as raw materials	PENRM	MJ, net calorific value
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)	PENRT	MJ, net calorific value
Use of secondary materials	SM	kg
Use of renewable secondary fuels	RSF	MJ, net calorific value
Use of non-renewable secondary fuels	NRSF	MJ, net calorific value
Net use fresh water	FW	m^3

Table 6: Abbreviations and units of Other environmental information describing waste categories

Other environmental information describing waste categories	Abbreviation	Units
Hazardous waste disposal	HWD	kg
Non-hazardous waste disposal	NHWD	kg
Radioactive waste disposal	RWD	kg

Table 7: Abbreviations and units of Environmental information describing output flows

Environmental information describing output flows	Abbreviation	Units
Components for re-use	CRU	kg
Material for recycling	MFR	kg
Materials for energy recovery	MER	kg
Exported energy	EE	MJ per energy carrier

Table 8: Abbreviations and units of Additional environmental impact indicators

Additional environmental impact indicators	Abbreviation	Unit
Potential incidence of disease due to PM emissions	PM	disease incidence
Potential human exposure efficiency relative to U235	IRP	kBq U235 equiv.
Potential comparative toxic unit for ecosystems	ETP-fw	CTUe
Potential comparative toxic unit for humans-cancerogenic	HTP-c	CTUh
Potential comparative toxic unit for humans-non-cancerogenic	HTP-nc	CTUh
Potential soil quality index	SQP	-

4.2 Results

The results of Core environmental impact indicators for 1 kg of the Product families Randdrahtgabione, Ösengabione and Hakengabione welded wire panels for gabions are shown in Table 9.

Table 9: Core environmental impact indicators for 1 kg of the Product families Randdrahtgabione, Ösengabione and Hakengabione welded wire panels for gabions

Impact Indicator	Unit	A1-A3	C1	C2	C3	C4	D	TOTAL (A1-C4)
GWP-total	[kg CO2 eq.]	1,45E+00	0,00E+00	2,58E-03	2,64E-03	0,00E+00	-5,60E-01	1,46E+00
GWP-fossil	[kg CO2 eq.]	1,47E+00	0,00E+00	2,59E-03	2,63E-03	0,00E+00	-5,64E-01	1,47E+00
GWP-biogenic	[kg CO2 eq.]	-9,91E-03	0,00E+00	-3,80E-05	-2,69E-06	0,00E+00	3,76E-03	-9,95E-03
GWP-luluc	[kg CO2 eq.]	1,73E-03	0,00E+00	2,39E-05	1,29E-05	0,00E+00	-1,01E-04	1,77E-03
ODP	[kg CFC-11 eq.]	5,06E-08	0,00E+00	3,35E-16	8,03E-15	0,00E+00	-2,75E-08	5,06E-08
AP	[Mole of H+ eq.]	6,78E-03	0,00E+00	3,41E-06	1,34E-05	0,00E+00	-2,85E-03	6,80E-03
EP-freshwater	[kg P eq.]	4,69E-04	0,00E+00	9,42E-09	6,95E-09	0,00E+00	-2,17E-04	4,69E-04
EP-marine	[kg N eq.]	1,55E-03	0,00E+00	1,18E-06	6,24E-06	0,00E+00	-5,44E-04	1,56E-03
EP-terrestrial	[Mole of N eq.]	1,55E-02	0,00E+00	1,41E-05	6,89E-05	0,00E+00	-5,88E-03	1,56E-02
POCP	[kg NMVOC eq.]	5,13E-03	0,00E+00	2,96E-06	1,68E-05	0,00E+00	-3,25E-03	5,15E-03
ADP-m&m	[kg Sb eq.]	6,44E-05	0,00E+00	1,71E-10	2,86E-09	0,00E+00	-1,63E-07	6,44E-05
ADP-fossil	[MJ]	1,94E+01	0,00E+00	3,51E-02	5,13E-02	0,00E+00	-8,11E+00	1,95E+01
WDP	[m^3 world eq.]	7,77E-01	0,00E+00	3,11E-05	4,66E-04	0,00E+00	-5,27E-02	7,78E-01

The results of Parameters describing resource use for 1 kg of the Product families Randdrahtgabione, Ösengabione and Hakengabione welded wire panels for gabions are shown in Table 10.

Table 10: Parameters describing resource use for 1 kg of the Product families Randdrahtgabione, Ösengabione and Hakengabione welded wire panels for gabions

Impact Indicator	Unit	A1-A3	C1	C2	C3	C4	D	TOTAL (A1-C4)
PERE	[MJ]	5,81E+00	0,00E+00	2,56E-03	5,65E-03	0,00E+00	-1,11E-01	5,82E+00
PERM	[MJ]	5,02E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	5,02E-01
PERT	[MJ]	9,49E+00	0,00E+00	2,56E-03	5,65E-03	0,00E+00	-1,11E-01	9,50E+00
PENRE	[MJ]	1,10E+01	0,00E+00	3,52E-02	5,14E-02	0,00E+00	-8,11E+00	1,11E+01
PENRM	[MJ]	3,49E+00	0,00E+00	0,00E+00	-9,71E-17	0,00E+00	-7,36E-05	3,49E+00
PENRT	[MJ]	1,70E+01	0,00E+00	3,52E-02	5,14E-02	0,00E+00	-8,11E+00	1,71E+01
SM	[kg]	7,54E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	7,54E-01
RSF	[MJ]	1,18E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,18E-03
NRSF	[MJ]	5,44E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	5,44E-05
FW	[m3]	7,56E-03	0,00E+00	2,80E-06	1,36E-05	0,00E+00	-1,23E-03	7,58E-03

The results of Other environmental information describing waste categories for 1 kg of the Product families Randdrahtgabione, Ösengabione and Hakengabione welded wire panels for gabions are shown in Table 11 and Environmental information describing output flows is shown in Table 12.

Table 11: Other indicators of environmental impacts for 1 kg of the Product families Randdrahtgabione, Ösengabione and Hakengabione welded wire panels for gabions

Impact Indicator	Unit	A1-A3	C1	C2	C3	C4	D	TOTAL (A1-C4)
HWD	[kg]	1,12E-02	0,00E+00	1,09E-13	-5,50E-13	0,00E+00	-3,12E-12	1,12E-02
NHWD	[kg]	1,21E+00	0,00E+00	5,37E-06	1,44E-05	0,00E+00	-2,38E-06	1,21E+00
RWD	[kg]	4,24E-04	0,00E+00	6,60E-08	4,21E-07	0,00E+00	-2,03E-08	4,25E-04

Table 12: Environmental information describing output flows for 1 kg of the Product families Randdrahtgabione, Ösengabione and Hakengabione welded wire panels for gabions

Impact Indicator	Unit	A1-A3	C1	C2	C3	C4	D	TOTAL (A1-C4)
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]	1,21E-02	0,00E+00	0,00E+00	1,00E+00	0,00E+00	0,00E+00	1,01E+00
MER	[kg]	5,77E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	5,77E-05
EE	[MJ]	2,24E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,24E-02

The results of Additional environmental impact indicators for 1 kg of the Product families Randdrahtgabione, Ösengabione and Hakengabione welded wire panels for gabions are shown in Table 13. Impacts are not defined (ND) due to the not defined results in reference EPDs for wire.

Table 13: Additional environmental impact indicators for 1 kg of the Product families Randdrahtgabione, Ösengabione and Hakengabione welded wire panels for gabions

Impact Indicator	Unit	A1-A3	C1	C2	C3	C4	D	TOTAL (A1-C4)
PM	[Disea.incid.]	ND	ND	ND	ND	ND	ND	ND
IRP	[kBq U235 eq.]	ND	ND	ND	ND	ND	ND	ND
ETP-fw	[CTUe]	ND	ND	ND	ND	ND	ND	ND
HTP-c	[CTUh]	ND	ND	ND	ND	ND	ND	ND
HTP-nc	[CTUh]	ND	ND	ND	ND	ND	ND	ND
SQP	[-]	ND	ND	ND	ND	ND	ND	ND

5 Interpretation of results

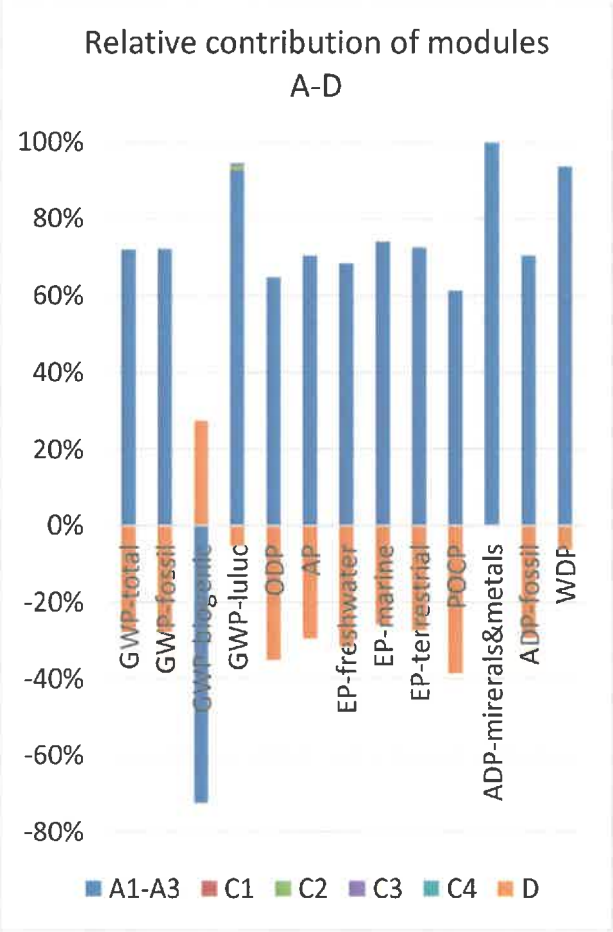


Figure 3: The relative environmental impact contributions of modules A to D for Core environmental impact indicators.

Figure 3 illustrates the contributions of different life cycle stages (modules A1-A3, C1-C4, and D) to the environmental footprint of the Randdrahtgabione, Ösengabione, and Hakengabione product families. The product stage (A1-A3) accounts for nearly 100% of the environmental impact across most indicators. GWP-biogenic is negative due to the carbon sequestration in wooden pallets used for packaging.

The end-of-life stage (C1-C4) contributes less than 1% to all indicators, with no impact from C1 and C4 due to the absence of landfilled waste and demolition machinery. Module D shows potential environmental benefits from the full recycling of the product and heat recovery from incinerating packaging materials in A5.

References

[1] LCA for Experts modelling software

[2] EN 15804:2012+A2:2019 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

[3] EN ISO 14040:2006 Environmental management - Life cycle assessment - Principles and framework (EN ISO 14040:2006)

[4] EN ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines (EN ISO 14044:2006)

[5] EN ISO 14025:2010 Environmental labels and declarations - Type III environmental

[6] EPD International Product category rules (PCR) for Construction products (2019:14, version 1.3.1).

[7] Environmental Product Declaration: Hot-Dip Coated Steel Wire EAF-Base from ArcelorMittal Europe – Long Products – valid until 14. 1. 2029.

[8] Type III Environmental Product Declaration No. 530/2023: Hot Dip zinc/zinc-alu/Bezinal ® coated steel wire produced in Bohumin – valid until 6. 10. 2028.

[9] REPORT 1067/23–250–1–EN Life Cycle Assessment of Product families Randdrahtgabione, Ösengabione and Hakengabione, dated 25. 9. 2024

The data specified in the EPD are calculated on the basis of the data provided by the manufacturer. In the event that the manufacturer's information is incorrect, calculations do not apply.