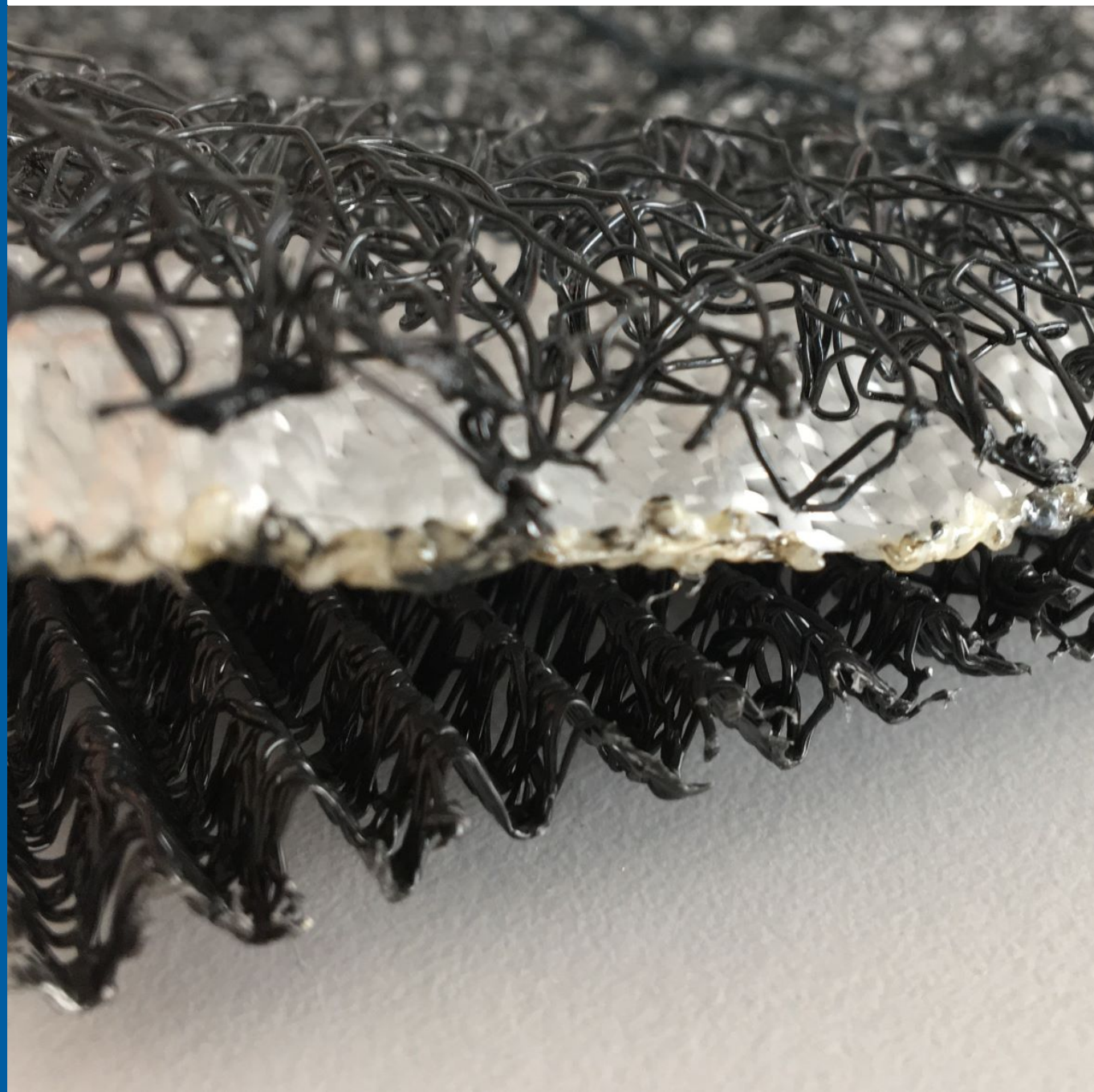
Environmental Product Declaration (EPD)
According to ISO 14025 and EN 15804

Enka®Grip&Drain



Registration number:	EPD-Kiwa-EE-170550-EN
Issue date:	16-04-2024
Valid until:	16-04-2029
Declaration owner:	Freudenberg Performance Materials B.V.
Publisher:	Kiwa-Ecobility Experts
Program operator:	Kiwa-Ecobility Experts
Status:	verified

1 General information

1.1 PRODUCT

Enka®Grip&Drain

1.2 REGISTRATION NUMBER

EPD-Kiwa-EE-170550-EN

1.3 VALIDITY

Issue date: 16-04-2024

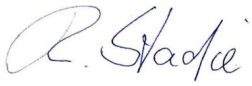
Valid until: 16-04-2029

1.4 PROGRAM OPERATOR

Kiwa-Ecobility Experts
Wattstraße 11-13
13355 Berlin
DE

Raoul Mancke

(Head of programme operations, Kiwa-Ecobility Experts)



Dr. Ronny Stadie

(Verification body, Kiwa-Ecobility Experts)

1.5 OWNER OF THE DECLARATION

Manufacturer: Freudenberg Performance Materials B.V.

Address: Westervoortsedijk 73, 6827 AV Arnhem, Netherlands

E-mail: info@freudenberg-pm.com

Website: https://www.freudenberg-pm.com/en

Production location: Glanzstoffstrasse 1

Address production location: Glanzstoffstrasse 1, 63906 Obernburg, Germany

1.6 VERIFICATION OF THE DECLARATION

The independent verification is in accordance with the ISO 14025:2011. The LCA is in compliance with ISO 14040:2006 and ISO 14044:2006. The EN 15804:2012+A2:2019 serves as the core PCR.

☐ Internal ☑ External

Lucas Pedro Berman, Senda

1.7 STATEMENTS

The owner of this EPD shall be liable for the underlying information and evidence. The programme operator Kiwa-Ecobility Experts shall not be liable with respect to manufacturer data, life cycle assessment data and evidence.

1.8 PRODUCT CATEGORY RULES

Kiwa-Ecobility Experts (Kiwa-EE) – General Product Category Rules (2022-02-14)

Kiwa-Ecobility Experts (Kiwa-EE) – Specific Product Category Rules: Geosynthetic products (2023-07-21)

1.9 COMPARABILITY

In principle, a comparison or assessment of the environmental impacts of different products is only possible if they have been prepared in accordance with EN 15804. For the evaluation of the comparability, the following aspects have to be considered in particular: PCR used, functional or declared unit, geographical reference, the definition of the system

1 General information

boundary, declared modules, data selection (primary or secondary data, background database, data quality), scenarios used for use and disposal phases, and the life cycle inventory (data collection, calculation methods, allocations, validity period). PCRs and general program instructions of different EPDs programs may differ. 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).

1.10 CALCULATION BASIS

LCA method R<THiNK: Ecobility Experts | EN15804+A2

LCA software*: Simapro 9.1

Characterization method: EN 15804 +A2 Method v1.0

LCA database profiles: EcoInvent version 3.6

Version database: v3.16 (2024-02-12)

** Used for calculating the characterized results of the Environmental profiles within R<THiNK.*

1.11 LCA BACKGROUND REPORT

This EPD is generated on the basis of the LCA background report 'Enka®Grip&Drain' with the calculation identifier ReTHiNK-70550.

2 Product

2.1 PRODUCT DESCRIPTION

Enka®Grip&Drain is a multifunctional geocomposite consisting of 3 or 4 layers that combines veneer stabilization, reinforcement, drainage, filtration and seperation. The upper layer is a 10 mm thick 3D open structure mat which is made of polyamide mono-filaments that are firmly fused. The 3D mat features an open void up to 95 % allowing for soil retention capacity. The middle layer is a reinforcing PET woven geotextile providing tensile strength. The needed strength of the woven is calculated based on project specific needs. The third and down facing layer consists of a polypropylene V-shape structured drainage mat of 4 or 6 mm height that ensures optimal discharge of rain water when it saturates the cover soil. As an addition to this down facing layer there is the possibility to choose an additional polypropylene non-woven layer above or below the drainage core, providing further filtration and separation functionality. All layers are connected by means of stitching. The PET woven geotextile is wider than the structure mat, allowing for an overlap between lanes during installation. The rolls are 5 m wide, saving labor time on the job site.

The composition of the product

Polyamide	18 - 27%
Polyester	18 - 38%
Polypropylene	30 - 32%
Masterbatches	1 - 2%
Packaging	13 -20%
Ancillary items	<1%

The following products are covered in this EPD using the scaling method:

Enka®Grip&Drain 7010/50.50PET/5004F
Enka®Grip&Drain 7010/100.50PET/5004F
Enka®Grip&Drain 7010/100.50PET/5006H
Enka®Grip&Drain 7010/200.50PET/5004F
Enka®Grip&Drain 7010/200.50PET/5006H
Enka®Grip&Drain 7010/300.50PET/5004F
Enka®Grip&Drain 7010/50.50PET/M110PP/5004F
Enka®Grip&Drain 7010/100.50PET/M110PP/5004F
Enka®Grip&Drai 7010/100.50PET/5004F/M110PP
Enka®Grip&Drain 7010/200.50PET/5004F/M110PP
Enka®Grip&Drain 7010/200.50PET/M110PP/5004F
Enka®Grip&Drain 7010/M110PP/5004F/200.50PET

Listed below the technical data for the Enka®Grip&Drain product range. The unit weight varies per product type depeding on the tensile strength chosen and the addition of a extra layer PP needlepunched non-woven.

Characteristics	Standard	Value	Unit
Unit weight	EN ISO 9864	720 - 1250	g/m2
Nominal tensile strength - MD*	EN ISO 10319	> 50 - 300	kN/m
Nominal tensile strength - CMD	EN ISO 10319	> 50	kN/m
Elongation at maximum load - MD	EN ISO 10319	< 12	%
Elongation at maximum load - CMD	EN ISO 10319	< 12	%
Static puncture resistance (CBR)	EN ISO 12236	5 - 11	kN
Dynamic perforation resistance	EN ISO 13433	18 - 15	mm
Water permeability (Vih50)**	EN ISO 11058	8,5 - 100	mm/s
Characteristic Opening Size (O90)	EN ISO 12956	90 - 190	µm
Predicted durability in years in natural soils with 4 < ph < 9 and temperature < 25°C***	EN 13253:2016, ANNEX B	≥ 100	years
Max. allowed installation time without covering of the geosynthetic	EN 12224	2	weeks

* The individual minimal tensile strength in the MD direction can be derived from the product naming. Where i.e. 100.50PET stands for >100 kN/m in MD and 50 kN in CMD direction.
** Water permeability is depended on the weaving pattern of the reinforcing PET woven where generally lighter wovens are less permeable than the heavier geotextiles.
*** Annex B of the geosysnthetic application standards descripe a interpretation of results of the accelerated aging test performed in accordance with EN 12447 (Hydrolisis) and EN ISO 13438 (Oxidation).

2.2 APPLICATION (INTENDED USE OF THE PRODUCT)

The multi-functional Enka®Grip&Drain is used as a combination of reinforced veneer stabilization and drainage on multi-layer lining systems, mostly in capping of waste containment and on geomembranes in retention ponds or reservoirs where it is installed on top of a geomembrane. Anchored in a trench on top of the slope, Enka®Grip&Drain delivers the required friction, tensile strength, anchorage resistance and drainage capacitie to stabilize the covering soil layer on large surfaces, preventing the soil from sliding. Because Enka®Grip&Drain includes a geosynthetic drainage layer, the product can replace or reduce the thickness of a traditional aggregate layer, thus minimizing transport movements to and from projects saving time, cost and emissions.

2 Product

2.3 REFERENCE SERVICE LIFE

RSL PRODUCT

As the service life of product is not taken into account, there is no need to specify a reference service life.

USED RSL (YR) IN THIS LCA CALCULATION:

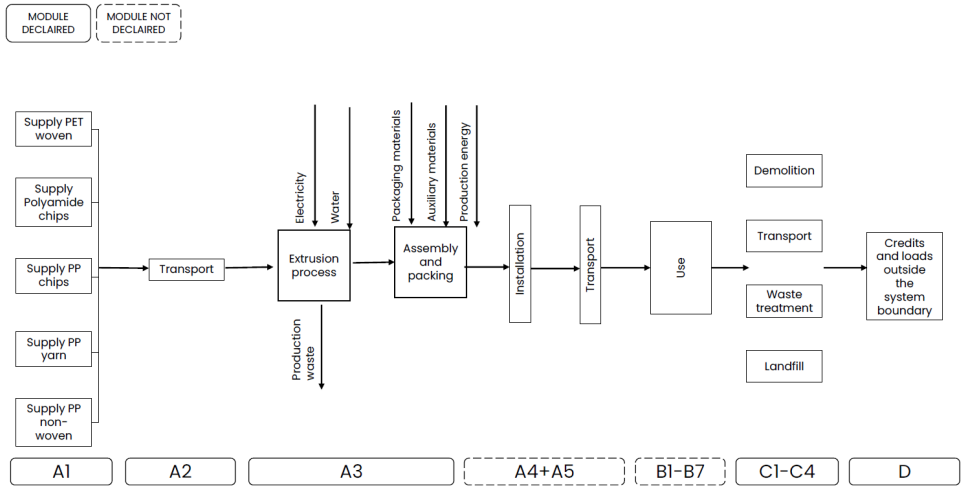
100

2.4 SUBSTANCES OF VERY HIGH CONCERN

The articles Freudenberg Performance Materials supply do not contain Substances Of very High Concern, according to the Candidate list EChA Article 59 (1) of Regulation (EC) Nr. 1907/2006, with a concentration > 0,1 % w/w (last update on January 23rd, 2024).

2.5 DESCRIPTION PRODUCTION PROCESS

The Enka®Grip&Drain consists of a polyamide 3D Mat on top followed by a PET woven geotextile and PP V-shape drainage core on the bottom. Depending on project needs a PP needlepunched nonwoven can be added to one of both sides of the drainage core. The PET Wovens are produced in South-Korea and shipped by sea freight in containers. The polyamide 3D mat is produced at the Obernburg am Main site through a monofilament extrusion process. The polyamide chips are delivered by truck from Luxembourg. The PP V-shape drainage core is also made at the Obernburg am Main site via a similar extrusion process. The PP chips are delivered by truck from Germany. The PP needle punched non-wovens are shipped by truck from Hungary. At the Obernburg am Main site all components are sewn together on an assembly line to make the final product. The sewing yarns are delivered to the site per truck from Belgium. After sewing the product is wound up on 5m wide cardboard tubes and afterwards packaged with PE foil. The final good is a 5m wide roll with a standard length of 80m. When there are project specific needs the lengths and thus roll weight and diameter can vary depending on the required slope length.



3 Calculation rules

3.1 DECLARED UNIT

m²

square meter of Enka®Grip&Drain

reference_unit: square meter (m2)

3.2 CONVERSION FACTORS

Description	Value	Unit
reference_unit	1	m2
weight_per_reference_unit	1.632	kg
Conversion factor to 1 kg	0.612604	m2

3.3 SCOPE OF DECLARATION AND SYSTEM BOUNDARIES

This is a Cradle to gate with modules C1-C4 and module D LCA. The life cycle stages included are as shown below:

(X = module included, ND = module not declared)

A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	ND	ND	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X

The modules of the EN15804 contain the following:

Module A1 = Raw material supply	Module B5 = Refurbishment
Module A2 = Transport	Module B6 = Operational energy use
Module A3 = Manufacturing	Module B7 = Operational water use
Module A4 = Transport	Module C1 = De-construction / Demolition
Module A5 = Construction - Installation process	Module C2 = Transport
Module B1 = Use	Module C3 = Waste Processing
Module B2 = Maintenance	Module C4 = Disposal
Module B3 = Repair	Module D = Benefits and loads beyond the product system boundaries
Module B4 = Replacement	

3.4 REPRESENTATIVENESS

The input data are representative for Enka®Grip&Drain, a product of Freudenberg Performance Materials B.V.. The data are representative for European Union.

The considered scenarios are currently in use and are representative of one of the most likely scenario alternatives.

3.5 CUT-OFF CRITERIA

Product Stage (A1-A3)

3 Calculation rules

All input flows and output flows are considered in this LCA. The total neglected input flows do therefore not exceed the limit of 5% of energy use and mass.

The following input has been placed under cut-off criteria (<1% of the total mass): Teflon belts.

The following processes are excluded:

- Manufacturing of equipment used in production, buildings or any other capital asset
- Transportation of personnel to the plant
- The transportation of personnel within the plant
- Research and development activities
- Long-term emissions

End of life stage (C1-C4)

All input flows (e.g. energy use for demolition or disassembly, transport to waste processing, etc.) and output flows (e.g. end-of-life waste processing of the product, etc.) are considered in this LCA. The total neglected input flows do therefore not exceed the limit of 5% of energy use and mass.

Benefits and Loads beyond the system boundary (Module D)

All benefits and loads beyond the system boundary resulting from reusable products, recyclable materials and/or useful energy carriers leaving the product system are considered in this LCA.

3.6 ALLOCATION

Allocation has not been applied in this LCA.

3.7 DATA COLLECTION & REFERENCE TIME PERIOD

All process-specific data were collected for the operating year 2022.

3.8 ESTIMATES AND ASSUMPTIONS

A scaling method was used to calculate the LCA results for the different Enka®Grip products. The scaling was done on the basis of mass per square meter. As a result of scaling there are results for both the fixed and the scalable part of the scaling function. The fixed part means that this number is the same for each product in the product group and the scalable part is the part that depends on the mass per unit area of the product. In order to calculate the correct number of each environmental impact category for each of the products in the product group, the following calculation should be done:

[number fixed part]+([specific mass]*[number scalable part])

3.9 DATA QUALITY

To ensure the comparability of the results, only consistent background data from the Ecoinvent data-base version 3.6 (2019) was used in the LCA (e.g. data sets on energy, transports, auxiliary and operat-ing materials). The database is regularly checked and thus complies with the requirements of EN 15804 (background data not older than 10 years). Almost all consistent data sets contained in the Ecoinvent database version 3.6 are documented and can be viewed in the online documentation. The raw material data were converted into reference flows (input per declared unit).The general rule was followed that specific data from specific production processes or average data derived from specific processes must have priority in the calculation of an LCA. Data for processes over which the manufacturer has no influence were assigned generic data.

The LCA calculation was carried out using Nibe's LCA & EPD tool R<THiNK.

3.10 GUARANTEES OF ORIGIN

The location-based approach was used, no Guarantees of Origin are required. Electricity is represented by the German powermix, low voltage, from the Ecoinvent database version 3.6 (2019).

3 Calculation rules

3.12 SCALING

Parameter	Value
Scaling type	Linear
Description dimension	mass
Dimension	0.000
Scalable dimension	1.000
Unit dimension	kg/m²

4 Scenarios and additional technical information

4.1 DE-CONSTRUCTION, DEMOLITION (C1)

The following information describes the scenario for demolition at end of life.

Description	Amount	Unit
Diesel, burned in machine (incl. emissions)	0.001	l

4.2 TRANSPORT END-OF-LIFE (C2)

The following distances and transport conveyance are assumed for transportation during end of life for the different types of waste processing.

Waste Scenario	Transport conveyance	Not removed (stays in work) [km]	Landfill [km]	Incineration [km]	Recycling [km]	Re-use [km]
plastics, via residue (NMD ID 43)	Lorry (Truck), unspecified (default) | market group for (GLO)	0	100	150	50	0
finishes (adhered to wood, plastic, metal) (NMD ID 2)	Lorry (Truck), unspecified (default) | market group for (GLO)	0	100	150	50	0
polyolefines (i.a. pe,pp) (i.a. pipes, foils) (NMD ID 57)	Lorry (Truck), unspecified (default) | market group for (GLO)	0	100	150	50	0

The transport conveyance(s) used in the scenario(s) for transport during end of life has the following characteristics.

	Value and unit
Vehicle type used for transport	Lorry (Truck), unspecified (default) | market group for (GLO)
Fuel type and consumption of vehicle	not available
Capacity utilisation (including empty returns)	50 % (loaded up and return empty)
Bulk density of transported products	inapplicable
Volume capacity utilisation factor	1

4.3 END OF LIFE (C3, C4)

The scenario(s) assumed for end of life of the product are given in the following tables.
First the assumed percentages per type of waste processing are displayed, followed by the assumed amounts.

4 Scenarios and additional technical information

Waste Scenario	Region	Not removed (stays in work) [%]	Landfill [%]	Incineration [%]	Recycling [%]	Re-use [%]
plastics, via residue (NMD ID 43)	NL	0	20	80	0	0
finishes (adhered to wood, plastic, metal) (NMD ID 2)	NL	0	0	100	0	0
polyolefines (i.a. pe,pp) (i.a. pipes, foils) (NMD ID 57)	NL	0	10	85	5	0

Waste Scenario	Not removed (stays in work) [kg]	Landfill [kg]	Incineration [kg]	Recycling [kg]	Re-use [kg]
plastics, via residue (NMD ID 43)	0.000	0.049	0.195	0.000	0.000
finishes (adhered to wood, plastic, metal) (NMD ID 2)	0.000	0.000	0.008	0.000	0.000
polyolefines (i.a. pe,pp) (i.a. pipes, foils) (NMD ID 57)	0.000	0.149	1.266	0.075	0.000
Total	**0.000**	**0.198**	**1.470**	**0.075**	**0.000**

4.4 BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY (D)

The presented Benefits and loads beyond the system boundary in this EPD are based on the following calculated Net output flows in kilograms and Energy recovery displayed in MJ Lower Heating Value.

Waste Scenario	Net output flow [kg]	Energy recovery [MJ]
plastics, via residue (NMD ID 43)	0.000	6.013
finishes (adhered to wood, plastic, metal) (NMD ID 2)	0.000	0.000
polyolefines (i.a. pe,pp) (i.a. pipes, foils) (NMD ID 57)	0.069	31.015
Total	**0.069**	**37.028**

5 Results

For the impact assessment, the characterization factors of the LCIA method EN 15804 +A2 Method v1.0 are used. Long-term emissions (>100 years) are not considered in the impact assessment. The results of the impact assessment are only relative statements that do not make any statements about end-points of the impact categories, exceedance of threshold values, safety margins or risks. The following tables show the results of the indicators of the impact assessment, of the use of resources as well as of waste and other output flows.

5 Results

5.1 ENVIRONMENTAL IMPACT INDICATORS PER SQUARE METER (FIXED PART)

CORE ENVIRONMENTAL IMPACT INDICATORS EN15804+A2

Abbreviation	Unit	A1	A2	A3	C1	C2	C3	C4	D
AP	mol H+ eqv.	1.20E-2	2.81E-4	7.19E-4	3.43E-5	6.94E-5	6.10E-4	8.09E-6	-6.89E-4
GWP-total	kg CO2 eqv.	3.28E+0	4.85E-2	9.75E-2	3.28E-3	1.20E-2	1.40E+0	1.19E-2	-7.56E-1
GWP-b	kg CO2 eqv.	-3.44E-2	2.24E-5	-7.02E-2	9.12E-7	5.52E-6	2.30E-4	9.56E-6	-3.24E-4
GWP-f	kg CO2 eqv.	3.31E+0	4.85E-2	1.67E-1	3.28E-3	1.20E-2	1.40E+0	1.19E-2	-7.56E-1
GWP-luluc	kg CO2 eqv.	1.71E-4	1.78E-5	6.79E-4	2.58E-7	4.38E-6	1.09E-4	4.62E-7	-2.86E-5
EP-m	kg N eqv.	2.51E-3	9.90E-5	1.53E-4	1.51E-5	2.44E-5	1.67E-4	5.83E-6	-1.95E-4
EP-fw	kg P eqv.	3.79E-5	4.89E-7	5.91E-6	1.19E-8	1.21E-7	4.09E-6	1.67E-8	-1.22E-6
EP-T	mol N eqv.	2.56E-2	1.09E-3	1.68E-3	1.66E-4	2.69E-4	1.86E-3	2.96E-5	-2.14E-3
ODP	kg CFC 11 eqv.	1.04E-8	1.07E-8	8.13E-9	7.08E-10	2.64E-9	4.20E-8	2.85E-10	-9.56E-8
POCP	kg NMVOC eqv.	9.69E-3	3.12E-4	5.51E-4	4.57E-5	7.69E-5	4.97E-4	1.11E-5	-7.36E-4
ADP-f	MJ	6.20E+1	7.31E-1	3.22E+0	4.51E-2	1.80E-1	1.02E+0	2.18E-2	-1.31E+1
ADP-mm	kg Sb-eqv.	2.36E-5	1.23E-6	1.23E-6	5.03E-9	3.03E-7	1.70E-6	9.86E-9	-4.21E-7
WDP	m3 world eqv.	1.48E+0	2.61E-3	8.41E-2	6.05E-5	6.45E-4	6.96E-2	9.34E-4	-7.36E-2

AP=Acidification (AP) | **GWP-total**=Global warming potential (GWP-total) | **GWP-b**=Global warming potential - Biogenic (GWP-b) | **GWP-f**=Global warming potential - Fossil (GWP-f) | **GWP-luluc**=Global warming potential - Land use and land use change (GWP-luluc) | **EP-m**=Eutrophication marine (EP-m) | **EP-fw**=Eutrophication, freshwater (EP-fw) | **EP-T**=Eutrophication, terrestrial (EP-T) | **ODP**=Ozone depletion (ODP) | **POCP**=Photochemical ozone formation - human health (POCP) | **ADP-f**=Resource use, fossils (ADP-f) | **ADP-mm**=Resource use, minerals and metals (ADP-mm) | **WDP**=Water use (WDP)

ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS EN15084+A2

Abbreviation	Unit	A1	A2	A3	C1	C2	C3	C4	D
ETP-fw	CTUe	3.11E+0	6.52E-1	2.48E+0	2.72E-2	1.61E-1	1.74E+1	5.64E-2	-8.50E-1
PM	disease incidence	1.10E-7	4.36E-9	7.36E-9	9.09E-10	1.08E-9	4.76E-9	1.52E-10	-2.45E-9

ETP-fw=Ecotoxicity, freshwater (ETP-fw) | **PM**=Particulate Matter (PM) | **HTP-c**=Human toxicity, cancer (HTP-c) | **HTP-nc**=Human toxicity, non-cancer (HTP-nc) | **IR**=Ionising radiation, human health (IR) | **SQP**=Land use (SQP)

5 Results

Abbreviation	Unit	A1	A2	A3	C1	C2	C3	C4	D
HTP-c	CTUh	3.21E-10	2.11E-11	7.11E-11	9.50E-13	5.22E-12	2.85E-10	6.20E-13	-5.27E-11
HTP-nc	CTUh	8.75E-9	7.13E-10	1.30E-9	2.34E-11	1.76E-10	5.52E-9	2.09E-11	-8.08E-10
IR	kBq U235 eqv.	1.37E-2	3.06E-3	5.81E-3	1.93E-4	7.56E-4	4.24E-3	8.55E-5	-4.53E-3
SQP	Pt	1.05E+0	6.34E-1	6.77E+0	5.76E-3	1.56E-1	3.47E-1	5.15E-2	-2.05E-1

ETP-fw=Ecotoxicity, freshwater (ETP-fw) | **PM**=Particulate Matter (PM) | **HTP-c**=Human toxicity, cancer (HTP-c) | **HTP-nc**=Human toxicity, non-cancer (HTP-nc) | **IR**=Ionising radiation, human health (IR) | **SQP**=Land use (SQP)

CLASSIFICATION OF DISCLAIMERS TO THE DECLARATION OF CORE AND ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS

ILCD classification	Indicator	Disclaimer
ILCD type / level 1	Global warming potential (GWP)	None
	Depletion potential of the stratospheric ozone layer (ODP)	None
	Potential incidence of disease due to PM emissions (PM)	None
ILCD type / level 2	AAcidification potential, Accumulated Exceedance (AP)	None
	Eutrophication potential, Fraction of nutrients reaching freshwater end compartment (EP-freshwater)	None
	Eutrophication potential, Fraction of nutrients reaching marine end compartment (EP-marine)	None
	Eutrophication potential, Accumulated Exceedance (EP-terrestrial)	None
	Formation potential of tropospheric ozone (POCP)	None
	Potential Human exposure efficiency relative to U235 (IRP)	1
ILCD type / level 3	Abiotic depletion potential for non-fossil resources (ADP-minerals&metals)	2
	Abiotic depletion potential for fossil resources (ADP-fossil)	2
	Water (user) deprivation potential, deprivation-weighted water consumption (WDP)	2
	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	2
	Potential Comparative Toxic Unit for humans (HTP-c)	2
	Potential Comparative Toxic Unit for humans (HTP-nc)	2
	Potential Soil quality index (SQP)	2

5 Results

ILCD classification	Indicator	Disclaimer
Disclaimer 1 – This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.		
Disclaimer 2 – The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.		

5.2 ENVIRONMENTAL IMPACT INDICATORS PER SQUARE METER (SCALABLE PART)

CORE ENVIRONMENTAL IMPACT INDICATORS EN15804+A2

Abbreviation	Unit	A1	A2	A3	C1	C2	C3	C4	D
AP	mol H+ eqv.	7.33E-3	7.66E-3	2.43E-4	0.00E+0	1.10E-4	1.02E-3	9.25E-6	-9.06E-4
GWP-total	kg CO2 eqv.	1.93E+0	2.36E-1	5.75E-2	0.00E+0	1.89E-2	2.28E+0	1.48E-2	-8.81E-1
GWP-b	kg CO2 eqv.	3.22E-1	-7.13E-5	5.14E-3	0.00E+0	8.72E-6	3.46E-4	1.14E-5	-5.62E-4
GWP-f	kg CO2 eqv.	1.60E+0	2.35E-1	5.23E-2	0.00E+0	1.89E-2	2.28E+0	1.48E-2	-8.80E-1
GWP-luluc	kg CO2 eqv.	2.36E-3	1.63E-4	4.26E-5	0.00E+0	6.92E-6	1.83E-4	5.24E-7	-4.36E-5
EP-m	kg N eqv.	1.56E-3	1.88E-3	5.64E-5	0.00E+0	3.86E-5	2.78E-4	5.60E-6	-2.41E-4
EP-fw	kg P eqv.	8.53E-5	9.65E-7	1.46E-6	0.00E+0	1.91E-7	6.81E-6	1.90E-8	-2.02E-6
EP-T	mol N eqv.	1.61E-2	2.09E-2	6.06E-4	0.00E+0	4.26E-4	3.10E-3	3.40E-5	-2.65E-3
ODP	kg CFC 11 eqv.	1.52E-7	4.72E-8	2.65E-9	0.00E+0	4.17E-9	6.94E-8	3.28E-10	-1.07E-7
POCP	kg NMVOC eqv.	4.62E-3	5.42E-3	1.61E-4	0.00E+0	1.22E-4	8.30E-4	1.30E-5	-9.49E-4
ADP-f	MJ	2.42E+1	3.01E+0	2.12E-1	0.00E+0	2.85E-1	1.74E+0	2.51E-2	-1.60E+1
ADP-mm	kg Sb-eqv.	1.35E-5	1.75E-6	2.84E-7	0.00E+0	4.79E-7	2.88E-6	1.13E-8	-8.16E-7
WDP	m3 world eqv.	3.14E-1	4.39E-3	5.17E-3	0.00E+0	1.02E-3	1.16E-1	1.08E-3	-1.13E-1

AP=Acidification (AP) | **GWP-total**=Global warming potential (GWP-total) | **GWP-b**=Global warming potential - Biogenic (GWP-b) | **GWP-f**=Global warming potential - Fossil (GWP-f) | **GWP-luluc**=Global warming potential - Land use and land use change (GWP-luluc) | **EP-m**=Eutrophication marine (EP-m) | **EP-fw**=Eutrophication, freshwater (EP-fw) | **EP-T**=Eutrophication, terrestrial (EP-T) | **ODP**=Ozone depletion (ODP) | **POCP**=Photochemical ozone formation - human health (POCP) | **ADP-f**=Resource use, fossils (ADP-f) | **ADP-mm**=Resource use, minerals and metals (ADP-mm) | **WDP**=Water use (WDP)

5 Results

ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS EN15084+A2

Abbreviation	Unit	A1	A2	A3	C1	C2	C3	C4	D
ETP-fw	CTUe	4.27E+1	1.94E+0	1.16E+0	0.00E+0	2.54E-1	2.86E+1	2.67E-2	-1.16E+0
PM	disease incidence	5.98E-8	7.24E-9	1.17E-9	0.00E+0	1.70E-9	8.13E-9	1.74E-10	-3.88E-9
HTP-c	CTUh	9.96E-10	1.33E-10	2.40E-11	0.00E+0	8.24E-12	4.33E-10	7.00E-13	-6.89E-11
HTP-nc	CTUh	2.02E-8	1.55E-9	4.80E-10	0.00E+0	2.78E-10	9.03E-9	1.74E-11	-1.14E-9
IR	kBq U235 eqv.	1.25E-1	1.29E-2	2.25E-3	0.00E+0	1.19E-3	7.16E-3	9.82E-5	-5.95E-3
SQP	Pt	9.08E+0	4.06E-1	1.62E-1	0.00E+0	2.47E-1	6.23E-1	5.93E-2	-2.73E-1

ETP-fw=Ecotoxicity, freshwater (ETP-fw) | **PM**=Particulate Matter (PM) | **HTP-c**=Human toxicity, cancer (HTP-c) | **HTP-nc**=Human toxicity, non-cancer (HTP-nc) | **IR**=Ionising radiation, human health (IR) | **SQP**=Land use (SQP)

CLASSIFICATION OF DISCLAIMERS TO THE DECLARATION OF CORE AND ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS

ILCD classification	Indicator	Disclaimer
ILCD type / level 1	Global warming potential (GWP)	None
	Depletion potential of the stratospheric ozone layer (ODP)	None
	Potential incidence of disease due to PM emissions (PM)	None
ILCD type / level 2	AAcidification potential, Accumulated Exceedance (AP)	None
	Eutrophication potential, Fraction of nutrients reaching freshwater end compartment (EP-freshwater)	None
	Eutrophication potential, Fraction of nutrients reaching marine end compartment (EP-marine)	None
	Eutrophication potential, Accumulated Exceedance (EP-terrestrial)	None
	Formation potential of tropospheric ozone (POCP)	None
	Potential Human exposure efficiency relative to U235 (IRP)	1
ILCD type / level 3	Abiotic depletion potential for non-fossil resources (ADP-minerals&metals)	2
	Abiotic depletion potential for fossil resources (ADP-fossil)	2
	Water (user) deprivation potential, deprivation-weighted water consumption (WDP)	2
	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	2
	Potential Comparative Toxic Unit for humans (HTP-c)	2

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ILCD classification	Indicator	Disclaimer
	Potential Comparative Toxic Unit for humans (HTP-nc)	2
	Potential Soil quality index (SQP)	2

Disclaimer 1 – This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Disclaimer 2 – The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

5 Results

5.3 ENVIRONMENTAL IMPACT INDICATORS PER SQUARE METER (FIXED PART)

PARAMETERS DESCRIBING RESOURCE USE

Abbreviation	Unit	A1	A2	A3	C1	C2	C3	C4	D
PERE	MJ	6.40E-1	9.15E-3	6.90E-1	2.44E-4	2.26E-3	1.07E-1	3.91E-4	-4.10E-2
PERM	MJ	0.00E+0	0.00E+0	6.57E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PERT	MJ	6.40E-1	9.15E-3	1.35E+0	2.44E-4	2.26E-3	1.07E-1	3.91E-4	-4.10E-2
PENRE	MJ	4.56E+1	7.76E-1	2.41E+0	4.79E-2	1.91E-1	1.08E+0	2.32E-2	-1.40E+1
PENRM	MJ	2.13E+1	0.00E+0	1.03E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-5.41E-1
PENRT	MJ	6.68E+1	7.76E-1	3.44E+0	4.79E-2	1.91E-1	1.08E+0	2.32E-2	-1.45E+1
SM	Kg	0.00E+0	0.00E+0	2.60E-4	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
RSF	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
NRSF	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
FW	M3	2.82E-2	8.90E-5	1.97E-3	2.32E-6	2.20E-5	2.05E-3	2.28E-5	-1.01E-3

PERE=renewable primary energy ex. raw materials | **PERM**=renewable primary energy used as raw materials | **PERT**=renewable primary energy total | **PENRE**=non-renewable primary energy ex. raw materials | **PENRM**=non-renewable primary energy used as raw materials | **PENRT**=non-renewable primary energy total | **SM**=use of secondary material | **RSF**=use of renewable secondary fuels | **NRSF**=use of non-renewable secondary fuels | **FW**=use of net fresh water

OTHER ENVIRONMENTAL INFORMATION DESCRIBING WASTE CATEGORIES

Abbreviation	Unit	A1	A2	A3	C1	C2	C3	C4	D
HWD	Kg	2.46E-6	1.85E-6	2.02E-6	1.23E-7	4.57E-7	1.99E-6	3.31E-8	-1.56E-5
NHWD	Kg	8.77E-3	4.64E-2	1.49E-2	5.34E-5	1.14E-2	2.39E-2	8.70E-2	-5.71E-3
RWD	Kg	1.18E-5	4.80E-6	5.88E-6	3.13E-7	1.18E-6	3.65E-6	1.29E-7	-6.37E-6

HWD=hazardous waste disposed | **NHWD**=non hazardous waste disposed | **RWD**=radioactive waste disposed

5 Results

ENVIRONMENTAL INFORMATION DESCRIBING OUTPUT FLOWS

Abbreviation	Unit	A1	A2	A3	C1	C2	C3	C4	D
CRU	Kg	0.00E+0	0.00E+0	3.12E-5	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	Kg	0.00E+0	0.00E+0	4.20E-4	0.00E+0	0.00E+0	1.90E-2	0.00E+0	0.00E+0
MER	Kg	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EET	MJ	0.00E+0	0.00E+0	6.73E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	5.43E+0
EEE	MJ	0.00E+0	0.00E+0	3.91E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	3.15E+0

CRU=Components for re-use | **MFR**=Materials for recycling | **MER**=Materials for energy recovery | **EET**=Exported Energy Thermic | **EEE**=Exported Energy Electric

5.4 ENVIRONMENTAL IMPACT INDICATORS PER SQUARE METER (SCALABLE PART)

PARAMETERS DESCRIBING RESOURCE USE

Abbreviation	Unit	A1	A2	A3	C1	C2	C3	C4	D
PERE	MJ	2.67E+0	2.03E-2	4.49E-2	0.00E+0	3.57E-3	1.78E-1	4.44E-4	-6.87E-2
PERM	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PERT	MJ	2.67E+0	2.03E-2	4.49E-2	0.00E+0	3.57E-3	1.78E-1	4.44E-4	-6.87E-2
PENRE	MJ	2.75E+0	3.19E+0	-1.29E-1	0.00E+0	3.03E-1	1.85E+0	2.67E-2	-1.62E+1
PENRM	MJ	2.29E+1	0.00E+0	3.44E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-1.42E+0
PENRT	MJ	2.57E+1	3.19E+0	2.15E-1	0.00E+0	3.03E-1	1.85E+0	2.67E-2	-1.76E+1
SM	Kg	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
RSF	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
NRSF	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
FW	M3	1.47E-2	1.57E-4	2.67E-4	0.00E+0	3.47E-5	3.40E-3	2.62E-5	-1.60E-3

PERE=renewable primary energy ex. raw materials | **PERM**=renewable primary energy used as raw materials | **PERT**=renewable primary energy total | **PENRE**=non-renewable primary energy ex. raw materials | **PENRM**=non-renewable primary energy used as raw materials | **PENRT**=non-renewable primary energy total | **SM**=use of secondary material | **RSF**=use of renewable secondary fuels | **NRSF**=use of non-renewable secondary fuels | **FW**=use of net fresh water

5 Results

OTHER ENVIRONMENTAL INFORMATION DESCRIBING WASTE CATEGORIES

Abbreviation	Unit	A1	A2	A3	C1	C2	C3	C4	D
HWD	Kg	2.28E-5	2.75E-6	1.95E-7	0.00E+0	7.22E-7	3.32E-6	3.81E-8	-1.75E-5
NHWD	Kg	4.48E-1	6.97E-3	9.72E-3	0.00E+0	1.81E-2	4.19E-2	1.00E-1	-7.59E-3
RWD	Kg	1.11E-4	2.09E-5	2.11E-6	0.00E+0	1.87E-6	6.25E-6	1.49E-7	-7.91E-6

HWD=hazardous waste disposed | **NHWD**=non hazardous waste disposed | **RWD**=radioactive waste disposed

ENVIRONMENTAL INFORMATION DESCRIBING OUTPUT FLOWS

Abbreviation	Unit	A1	A2	A3	C1	C2	C3	C4	D
CRU	Kg	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	Kg	0.00E+0	0.00E+0	8.00E-4	0.00E+0	0.00E+0	5.00E-2	0.00E+0	0.00E+0
MER	Kg	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EET	MJ	0.00E+0	0.00E+0	9.68E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	6.05E+0
EEE	MJ	0.00E+0	0.00E+0	5.62E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	3.51E+0

CRU=Components for re-use | **MFR**=Materials for recycling | **MER**=Materials for energy recovery | **EET**=Exported Energy Thermic | **EEE**=Exported Energy Electric

5 Results

5.5 INFORMATION ON BIOGENIC CARBON CONTENT PER SQUARE METER

BIOGENIC CARBON CONTENT

The following Information describes the biogenic carbon content in (the main parts of) the product at the factory gate per square meter:

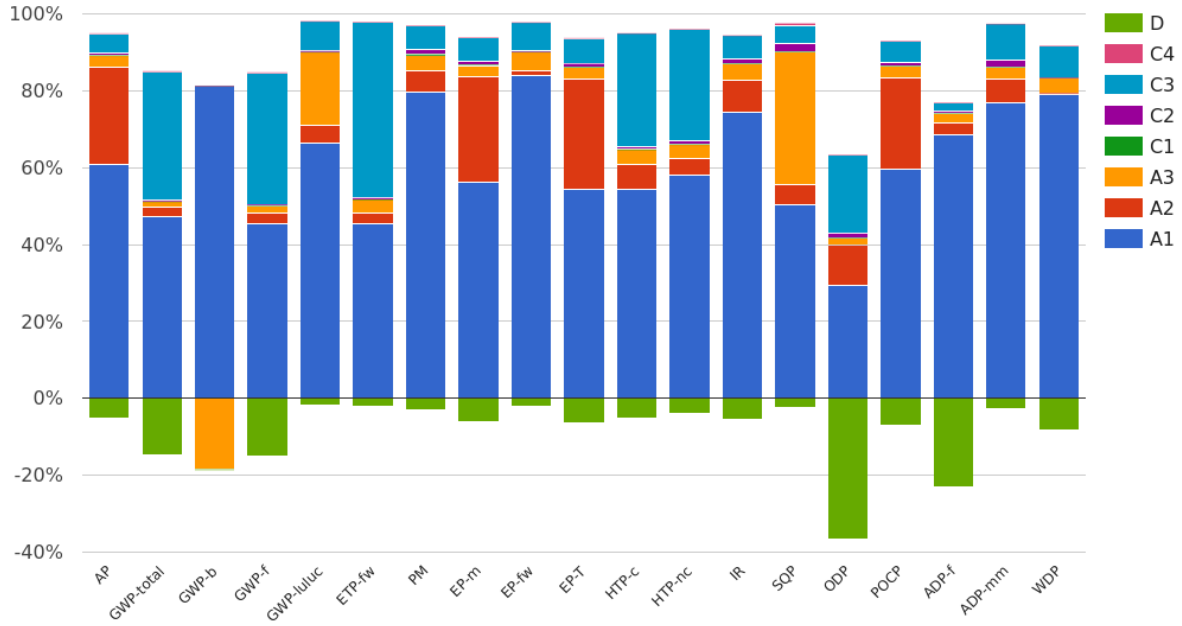
Biogenic carbon content	Amount	Unit
Biogenic carbon content in the product	0	kg C
Biogenic carbon content in accompanying packaging	0.01875	kg C

UPTAKE OF BIOGENIC CARBON DIOXIDE

The following amount of uptake of carbon dioxide is account in module A1 by the main parts of the product. Related uptake and release of carbon dioxide in downstream processes are not taken into account in this number although they do appear in the presented results.

Uptake Biogenic Carbon dioxide	Amount	Unit
Packaging	0.06876	kg CO2 (biogenic)

6 Interpretation of results



For easier understanding, the results are presented graphically in order to be able to see correlations and connections between the data more clearly.

As can be seen in the graph, raw material provision (module A1) dominates in almost all environmental impacts, sometimes followed by waste processing for reuse, recovery and/ or recycling (C3). The highest influence on the Global Warming Potential has module A1.

7 References

ISO 14040
ISO 14040:2006-10, Environmental management - Life cycle assessment - Principles and framework; EN ISO 14040:2006

ISO 14044
ISO 14044:2006-10, Environmental management - Life cycle assessment - Requirements and guidelines; EN ISO 14040:2006

ISO 14025
ISO 14025:2011-10: Environmental labels and declarations — Type III environmental declarations — Principles and procedures

EN 15804+A2
EN 15804+A2: 2019: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products

PCR A: General Program Category Rules for Construction Products from the EPD program Kiwa-Ecobility Experts, 2022-02-14

PCR B: Product Category Rules (PCR) from the Kiwa-Ecobility Experts (Kiwa-EE) – Specific Product Category Rules: Geosynthetic products, 2023-07-21

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