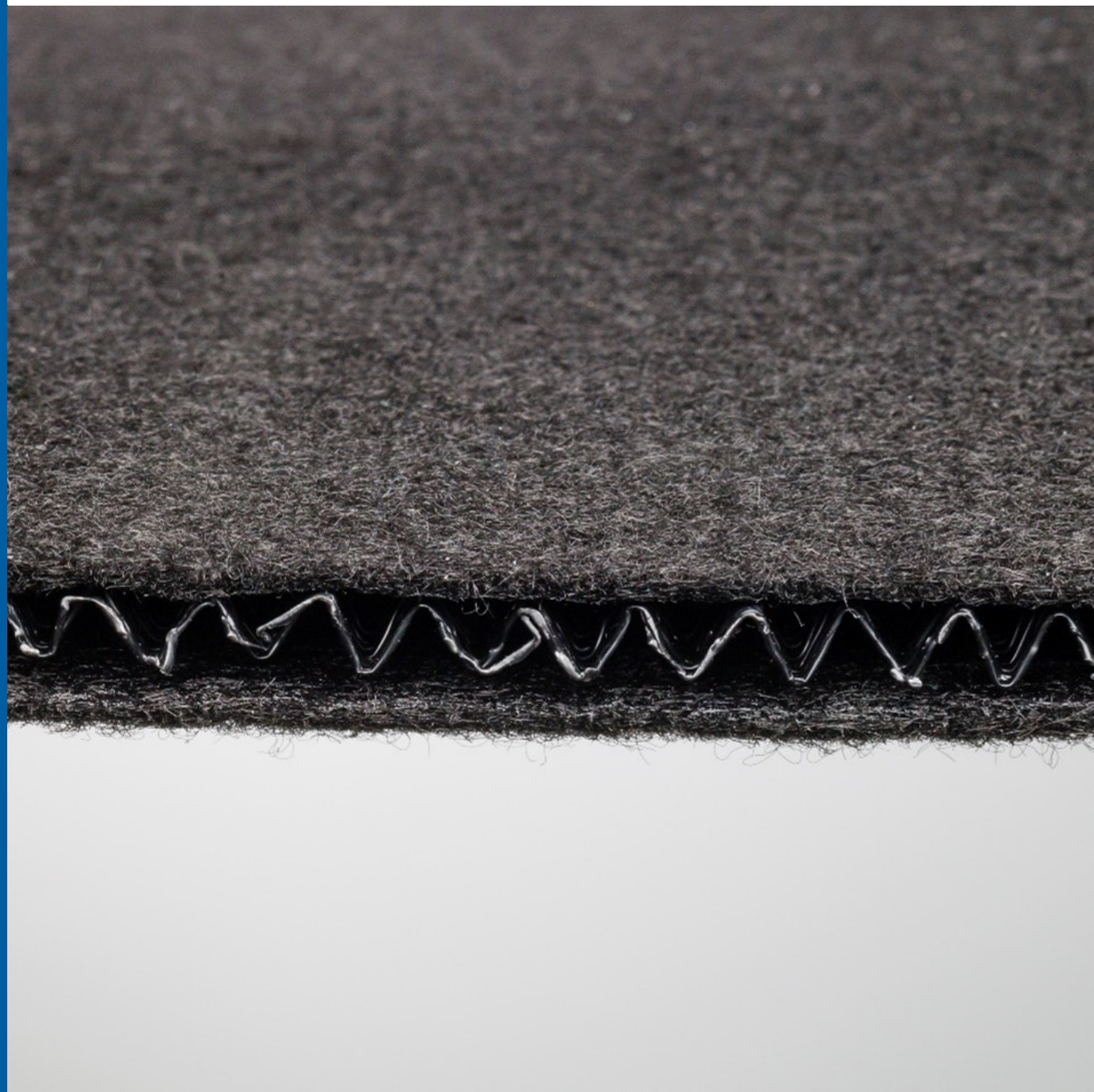
Environmental Product Declaration (EPD)
According to ISO 14025 and EN 15804

EnkaDrain® and Enka®Break



Registration number:	EPD-Kiwa-EE-177999-en
Issue date:	29-07-2024
Valid until:	29-07-2029
Declaration owner:	Freudenberg Performance Materials B.V.
Publisher:	Kiwa-Ecobility Experts
Program operator:	Kiwa-Ecobility Experts
Status:	verified

1 General information

1.1 PRODUCT

EnkaDrain® and Enka®Break

1.2 REGISTRATION NUMBER

EPD-Kiwa-EE-177999-en

1.3 VALIDITY

Issue date: 29-07-2024

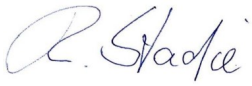
Valid until: 29-07-2029

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+A2. 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

1 General information

the system 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 EPD program operators 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: v3.17 (2024-05-22)

** Simapro is 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 'EnkaDrain® and Enka®Break ' with the calculation identifier ReTHiNK-77999.

2 Product

2.1 PRODUCT DESCRIPTION

Polypropylene EnkaDrain® and Enka®Break products are geotechnical composites for drainage, filtration, separation and capillary break layers. Each EnkaDrain® and Enka®Break consists of a polypropylene v-shaped core which is covered on one or both sides with a polypropylene geotextile. Thanks to the specific shape of the core, the products are highly pressure resistant which results in, long lasting, high water flow capacities in i.e. embankments, landfill capping or other application areas.

The scaling method was used because the thickness of the polypropylene in the product varies.

The composition of the product

Materials	Weight %
Polypropylene	98 – 99%
Masterbatches	1%
Ancillary items	<1%

2.2 APPLICATION (INTENDED USE OF THE PRODUCT)

The EnkaDrain® range of multifunctional products is used for drainage, filtration and separation in many applications. Examples are landfill capping drainage, landfill side and base drainage and in general large surface area drainage. EnkaDrain® is applied to create drainage capabilities and protection in order to prevent damage to the construction and safeguard normal functionality now and in the long future, with proven performances. Enka®Break products are applied as a capillary break layer by creating an air gap between i.e. two soil layers. Stopping the capillary break phenomenon in this manner, project designs can be optimized thanks to a reduction of required natural resources (i.e. gravel, sand), lower total project emissions and cost savings.

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 TECHNICAL DATA

Listed below the technical data for the declared Enkadrain® and Enka®Break product range. The unit weight varies per product type depending on necessary performance needed.

Characteristics	Standard	Value	Unit
Unit weight	EN ISO 9864	310 - 1050	g/m2
Nominal tensile strength - MD	EN ISO 10319	8 - 36	kN/m
Nominal tensile strength - CMD	EN ISO 10319	8 - 42	kN/m
Elongation at maximum load - MD	EN ISO 10319	45 - 70	%
Elongation at maximum load - CMD	EN ISO 10319	45 - 75	%
Static puncture resistance top fleece (CBR)	EN ISO 12236	1 – 3,5	kN
Dynamic perforation resistance top fleece	EN ISO 13433	8 - 35	mm
Water permeability (Vih50)	EN ISO 11058	70 - 105	mm/s
Characteristic Opening Size (O90)	EN ISO 12956	70 - 90	µm
Water flow capacity in the plane 20 kPa, rigid/ foam	EN ISO 12958	1,0 – 3,0	l/m.s
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	4	weeks

* Annex B of the geosynthetic application standards describe a interpretation of results of the accelerated aging test performed in accordance with EN 12447 (Hydrolysis) and EN ISO 13438 (Oxidation).

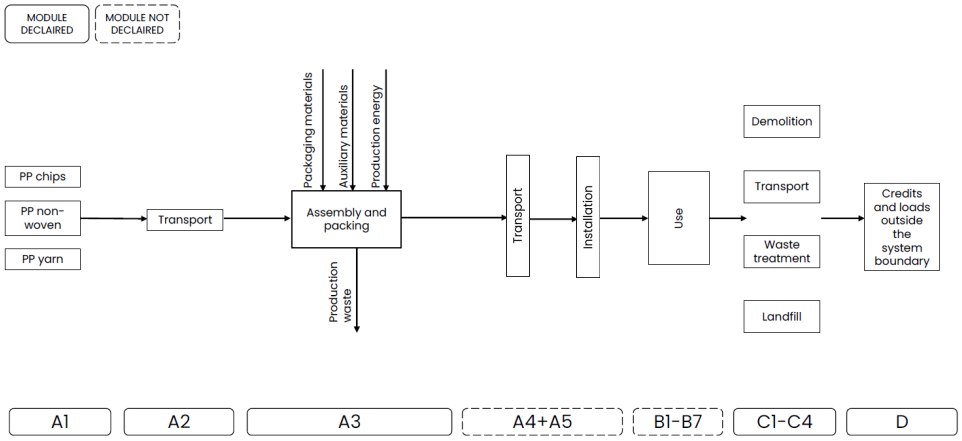
2.5 SUBSTANCES OF VERY HIGH CONCERN

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, 2023).

2 Product

2.6 DESCRIPTION PRODUCTION PROCESS

All products from both EnkaDrain® and Enka®Break ranges are 100% polypropylene geocomposites with a v-shape core attached to one or two geotextiles. The weight of the geotextiles and/or the core can vary to answer to individual project performance requirements. The geotextiles are produced in Hungary. The v-shape drainage core is manufactured at Freudenberg's production site in Obernburg am Main in Germany, through a monofilament extrusion process. The polypropylene chips are delivered in Obernburg by truck from within Germany. At the Obernburg am Main site the components are assembled by means of sewing to make the final product. The yarn for the sewing process is delivered by truck from Belgium. After sewing, the product is wound up onto a carboard tube before being packaged with a polyethylene foil. The final roll is up to 5m wide. The standard roll length is 100m but length can be altered to fulfill project specific needs. Therefore roll weight and diameter can vary.



3 Calculation rules

3.1 DECLARED UNIT

m^2

The declared unit is square meter of EnkaDrain® and Enka®Break

Reference unit: square meter (m2)

3.2 CONVERSION FACTORS

Description	Value	Unit
Reference unit	1	m2
Weight per reference unit	0.978	kg
Conversion factor to 1 kg	1.022809	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 EnkaDrain® and Enka®Break, a products of Freudenberg Performance Materials B.V. The data are representative for the 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 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

Allocations were avoided as far as possible. There are no coproducts or by-product in the manufacturing of the examined product. Based on energy consumption measurements, the energy requirements of the production were allocated to the individual products. Specific information about allocations within the background data is included in the documentation of the Ecoinvent datasets.

3.7 DATA COLLECTION & REFERENCE TIME PERIOD

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

3.8 ESTIMATES AND ASSUMPTIONS

All datasets chosen for the LCA refer to Europe as the geographic reference.

A data set for a non-specific truck was used for phase A2.

For the end-of-life, waste scenarios from the Dutch Nationale Milieudatabase (NMD) waste scenarios were used.

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 residual electricity mix, low voltage, from the Ecoinvent database version 3.6 (2019).

3 Calculation rules

3.12 SCALING

A scaling method was used to calculate the LCA results for the different EnkaDrain® and Enka®Break 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])

These products are covered by this EPD:

Name	Unit weight (g/m²)
5004L/5-1s/M110PP	0,31
5004F/5-1s/M110PP	0,41
5004L/5-1s/M200PP	0,415
5004L/5-2s/M110PP	0,42
5004F/5-1s/M200PP	0,5
5006H/5-1s/M110PP	0,51
5006H/5-1s/T110PP	0,51
5004F/2-2s/T110PP	0,52
5004F/2-2s/M110PP	0,52
5004F/5-2s/M110PP	0,52
5004F/5-2s/T110PP	0,52
Enka®Break S	0,52
5004F/5-1s/M300PP	0,6
5006H/5-1s/M200PP	0,6
5006H/2-2s/T110PP	0,62
5004F/5-2s/M160PP	0,62
5006H/5-2s/M110PP	0,62

3 Calculation rules

Name	Unit weight (g/m²)
5006H/5-2s/T110PP	0,62
5004F/5-2s/T165PP	0,63
5004F/5-2s/M200PP	0,7
5006H/5-1s/M300PP	0,7
5006C/2-2s/T110PP	0,72
5004C/2-2s/M110PP	0,72
5006H/2-2s/M160PP	0,72
5004C/2-2s/T110PP	0,72
5004C/5-2s/M110PP	0,72
5004C/5-2s/T110PP	0,72
Enka®Break P	0,72
5006H/5-2s/M160PP	0,72
5006C/5-2s/T110PP	0,72
5004C/5-2s/M110PP	0,72
5006B/2-1s/T200PF	0,8
5006H/5-2s/M200PP	0,8
5004F/5-2s/M300PP	0,9
5004C/5-2s/M200PP	0,9
5006C/5-2s/M200PP	0,9
5020Z/2-1s/T200PF	1
5006B/5-2s/M200PP	1
5006H/5-2s/M300PP	1
ZB 350	1,05

Parameter	Value
Scaling type	Linear
Description dimension	Specific mass
Dimension	0.000

3 Calculation rules

Parameter	Value
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

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.

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

4 Scenarios and additional technical information

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	0.196	0.782	0.000	0.000
Total	**0.000**	**0.196**	**0.782**	**0.000**	**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	25.639
Total	**0.000**	**25.639**

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

Abbr.	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
AP	mol H+ eqv.	5.66E-5	4.31E-6	1.03E-3	1.09E-3	3.43E-5	5.37E-7	4.45E-6	9.17E-8	-4.38E-6
GWP-total	kg CO2 eqv.	1.43E-2	7.45E-4	2.10E-1	2.25E-1	3.28E-3	9.27E-5	1.04E-2	1.26E-4	-5.36E-3
GWP-b	kg CO2 eqv.	-2.06E-4	3.43E-7	1.02E-2	1.00E-2	9.12E-7	4.27E-8	1.95E-6	1.05E-7	3.02E-14
GWP-f	kg CO2 eqv.	1.45E-2	7.44E-4	2.00E-1	2.15E-1	3.28E-3	9.26E-5	1.04E-2	1.26E-4	-5.36E-3
GWP-luluc	kg CO2 eqv.	9.88E-6	2.73E-7	1.54E-4	1.64E-4	2.58E-7	3.39E-8	7.96E-7	5.28E-9	-1.52E-7
EP-m	kg N eqv.	8.78E-6	1.52E-6	1.24E-4	1.35E-4	1.51E-5	1.89E-7	1.22E-6	7.44E-8	-1.32E-6
EP-fw	kg P eqv.	4.79E-7	7.50E-9	1.92E-5	1.97E-5	1.19E-8	9.34E-10	3.00E-8	1.90E-10	-5.77E-9
EP-T	mol N eqv.	1.01E-4	1.68E-5	1.64E-3	1.76E-3	1.66E-4	2.09E-6	1.35E-5	3.35E-7	-1.44E-5
ODP	kg CFC 11 eqv.	8.29E-10	1.64E-10	4.97E-9	5.97E-9	7.08E-10	2.04E-11	3.14E-10	3.21E-12	-6.97E-10
POCP	kg NMVOC eqv.	4.15E-5	4.79E-6	3.77E-4	4.24E-4	4.57E-5	5.96E-7	3.59E-6	1.23E-7	-4.78E-6
ADP-f	MJ	4.53E-1	1.12E-2	2.68E+0	3.14E+0	4.51E-2	1.40E-3	7.18E-3	2.47E-4	-8.95E-2
ADP-mm	kg Sb-eqv.	1.24E-7	1.88E-8	1.05E-6	1.20E-6	5.03E-9	2.35E-9	1.22E-8	1.12E-10	-1.42E-9
WDP	m3 world eqv.	8.79E-3	4.01E-5	6.43E-1	6.52E-1	6.05E-5	5.00E-6	5.17E-4	1.05E-5	-3.90E-4

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 EN15804+A2

Abbr.	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
ETP-fw	CTUe	1.00E-1	1.00E-2	1.44E+0	1.55E+0	2.72E-2	1.25E-3	1.31E-1	9.27E-4	-5.19E-3
PM	disease incidence	3.78E-10	6.69E-11	6.33E-9	6.78E-9	9.09E-10	8.33E-12	3.33E-11	1.72E-12	-1.24E-11
HTP-c	CTUh	3.81E-12	3.25E-13	3.30E-11	3.71E-11	9.50E-13	4.04E-14	1.91E-12	7.11E-15	-3.37E-13
HTP-nc	CTUh	9.75E-11	1.09E-11	1.30E-9	1.41E-9	2.34E-11	1.36E-12	4.04E-11	2.87E-13	-4.78E-12
IR	kBq U235 eqv.	7.91E-4	4.70E-5	5.43E-3	6.27E-3	1.93E-4	5.85E-6	3.05E-5	9.66E-7	-2.88E-5
SQP	Pt	5.76E-2	9.73E-3	4.15E-1	4.83E-1	5.76E-3	1.21E-3	2.20E-3	5.82E-4	-1.29E-3

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	Acidification 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

5 Results

ILCD classification	Indicator	Disclaimer
	Potential Comparative Toxic Unit for humans (HTP-c)	2
	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.

5.2 ENVIRONMENTAL IMPACT INDICATORS PER SQUARE METER (SCALABLE PART)

CORE ENVIRONMENTAL IMPACT INDICATORS EN15804+A2

Abbr.	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
AP	mol H+ eqv.	1.12E-2	8.57E-4	2.56E-4	1.23E-2	0.00E+0	1.07E-4	8.83E-4	1.82E-5	-8.70E-4
GWP-total	kg CO2 eqv.	2.84E+0	1.48E-1	6.24E-2	3.05E+0	0.00E+0	1.84E-2	2.07E+0	2.50E-2	-1.06E+0
GWP-b	kg CO2 eqv.	-4.09E-2	6.82E-5	-1.28E-3	-4.21E-2	0.00E+0	8.48E-6	3.88E-4	2.08E-5	6.00E-12
GWP-f	kg CO2 eqv.	2.88E+0	1.48E-1	6.35E-2	3.09E+0	0.00E+0	1.84E-2	2.07E+0	2.49E-2	-1.06E+0
GWP-luluc	kg CO2 eqv.	1.96E-3	5.41E-5	2.00E-4	2.22E-3	0.00E+0	6.73E-6	1.58E-4	1.05E-6	-3.02E-5
EP-m	kg N eqv.	1.74E-3	3.02E-4	4.64E-5	2.09E-3	0.00E+0	3.76E-5	2.41E-4	1.48E-5	-2.61E-4
EP-fw	kg P eqv.	9.50E-5	1.49E-6	1.94E-6	9.85E-5	0.00E+0	1.85E-7	5.96E-6	3.77E-8	-1.15E-6
EP-T	mol N eqv.	2.00E-2	3.33E-3	5.16E-4	2.38E-2	0.00E+0	4.14E-4	2.69E-3	6.65E-5	-2.87E-3
ODP	kg CFC 11 eqv.	1.65E-7	3.26E-8	3.60E-9	2.01E-7	0.00E+0	4.06E-9	6.23E-8	6.38E-10	-1.38E-7
POCP	kg NMVOC eqv.	8.25E-3	9.50E-4	2.20E-4	9.42E-3	0.00E+0	1.18E-4	7.13E-4	2.45E-5	-9.48E-4

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

Abbr.	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
ADP-f	MJ	8.99E+1	2.23E+0	1.58E+0	9.37E+1	0.00E+0	2.77E-1	1.43E+0	4.90E-2	-1.78E+1
ADP-mm	kg Sb-eqv.	2.46E-5	3.74E-6	6.10E-7	2.89E-5	0.00E+0	4.66E-7	2.43E-6	2.22E-8	-2.81E-7
WDP	m3 world eqv.	1.74E+0	7.97E-3	3.96E-2	1.79E+0	0.00E+0	9.92E-4	1.03E-1	2.09E-3	-7.74E-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 EN15804+A2

Abbr.	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
ETP-fw	CTUe	1.98E+1	1.99E+0	7.93E-1	2.26E+1	0.00E+0	2.47E-1	2.60E+1	1.84E-1	-1.03E+0
PM	disease incidence	7.51E-8	1.33E-8	2.02E-9	9.04E-8	0.00E+0	1.65E-9	6.61E-9	3.40E-10	-2.46E-9
HTP-c	CTUh	7.56E-10	6.44E-11	2.24E-11	8.43E-10	0.00E+0	8.02E-12	3.78E-10	1.41E-12	-6.70E-11
HTP-nc	CTUh	1.93E-8	2.17E-9	5.86E-10	2.21E-8	0.00E+0	2.70E-10	8.02E-9	5.70E-11	-9.49E-10
IR	kBq U235 eqv.	1.57E-1	9.33E-3	2.69E-3	1.69E-1	0.00E+0	1.16E-3	6.05E-3	1.92E-4	-5.72E-3
SQP	Pt	1.14E+1	1.93E+0	2.82E-1	1.36E+1	0.00E+0	2.40E-1	4.37E-1	1.15E-1	-2.56E-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	Acidification potential, Accumulated Exceedance (AP)	None
		None

5 Results

ILCD classification	Indicator	Disclaimer
ILCD type / level 3	Eutrophication potential, Fraction of nutrients reaching freshwater end compartment (EP-freshwater)	
	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
	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
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

Abbr.	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
PERE	MJ	2.05E-2	1.40E-4	3.15E-1	3.35E-1	2.44E-4	1.75E-5	7.80E-4	4.46E-6	-1.90E-4
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	0.00E+0
PERT	MJ	2.05E-2	1.40E-4	3.15E-1	3.35E-1	2.44E-4	1.75E-5	7.80E-4	4.46E-6	-1.90E-4
PENRE	MJ	3.25E-1	1.19E-2	2.80E+0	3.14E+0	4.79E-2	1.48E-3	7.63E-3	2.62E-4	-9.93E-2
PENRM	MJ	1.61E-1	0.00E+0	7.21E-4	1.61E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PENRT	MJ	4.85E-1	1.19E-2	2.80E+0	3.30E+0	4.79E-2	1.48E-3	7.63E-3	2.62E-4	-9.93E-2
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	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	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	0.00E+0
FW	M3	1.84E-4	1.37E-6	1.56E-2	1.58E-2	2.32E-6	1.70E-7	1.52E-5	2.58E-7	-5.16E-6

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

Abbr.	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
HWD	Kg	2.71E-7	2.84E-8	1.35E-4	1.36E-4	1.23E-7	3.54E-9	1.40E-8	3.74E-10	-1.13E-7
NHWD	Kg	6.52E-4	7.12E-4	7.39E-3	8.75E-3	5.34E-5	8.86E-5	1.53E-4	9.82E-4	-3.60E-5
RWD	Kg	7.02E-7	7.37E-8	6.96E-6	7.74E-6	3.13E-7	9.17E-9	2.56E-8	1.46E-9	-4.28E-8

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

5 Results

ENVIRONMENTAL INFORMATION DESCRIBING OUTPUT FLOWS

Abbr.	Unit	A1	A2	A3	A1-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	0.00E+0
MFR	Kg	0.00E+0	0.00E+0	1.18E-6	1.18E-6	0.00E+0	0.00E+0	0.00E+0	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	0.00E+0
EET	MJ	0.00E+0	0.00E+0	-2.03E-4	-2.03E-4	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-3.98E-2
EEE	MJ	0.00E+0	0.00E+0	-1.18E-4	-1.18E-4	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-2.31E-2

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

Abbr.	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
PERE	MJ	4.06E+0	2.79E-2	7.29E-2	4.16E+0	0.00E+0	3.47E-3	1.55E-1	8.86E-4	-3.78E-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	0.00E+0
PERT	MJ	4.06E+0	2.79E-2	7.29E-2	4.16E+0	0.00E+0	3.47E-3	1.55E-1	8.86E-4	-3.78E-2
PENRE	MJ	6.44E+1	2.37E+0	9.85E-1	6.78E+1	0.00E+0	2.94E-1	1.51E+0	5.21E-2	-1.97E+1
PENRM	MJ	3.19E+1	0.00E+0	7.06E-1	3.26E+1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PENRT	MJ	9.63E+1	2.37E+0	1.69E+0	1.00E+2	0.00E+0	2.94E-1	1.51E+0	5.21E-2	-1.97E+1
SM	Kg	0.00E+0	0.00E+0	2.60E-4	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	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	0.00E+0
FW	M3	3.65E-2	2.71E-4	9.33E-4	3.77E-2	0.00E+0	3.38E-5	3.02E-3	5.12E-5	-1.02E-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

Abbr.	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
HWD	Kg	5.38E-5	5.64E-6	7.03E-7	6.01E-5	0.00E+0	7.02E-7	2.78E-6	7.43E-8	-2.25E-5
NHWD	Kg	1.29E-1	1.41E-1	6.43E-3	2.77E-1	0.00E+0	1.76E-2	3.03E-2	1.95E-1	-7.14E-3
RWD	Kg	1.39E-4	1.46E-5	2.66E-6	1.57E-4	0.00E+0	1.82E-6	5.08E-6	2.90E-7	-8.50E-6

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

ENVIRONMENTAL INFORMATION DESCRIBING OUTPUT FLOWS

Abbr.	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
CRU	Kg	0.00E+0	0.00E+0	3.12E-5	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	4.97E-4	4.97E-4	0.00E+0	0.00E+0	0.00E+0	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	0.00E+0
EET	MJ	0.00E+0	0.00E+0	-4.31E-2	-4.31E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-7.91E+0
EEE	MJ	0.00E+0	0.00E+0	-2.50E-2	-2.50E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-4.59E+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

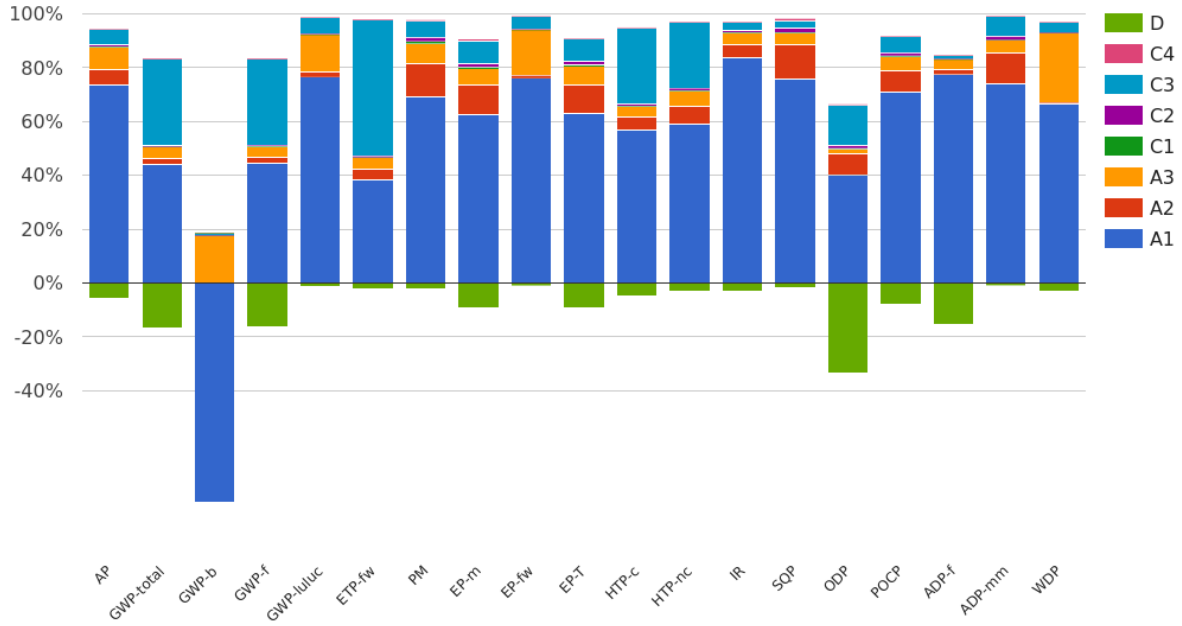
5.5 INFORMATION ON BIOGENIC CARBON CONTENT PER SQUARE METER

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	kg C

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

EN ISO 9864
Geosynthetics — Test method for the determination of mass per unit area of geotextiles and geotextile-related products.

EN ISO 10319
Geosynthetics — Wide-width tensile test.

EN ISO 12236
Geosynthetics — Static puncture test (CBR test).

EN ISO 13433
Geosynthetics — Dynamic perforation test (cone drop test).

EN ISO 11058
Geotextiles and geotextile-related products — Determination of water permeability characteristics normal to the plane, without load.

EN ISO 12956
Geotextiles and geotextile-related products — Determination of the characteristic opening size.

EN 12224
Geotextilien und geotextilverwandte Produkte - Bestimmung der Witterungsbeständigkeit.

EN 13253:2016
Geotextilien und geotextilverwandte Produkte - Geforderte Eigenschaften für die Anwendung in Erosionsschutzanlagen (Küstenschutz, Deckwerksbau).

7 References

NMD EoL scanarios 2022
Forfaitaire waarden voor verwerking-scenario's einde leven behorende bij:
Bepalingsmethode Milieuprestatie Bouwwerken

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

8 Contact information

Publisher	Operator	Owner of declaration

Kiwa-Ecobility Experts
Wattstraße 11-13
13355 Berlin, DE

E-mail:
DE.Ecobility.Experts@kiwa.com
Website:
https://www.kiwa.com/de/en/themes/ecobility-experts/ecobility-experts-epd-program/

Kiwa-Ecobility Experts
Wattstraße 11-13
13355 Berlin, DE

E-mail:
DE.Ecobility.Experts@kiwa.com
Website:
https://www.kiwa.com/de/en/themes/ecobility-experts/ecobility-experts-epd-program/

Freudenberg Performance Materials B.V.
Westervoortsedijk 73
6827 AV Arnhem, Netherlands, NL

E-mail:
info@freudenberg-pm.com
Website:
https://www.freudenberg-pm.com/en

Kiwa-Ecobility Experts is established member of the ECO PLATFORM