ENGINEERING TOMORROW

Environmental **Product Declaration**

Solenoid valve, EV221BW, function: NO, G, ¾, EPDM

Solenoid Coil, BB230AS 230

EPD issued	2023-11-30
EPD expires	2028-11-30
EPD author	Danfoss Climate Solutions RAC-RP
EPD type	Cradle-to-grave
Declared unit	One product over its Reference Service Life
Products included	Solenoid Valve EV221BW (132U2003) with Solenoid Coil BB230AS (018F7351)
Manufacturing Location	Grodzisk, Poland
Use Location	Norway
Application	Water applications
Mass	0,993 kg without packaging 1,25 kg with packaging
Dimensions (H×W×D)	51,5x81x48 mm
Verification	[ ] External [X] Internal [ ] None
Produced to	Danfoss Product Category Rules (2022-09)
Internal independent verifier	Danfoss Power Electronics & Drives

Introduction

This Environmental Product Declaration (EPD) follows the Danfoss Product Category Rules (PCR) (2022-09-20). These rules provide a consistent framework for calculating and reporting the environmental performance of Danfoss' products and are aligned with relevant international standards, particularly ISO 14025:2006 and EN 15804+A2:2019.

This document has been produced by Danfoss A/S following an internal verification process, but it is not a third-party verified document.

What is an EPD?

An EPD is a document used to communicate transparently, the quantified environmental impacts of a product over its lifecycle stages. This quantification is done by performing a Life Cycle Assessment (LCA) in line with a consistent set of rules known as a PCR (Product Category Rules).

An EPD provides:

- A product's carbon footprint together with other relevant environmental indicators, including air pollution, water use, energy consumption, and waste, over its life cycle (Module A-C), as well as the expected benefits of reuse and recycling in reducing the impact of future products (Module D). See Table 1 for module descriptions.
- Environmental data allows customers to calculate LCAs and produce EPDs for their products.

Type of EPD

This EPD is of the type 'cradle-to-grave' and includes all relevant modules: production (A1-A3), shipping (A4) and installation (A5); operational energy use (B6); deconstruction (C1), waste collection and transport (C2), treatment (C3) and disposal (C4). It also includes potential net benefits to future products from recycling or reusing post-consumer waste (D). The codes in brackets are the module labels from EN 15804+A2. Modules concerning the use, maintenance, repair, replacement, refurbishment (B1-B5), and operational water use (B7) are excluded, following the cut-off rules from EN 15804.

Table 1: Modules of the product's life cycle included in the EPD.

Product stage			Installation		Use stage							End-of-life stage				Benefits
Raw materials	Transport	Manufacture	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-install.	Transport	Waste processing	Disposal	Benefits and loads outside system boundaries
A1	**A2**	**A3**	**A4**	**A5**	B1	B2	B3	B4	B5	B6	B7	**C1**	**C2**	**C3**	**C4**	**D**
X	**X**	**X**	**X**	X	MNR	MNR	MNR	MNR	MNR	**X**	MNR	**X**	**X**	**X**	**X**	**X**

(X = declared module; MNR = module not relevant)

Product Description

Danfoss direct servo operated solenoid valves are an easy way to control and shut off fluids in fluctuating pressure conditions.

The valve type is designed with EPDM seals in, lead-free dezincification resistant Eco brass for drinking water applications such as water supply / main inlet shut-off:

- Houses and large apartments,
- Commercial buildings
- Industrial buildings
- Kitchens and bathrooms
- Zoning

Industrial applications

- Laundry
- Dishwashing
- Dosing machines
- Food processing

See more information about solenoid valve (132U2003) on Danfoss product store and solenoid coil on (018F7351) Danfoss product store.

Figure 1: EW221BW with BB230AS.

Reference Service Life

For the purpose of this EPD the reference service life (RSL) of the product is considered to be 10 years.

Intended market.

The intended market of this study is Norway, and the baseline scenario involves the distribution, installation, and end-of-life in Norway.

Product Description

Table 2: Product composition

Material	Mass (kg)	%
Metals	0,883	89%
Steel	0,225	23%
Brass	0,528	53%
Stainless Steel	0,056	6%
Copper	0,074	7%
Plastics	0,101	10%
PBT	0,101	10%
LDPE	0,000003	0,0003%
Other	0,008	1%
PPEPDM	0,003	0,3%
EPDM	0,0002	0,02%
Paper	0,005	0,5%
Total product	0,993	100%
Polyethylene Film	0,122	47%
Cardboard	0,139	53%
Total packaging	0,261	100%
Total product & packaging	1,250	

The EPD values were calculated for this composition.

The declared unit is One product over its Reference Service Life (10 years), with a mass of 0,99 kg.

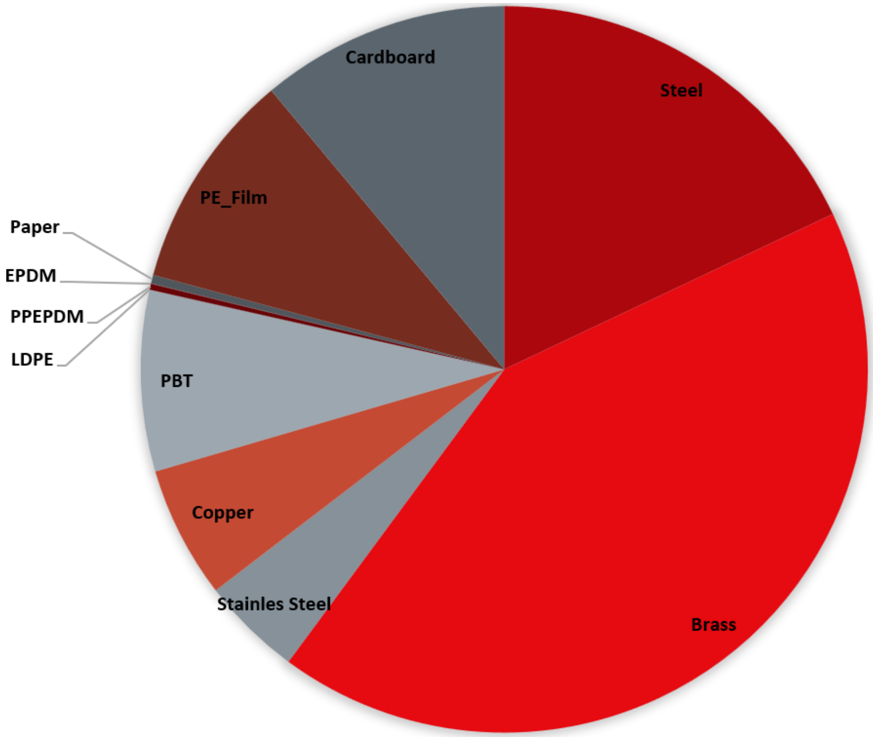

Figure 2: Material Composition Overview

Overview of LCA study

Data quality

The data quality of the selected datasets is generally assessed as good and very good in terms of geographical, time, and technology representativeness and applicability. Background data is from LCA software LCA for Experts (Sphera) database version 2023.1.

Allocation and cut-off criteria

The allocation is made in accordance with the provisions of EN 15804+A2. All major raw materials and all the essential energy are included. All hazardous materials and substances are considered in the inventory. Data sets within the system boundary are complete and fulfill the criteria for the exclusion of inputs and output criteria. No known material or energy flows were ignored, including those which fell below the limit of 1%. Accordingly, the total sum of input flows ignored is certainly less than 5% of the energy and mass applied.

Due to unavailable data sets for springs, and production methods such as machining/turning, it was assumed to be produced from a sheet instead, with its corresponding mass, the production waste for parts produced from a sheet was left unchanged. Moreover, the plastic cap used to cover the open ends was assumed to be LDPE.

Accordingly, the total sum of input flows ignored is certainly less than 5% of the energy and mass applied.

System boundaries

The results in this EPD are split into life cycle modules following EN 15804 (Figure 3): production (A1-A3), distribution (A4), (A5) installation, use (B6), and the end of the product's life (C1-C4). Module D represents environmental benefits and loads that occur beyond the system boundary (i.e., in future products).

Overview of LCA study

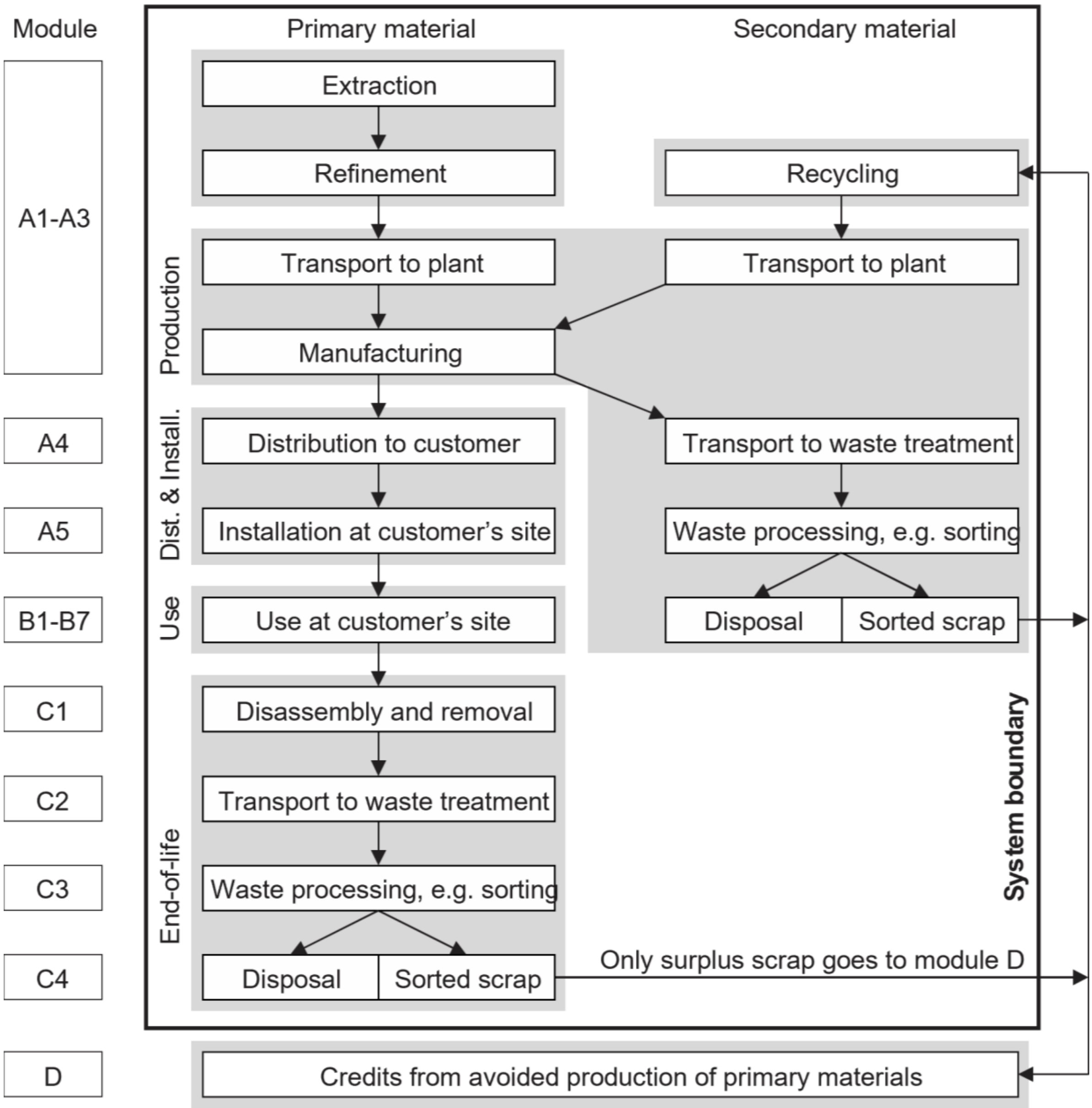

Figure 3: Modular structure used in this EPD (following EN 15804+A2)

Overview of LCA study

Product and packaging manufacture (A1-A3)

Final manufacturing occurs in the Grodzisk plant, in Poland, data collected in 2022. The facility is certified according to IATF 16949 compliant, ISO 14001, ISO 9001, PED/PESR, UL & MID. Where waste generated on-site is recyclable, it is separated and recycled. For further information, see here.. All packaging materials can be safely recycled or incinerated if appropriate local facilities are available.

Table 3: Biogenic carbon content in the product

	Total (excluding recycling)
Biogenic carbon content in accompanying packaging [kg]	6,14E-02

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

Shipping and installation (A4-A5)

The intended market for EW221BW with BB230AS is Norway. The assembly factory is in Poland, so 1320 km by truck, and 163km by ferry were used to represent the distance between the factory and the final customer. The average distance was calculated using sales data.

Module A5 includes disposal of packaging materials only, the benefits from e.g., energy recovered after plastic incineration are allocated to module D. The product is assumed to be installed by hand and there is no loss of product during installation. Energy use in handheld tools during installation is not included as it falls under the cut-off criteria.

Use phase (B1-B6)

The Reference Service Life (RSL) applied in this EPD is 10 years. The use of electricity consumption is bound to the analyzed product.

Table 4: Use phase data for EW221BW with BB230AS

Aspect	Value	Unit	Comment / Source
Power consumption "in operation"	11,0	W	Danfoss team
Power consumption "on standby"	0,0	W	Danfoss team
Daily total time "in operation"	0,00014	h/day	Danfoss team
Yearly total time "working"	0,051	h/year	Danfoss team

The scope of this study is targeted at the Norwegian market; therefore, the product under study is sold and used in Norway. To represent the Norwegian market for this assessment, and Norway electricity grid mix CO_2 factor from LCA for Experts database (2023.1) is applied.

The major limitation of the impact calculations for the use phase is that the electricity grid mix in use is assumed to remain at the same carbon intensity over time. Following the plans for the decarbonization of the grid across Norway, the environmental impacts are expected to decrease over time within the course of the next 10 years. However, as decarbonization will occur in the future and as the pace of decarbonization is uncertain, the use of the emission intensity of today's grid should prove to be a "worst-case", conservative assumption.

End-of-life (C1-C4)

The following end-of-life procedure has been applied:

- Manual dismantling is used to separate recyclable bulk materials, e.g., bulk metals and plastics.
- Shredding is used for the remaining parts, such as printed circuit board assemblies.
- Ferrous metals, non-ferrous metals, and bulk plastics are recovered through recycling.
- The remaining materials go to either energy recovery or landfill.

In line with EN 15804+A2, only the 'net scrap' (i.e., the leftover recyclable materials remaining after inputs of recycled content required in the manufacturing phase are first satisfied) is used to calculate the benefits and loads beyond the system boundary (Module D).

For this EPD an average scenario with 50% of the product sent to recycling and 50% of the product sent to landfill (C3, C4, D) was used.

This scenario is designed to represent an average end-of-life scenario.

For the EPD this average scenario was chosen as it is assumed that it represents the majority of cases on average.

1. Recycling scenario with 100% of the product sent to recycling at the end-of-life, excluding fractions that cannot be recycled or incinerated (e.g., glass reinforcing in glass-filled plastics) and are sent to landfill.

This scenario illustrates best-case performance. It assumes a 100% collection rate and the best available recycling technologies. Under this scenario, electrical cables, and all metals, flat glass, and unreinforced plastics found within the body and chassis of the product are recycled. Printed circuit board assemblies are incinerated, and the copper and precious metals (gold, silver, palladium, and platinum) are recycled.

2. Landfill scenario with 100% of the product sent to landfill.

This scenario assumes that the whole product, including its packaging, is landfilled. It is designed to represent a poor end-of-life route where valuable resources are lost.

Benefits and loads beyond the system boundary (D)

Module D considers the net benefit of recycling (including energy recovery) of materials in the product and packaging, taking into account losses in the recycling process and the recycled material used in the production of the product. Module D covers the two end-of-life scenarios, as described above.

Environmental performance

This section presents the environmental performance of one-unit EV221BW with BB230AS. Figure 5 presents the environmental impact of one-unit EV221BW with BB230AS across several environmental impact categories (following EN 15804+A2:2019) per life cycle stage, over its full life cycle, including Global Warming Potential.

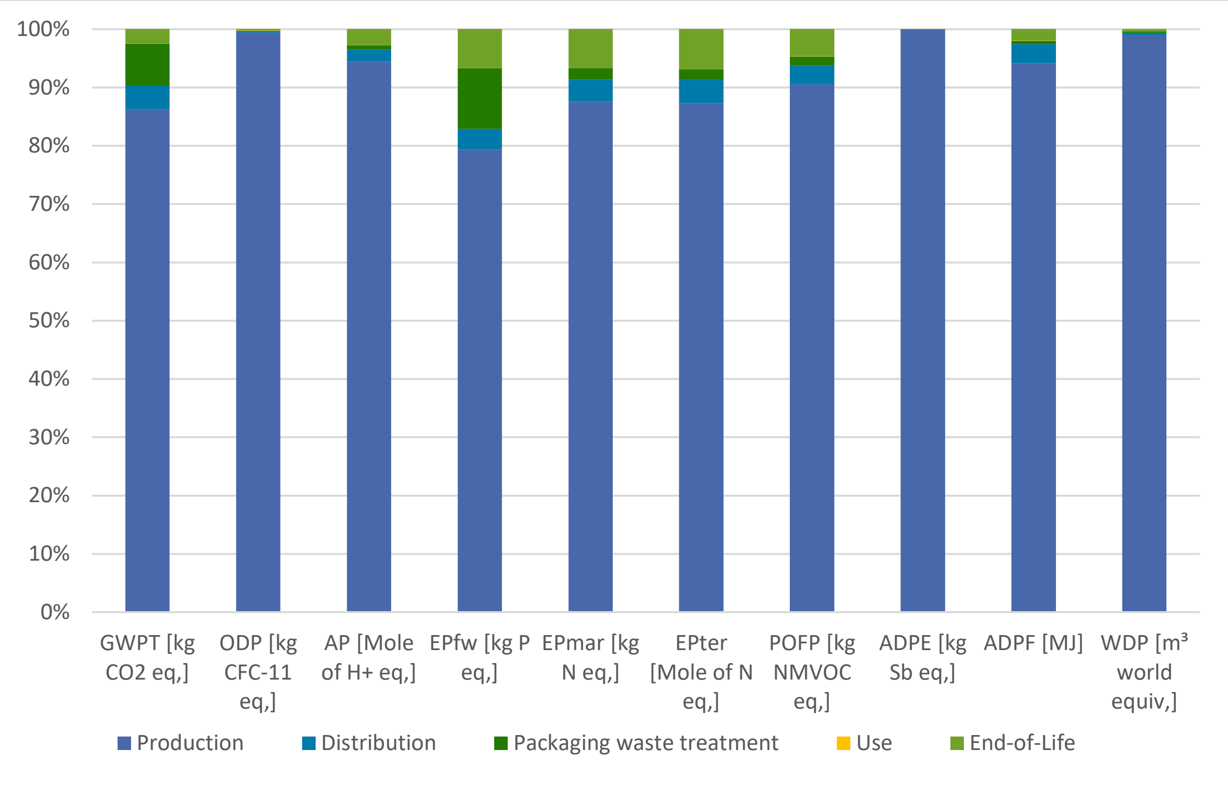

Figure 4: Breakdown of environmental impacts by life cycle stages (see Table 6 for descriptions of environmental impact indicators).

Table 5: Environmental Impact Indicators

	Production	Distribution	Packaging waste treatment	Use	End-of-Life				(Not included in Figure 5)
Life cycle stages based on EN 15804+A2	**A1-A3**	**A4**	**A5**	**B6**	**C1**	**C2**	**C3**	**C4**	**D**
Description / **Environmental Impact Indicators**	Manufacture of the product from 'cradle-to-gate'	Transport of the product to the customer	Installation of the product and disposal of used packaging	Use of the product over its lifetime e.g., 10 years	Deinstallation of the product from the site	Transport of the product to waste treatment	Processing waste for recycling	Disposal of waste that cannot be recycled (through landfill and incineration)	Potential benefits and loads beyond the system boundary due to reuse, recycling, and energy recovery
GWPT [kg CO2 eq.]	2,98E+00	1,38E-01	2,50E-01	3,67E-04	0,00E00	1,06E-02	5,65E-02	1,98E-02	-9,32E-01
GWPF [kg CO2 eq.]	3,20E+00	1,37E-01	2,49E-02	3,66E-04	0,00E00	1,01E-02	5,60E-02	1,64E-02	-9,30E-01
GWPB [kg CO2 eq.]	-2,25E-01	0,00E+00	2,25E-01	9,63E-07	0,00E00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
GWPLULUC [kg CO2 eq.]	3,27E-03	1,24E-03	2,54E-05	4,45E-08	0,00E00	2,45E-07	5,15E-04	2,39E-05	-1,59E-03
ODP [kg CFC-11 eq.]	1,13E-11	1,76E-14	1,68E-14	2,53E-15	0,00E00	1,18E-18	7,20E-15	2,32E-14	4,60E-13
AP [Mole of H+ eq.]	1,55E-02	3,38E-04	1,25E-04	3,51E-07	0,00E00	1,39E-05	3,49E-04	9,25E-05	-5,50E-03
EPfw [kg P eq.]	1,10E-05	4,89E-07	1,44E-06	1,07E-09	0,00E00	2,19E-09	2,03E-07	7,25E-07	-7,20E-07
EPmar [kg N eq.]	2,73E-03	1,17E-04	6,24E-05	1,15E-07	0,00E00	5,53E-06	1,71E-04	3,18E-05	-6,75E-04
EPter [Mole of N eq.]	2,92E-02	1,33E-03	6,13E-04	1,17E-06	0,00E00	6,09E-05	1,89E-03	3,47E-04	-7,25E-03
POFP [kg NMVOC eq.]	8,06E-03	2,82E-04	1,45E-04	2,88E-07	0,00E00	1,32E-05	3,24E-04	7,80E-05	-2,28E-03
ADPE [kg Sb eq.]	2,98E-04	8,83E-09	1,29E-09	2,22E-10	0,00E00	3,61E-10	3,65E-09	6,05E-10	-1,04E-04
ADPF [MJ]	5,39E+01	1,86E+00	3,41E-01	5,36E-03	0,00E00	1,46E-01	7,55E-01	2,25E-01	-1,34E+01
WDP [m^3 world equiv.]	4,07E-01	1,62E-03	1,19E-03	7,37E-05	0,00E00	1,71E-05	6,70E-04	7,25E-04	-2,43E-01

How to read scientific numbers:

e.g. 2,05E02 = $2,05 \times 10^2$ = 205

2,04E-01 = $2,04 \times 10^{-1}$ = 0,204

Table 6: Environmental impact indicator descriptions

Acronym	Unit	Indicator
GWPT	kg CO_2 eq.	Carbon footprint (Global Warming Potential) – total
GWPF	kg CO_2 eq.	Carbon footprint (Global Warming Potential) – fossil
GWPB	kg CO_2 eq.	Carbon footprint (Global Warming Potential) – biogenic
GWPLULUC	kg CO_2 eq.	Carbon footprint (Global Warming Potential) – land use and land use change
ODP	kg CFC-11 eq.	Depletion potential of the stratospheric ozone layer
AP	Mole H+ eq.	Acidification potential
EPfw	kg P eq.	Eutrophication potential – aquatic freshwater
EPmar	kg N eq.	Eutrophication potential – aquatic marine
EPter	Mole of N eq.	Eutrophication potential – terrestrial
POFP	kg NMVOC eq.	Summer smog (photochemical ozone formation potential)
ADPE*	kg Sb eq.	Depletion of abiotic resources – minerals and metals
ADPF*	MJ	Depletion of abiotic resources – fossil fuels
WDP*	m^3 world eq.	Water deprivation potential (deprivation-weighted water consumption)

Results for modules A1-A3 are specific to the product. All results from module A4 onwards should be considered as scenarios that represent one possible outcome. The true environmental performance of the product will depend on actual use.

The results in this section are relative expressions only and do not predict actual impacts, the exceeding of thresholds, safety margins, or risks. EPDs from others may not be comparable.

Carbon footprint

The total carbon footprint (GWPT), cradle-to-grave, of the product is 3,49E+00 kg CO2-eq (A1-C4). The carbon footprint (GWPT) of production of this product, cradle-to-gate, is 2,98E+00 kg CO2-eq (A1-A3).

Table 7: Resource use

	A1-A3	A4	A5	B6	C1	C2	C3	C4	D
PERE [MJ]	2,26E+01	1,33E-01	2,07E-02	4,59E-02	0,00E00	4,82E-04	5,50E-02	1,98E-02	-7,35E-01
PERM [MJ]	7,17E-02	0,00E00	0,00E+00	0,00E00	0,00E00	0,00E00	0,00E+00	0,00E+00	0,00E+00
PERT [MJ]	2,27E+01	1,33E-01	2,07E-02	4,59E-02	0,00E00	4,82E-04	5,50E-02	1,98E-02	-7,35E-01
PENRE [MJ]	5,38E+01	1,87E+00	3,56E-01	5,36E-03	0,00E00	1,46E-01	7,60E-01	2,25E-01	-1,35E+01
PENRM [MJ]	1,48E-01	0,00E+00	0,00E+00	0,00E+00	0,00E00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PENRT [MJ]	5,40E+01	1,87E+00	3,56E-01	5,36E-03	0,00E00	1,46E-01	7,60E-01	2,25E-01	-1,35E+01
SM [kg]	6,82E-01	0,00E+00	0,00E+00	0,00E+00	0,00E00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RSF [MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF [MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
FW [m3]	1,60E-02	1,45E-04	4,09E-05	6,39E-05	0,00E00	7,74E-07	6,00E-05	2,42E-05	-8,05E-03

Table 8: Resource use indicator descriptions

Acronym	Unit	Indicator
PERE	MJ	Use of renewable primary energy excluding renewable primary energy resources used as raw materials
PERM	MJ	Use of renewable primary energy resources used as raw materials
PERT	MJ	Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)
PENRE	MJ	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials
PENRM	MJ	Use of non-renewable primary energy resources used as raw materials
PENRT	MJ	Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)
SM	kg	Use of secondary material
RSF	MJ	Use of renewable secondary fuels
NRSF	MJ	Use of non-renewable secondary fuels
FW	m^3	Net use of fresh water

Table 9: Waste categories and output flows

	A1-A3	A4	A5	B6	C1	C2	C3	C4	D
HWD [kg]	1,35E-07	5,78E-12	1,20E-11	-4,04E-12	0,00E00	1,01E-12	2,35E-12	7,20E-12	-4,02E-05
NHWD [kg]	2,18E-01	2,82E-04	1,12E-01	2,06E-05	0,00E00	1,46E-05	1,16E-04	4,96E-01	-4,35E-02
RWD [kg]	1,11E-03	3,47E-06	2,13E-06	8,91E-07	0,00E00	1,57E-07	1,42E-06	1,76E-06	5,75E-05
CRU [kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MFR [kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E00	0,00E+00	0,00E+00	4,94E-01	0,00E+00
MER [kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EEE [MJ]	1,44E-05	0,00E+00	0,00E+00	0,00E+00	0,00E00	0,00E+00	0,00E+00	4,47E-04	0,00E+00
EET [MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E00	0,00E+00	0,00E+00	8,00E-04	0,00E+00

Table 10: Waste category and output flow descriptions

Acronym	Unit	Indicator
HWD	kg	Hazardous waste disposed
NHWD	kg	Non-hazardous waste disposed
RWD	kg	Radioactive waste disposed
CRU	kg	Components for reuse
MFR	kg	Materials for recycling
MER	kg	Materials for energy recovery
EEE	kg	Exported energy (electrical)
EET	kg	Exported energy (thermal)

Table 11: Additional indicators*

	A1-A3	A4	A5	B6	C1	C2	C3	C4	D
PM [Disease incidences]	1,77E-07	3,52E-09	9,07E-10	3,58E-12	0,00E00	1,93E-10	2,25E-09	9,00E-10	-7,95E-08
IRP [kBq U235 eq.]	1,61E-01	5,17E-04	2,81E-04	1,04E-04	0,00E00	2,22E-05	2,12E-04	2,27E-04	8,75E-03
ETPfw [CTUe]	2,22E+01	1,32E+00	2,97E-01	1,59E-03	0,00E00	1,06E-01	5,35E-01	1,20E+00	-7,20E+00
HTPc [CTUh]	1,92E-07	2,70E-11	8,56E-12	1,14E-12	0,00E00	1,97E-12	1,10E-11	1,10E-11	-6,05E-09
HTPnc [CTUh]	6,06E-08	1,51E-09	7,20E-10	2,17E-12	0,00E00	8,61E-11	6,90E-10	1,08E-09	-1,70E-08
SQP [Pt]	2,40E+01	7,61E-01	5,06E-02	2,93E-03	0,00E00	3,74E-04	3,16E-01	2,66E-02	-1,94E+00

Table 12: Optional indicator descriptions

Acronym	Unit	Indicator
PM	Disease incidence	Potential incidence of disease due to particulate matter emissions
IRP**	kBq U235 eq.	Potential human exposure efficiency relative to U235
ETPfw*	CTUe	Potential Comparative Toxic Unit for Ecosystems (freshwater)
HTPc*	CTUh	Potential Comparative Toxic Unit for humans (cancer)
HTPnc*	CTUh	Potential Comparative Toxic Unit for humans (non-cancer)
SQP*	Dimensionless	Potential soil quality index

**Disclaimer for ADPE, ADPF, WDP, ETPfw, HTPc, HTPnc, SQP:* The results of these environmental impact indicators shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

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

References

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