ENVIRONMENTAL Product Declaration

as per *ISO 14025* and *EN 15804+A2*

Owner of the Declaration	WILO SE
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-WIL-20210308-IBA1-DE
Issue date	04.03.2022
Valid to	03.03.2027

Wilo-Stratos MAXO 25/0,5-4/0,5-6/0,5-8/ PN10/16

WILO SE

Institut Bauen und Umwelt e.V.

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1. General Information

WILO SE

Programme holder
IBU – Institut Bauen und Umwelt e.V.
Panoramastr. 1
10178 Berlin
Germany

Declaration number
EPD-WIL-20210308-IBA1-DE

This declaration is based on the product category rules:
Pumps for liquids and liquids with solids, 08.2018
(PCR checked and approved by the SVR)

Issue date
04.03.2022

Valid to
03.03.2027

Dipl. Ing. Hans Peters
(chairman of Institut Bauen und Umwelt e.V.)

Dr. Alexander Röder
(Managing Director Institut Bauen und Umwelt e.V.))

Wilo-Stratos MAXO 25/0,5-4/0,5-6/0,5-8/ PN10/16

Owner of the declaration
WILO SE
Wilopark 1
44263 Dortmund
Germany

Declared product / declared unit
1 pce of Wilo-Stratos MAXO 25/0,5-4/0,5-6/0,5-8/ PN10/16

Scope:
The declared product is one piece of the pump Wilo-Stratos MAXO 25/0,5-4/0,5-6/0,5-8/ PN10/16. The product is produced in Dortmund, Germany, and the life cycle assessment is based on the collected data at the production site. The declaration covers three different types of the Stratos MAXO 25/ product (0,5-4/0,5-6/0,5-8). All modules of the life cycle assessment are identical for all three types, except module B6. The results of module B6 are declared for Stratos MAXO 25/ 0,5-8. Module B6 results for 0.5-4 or 0.5-6 can be obtained by multiplying the B6 indicator results by the factors given in the LCA section: Results.

The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

The EPD was created according to the specifications of *EN 15804+A2*. In the following, the standard will be simplified as *EN 15804*.

Verification

The standard *EN 15804* serves as the core PCR
Independent verification of the declaration and data according to *ISO 14025:2010*
☐ internally ☒ externally

Angela Schindler
(Independent verifier)

2. Product

2.1 Product description/Product definition

The Wilo-Stratos MAXO is a smart glandless circulator pump with a screwed or flanged connection and an EC motor with integrated electronic power adjustment.

The pump is suitable for circulating water in heating systems of all kinds, air-conditioning systems, closed cooling circuits and industrial circulation systems.

By precisely setting the control mode for the respective system-specific application (e.g. radiators, underfloor heating, ceiling cooling), the pump enables operation with maximum system efficiency.

This EPD includes three types of Wilo-Stratos MAXO. They are 100% physically identical. They have the same design, material, supply chain, manufacturing process, packaging, distribution as well as end-of-life-treatment. The only difference between the product types is the software setting that determines how the pump runs in the application. Therefore, all life cycle modules are identical, except for module B6 for the use phase, which will change if the applied scenarios for electricity consumption change.

Legal Provisions
For the placing on the market in the European Union/European Free Trade Association (EU/EFTA) (with the exception of Switzerland) the following legal provisions apply:

Machinery Directive (2006/42/EC)
Standard used: *EN 809:1998 + A1:2009, EN 60335-1:2012/AC:2014 +A11:2014, EN 60335-2-51:2003 + A1:2008 + A2:2012*

Ecodesign Directive (2009/125/EC)
Standards used: *EN 16297-1:2012, EN 16297-2:2012.*

Restriction of the use of certain hazardous substances 2011/65/EU + 2015/863
Standard used: *EN IEC 63000*

Radio Equipment Directive (2014/53/EU)
Standards used: *ETSI EN 301 489-1 V2.2.1, ETSI EN 300 328 V2.1.1*

Low Voltage Directive (2014/35/EU)

Electromagnetic Compatibility Directive (2014/30/EU)

The CE-marking takes into account the proof of conformity with the respective harmonized standards based on the legal provisions above.

Wilo-Stratos MAXO pumps are not covered by a harmonized standard under the *Regulation EU No. 305/2011*

2.2 Application

The pump is designed for circulating liquids in the following systems:

Heating
- Radiator
- Underfloor heating
- Ceiling heating
- Air heater
- Hydraulic separator
- Heat exchanger

Cooling
- Ceiling cooling
- Floor cooling
- Air-conditioning units
- Hydraulic separator
- Heat exchanger

Heating and cooling combined
- Automatic changeover

2.3 Technical Data

The relevant technical specifications according to the *PCR Part B* is given in the table below. Characteristics that are the same for all three product groups are only given once. Others are given individually for all three groups.

Name	Value	Unit
Frequency	50	Hz
Voltage	230	V
Pumped liquid (e.g. Water)	Clean Water	-
Energy efficiency index, Gr. 1	0.18	
Energy efficiency index, Gr. 2	0.18	
Energy efficiency index, Gr. 3	0.19	
Flow range, Gr. 1	7	m3/h
Flow range, Gr. 2	9	m3/h
Flow range, Gr. 3	9.8	m3/h
Head max., Gr. 1	4	m
Head max., Gr. 2	6	m
Head max., Gr. 3	8	m
Power input, Gr. 1 Average (from load profile describing use)	0.02985	kW
Power input, Gr. 2 Average (from load profile describing use)	0.04376	kW
Power input, Gr. 3 Average (from load profile describing use)	0.06423	kW
Nominal capacity, Gr. 1	0.069	kW
Nominal capacity, Gr. 2	0.114	kW
Nominal capacity, Gr. 3	0.133	kW

The performance data of the product according to the harmonised norms, based on the harmonisation provisions above apply.

2.4 Delivery status

The scope of delivery of the pump includes the following items:

- Pump
- Optimised Wilo connector for all sizes
- 2x threaded cable connection M16 x 1.5
- Washers for flange bolts M12 and M16 (for nominal connection diameters DN32 to DN65)
- 2x gaskets for threaded connection
- Thermal insulation shell
- Concise Installation and operating instruction

2.5 Base materials/Ancillary materials

Name	Value	Unit
Aluminium	24.2	%
Brass	1.4	%
Cable	0.7	%
Cast iron	31.8	%
Copper	0.5	%
Electronics	10.0	%
Magnet	9.3	%
Plastic	14.5	%
Plug	1.0	%
Rubber	2.4	%
Steel	2.4	%
Stainless steel	1.7	%
Tin	0.1	%
TOTAL	100	%

This product contains substances listed in *the candidate list* (18.12.2019) exceeding 0.1 percentage by mass: no.

This product contains other carcinogenic, mutagenic, reprotoxic (CMR) substances in categories 1A or 1B which are not on *the candidate list*, exceeding 0.1 percentage by mass: no.

Biocide products were added to this construction product or it has been treated with biocide products /this then concerns a treated product as defined by the (EU) *Ordinance on Biocide Products* No. 528/2012: no.

2.6 Manufacture

The manufacturing of the Wilo-Stratos MAXO is divided into the two areas of Electronics and Mechanics. Both areas are supplied with materials by the intralogistics.

Electronics:
In the first step, the delivered delivered printed circuit board (PCB)s are assembled fully automatically by SMT (Surface Mounted Technology), then separated into individual PCBs by cutting processes (depanelling) and manually assembled in the second assembly step by THT (Through Hole Technology), before being assembled with the other components of the electronics module in the final module assembly.

Mechanics:
The mechanics area is subdivided as follows:

- Mechanical production: this is where the machining of the components takes place; motor housings made of aluminium, impellers made of plastic, motor shields made of brass are the main components here.
- Engine production: Here there are two main components; in the stator production the stators are wound and assembled, in the rotor production the rotors are assembled, then welded and magnetised.
- Final assembly: here the previously machined components and the purchased parts are assembled into complete pumps, final tested and packed ready for dispatch.

The finished pumps are then transported to the outbound logistics department and shipped.

2.7 Environment and health during manufacturing

Wilo-HSE-Management ensures the implementation of standards and tools to avoid personal-, property-, environmental damages and financial losses as well as reducing liability risks by applying preventive actions.
Main Elements:
- Risk management
- Definition and implementation of protection rules
- Management of chemical products
- Emergency Management
- Ensure safe operation of technical equipment
- Analysis of nonconformities and action follow up

The production site is *ISO 14001, ISO 50001* and *ISO45001* certified.

2.8 Product processing/Installation

The old unit is disconnected from the mains and electrically disconnected. Then the valves upstream and downstream of the pump are closed and, if possible, the pump is relieved of system pressure. After the pumped medium has been drained, the union connections to the attached pipes are loosened with pliers and a spanner. Using the same tools, the new unit is inserted in the same place and the seals are renewed. Union connections are tightened and everything is checked for leakages. Finally, the pump is electrically reconnected in accordance with the regional regulations and connected to the mains.

The pump is ready for use and can be parameterized as needed.

2.9 Packaging

The declared unit includes the following packaging materials and their percentages by mass:

Name	Value	Unit
Cardboard	83,88	%
Paper	16,12	%
Plastic	0	%
Total	100	%

2.10 Condition of use

The pump is maintenance-free.

2.11 Environment and health during use

In the operating phase, the pump does not emit any pollutants that are hazardous to the environment or health.

2.12 Reference service life

No usage level scenario is given that relates to the life of the product.

According to *Appendix 7: EUP Lot 11, Circulators in buildings with* a RSL of 10 years can be used to facilitate construction calculations. On Page 37:

There is no definitive information on average circulator life available, there is consensus within the industry that it is at least 12 years. However, this is complicated by many factors, including many being scrapped prematurely when e.g. the boiler they are connected to is replaced.

From the estimated stock (140Mpa) and annual sales (14Mpa), the average lifetime of the circulator is taken as being 10 years for the purposes of this study.

The RSL of the declared product does not directly affect the results of this study because no scenario of the declared use level depends on the RSL; the B6 module of the use level is declared per year according to *PCR Part B*.

2.13 Extraordinary effects

Fire
Not applicable

Water
Not applicable

Mechanical destruction
Not applicable

2.14 Re-use phase

The following possibilities arise in terms of material composition:

Material recycling
The materials suitable for material recycling largely comprise the metallurgical materials processed in the product.

Energy recovery

The materials suitable for energy recovery primarily comprise the plastics contained in the product.

Landfilling
The entire product system must not be landfilled and must be recycled or recovered.

2.15 Disposal

Cuttings incurred during the manufacturing phase is directed towards metallurgical recycling and energy recovery. Cuttings are collected separately and collected by a disposal company.
Waste codes in accordance with the *European Waste Catalogue* EWC 2001 118 EC:

- *EWC 07 02 13* Plastic waste
- *EWC 12 01 01* Ferrous metal filings and turnings
- *EWC 12 01 03* Non-ferrous metal filings and turnings

Packaging
The paper and cardboard packaging components produced during installation in the building are recycled and plastics are incinerated.

- *EWC 15 01 01* Paper and cardboard packaging
- *EWC 15 01 02* Plastic packaging
- *EWC 15 01 03* Wooden packaging

EoL
The possible recycling rate of a Wilo pump is almost 100%. Together with recycling partners, Wilo aims to collect all dismantled old pumps and recycle them in a qualified manner. For the return of old products, Wilo has set up a collection process via wholesalers, through which installers can return their dismantled old pumps.

- *EWC 16 02 14* Used devices with the exception of those included in *16 02 09* to *16 02 13*
- *EWC 16 02 16* Components removed from used devices with the exception of those included in *16 02 15*
- *EWC 16 06 01* Lead batteries
- *EWC 17 02 03* Plastic
- *EWC 17 04 02* Aluminium
- *EWC 17 04 05* Iron and steel
- *EWC 17 04 11* Cables with the exception of those included in *17 04 10*

Disposal of the drive unit in Europe is subject to the Waste from Electrical and Electronical Equipment (*WEEE) Directive 2012/19/EU*.

2.16 Further information

www.wilo.com

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit is 1 piece (pce) of product.

Declared unit

Name	Value	Unit
Declared unit	1	pce.
conversion factor [Mass/Declared Unit]	6.977	-

3.2 System boundary

This EPD is Cradle-To-Gate with options.

The system boundaries of the EPD follow the modular approach in *EN 15804+A2.*

The product stage (A1-A3) includes raw material supply, processing, transport and the manufacturing process according to *EN 15804+A2*. The system boundary includes the material and energy input into the system, the subsequent manufacture of the product, the transport to the factory gate and the processing of waste generated by these processes. For secondary material inputs, the system boundary to the previous system (providing the secondary material) is set where outputs reach the end-of-waste state. The recycling of secondary material into new raw materials is included in the system boundary of this study. The Input of biogenic carbon from the production of packaging material is considered in module A3.

The product stage includes:

- A1 Extraction and processing of raw materials
- A1 Reuse of products or materials from a previous product system
- A1 Processing of secondary materials as input for manufacturing
- A1 Generation of electricity, heat from primary energy resources, also including their extraction, refining and transports
- A2 Transportation up to the factory gate and internal transport
- A3 Production of ancillary materials or pre-products
- A3 Manufacturing of products
- A3 Manufacturing of packaging
- A1-A3 processing up to the end-of-waste state or disposal of final residues

The environmental impacts of the incineration process are reported in the module in which they occur. The electricity and heat generated during combustion, as well as recycled materials, are considered as a closed-loop within A1-A3, as described in *PCR Part A*, 5.5.1.

The construction process stage (A4-A5) includes:

A4 Transport to the building site:

- Transportation to the building site

A5 Installation in the building:

- Transportation of a technician who installs the product in the building
- Transport of packaging waste to the treatment site
- Waste treatment of packaging material

Use stage (B1-B7):

The use stage, related to the building fabric are not included:

- B1, use or application of the installed product
- B2, maintenance

The use stage includes the operation of the product in the building:

- B6, operational energy use
- B7, operational water use (not included)

By decision no. 20170712-n of the SVR, the modules B3, B4 and B5 are by default declared as "MNR" (module not relevant).
The contribution to operational energy use during the use phase (B6) is derived from the electricity consumption of the product. The RSL of 10 years is based on *Appendix 7: EUP Lot 11, Circulators in buildings*. For this study, the calculation principle recommended by PCR Part B is used. For the calculation of the energy demand of the pump, the absorbed power according to the *RAL-UZ 105, Blauer Engel für Heizungsumwälzpumpen* is applied. The running time of 5000h per year is estimated based on V*DMA - Technical Report*

The End-of-Life stage (C1-C4) starts when the product has to be deconstructed at the end of service life. During the end-of-life stage of the product, all output from deconstruction, are first considered to be waste.

- C1 deconstruction of the product from the building
- C2 transportation of deconstructed product to the waste processing stage
- C3 waste processing, separation of the deconstructed waste and waste processing of material flows intended for reuse, recycling and energy recovery
- C4 waste disposal.

The definition of the applied end-of-life scenario in this EPD follows the requirements in the *PCR Part A*, 6.2 regarding complex products, with a combination of recycling and incineration of waste. 100 % of the material is considered in the end-of-life scenario as required by the PCR. An overall collection rate of 100 % has been assumed. The recovery efficiency of the municipal waste incineration is assumed 15 % electricity and 28 % heat. The amount of energy out of incineration can possibly substitute an amount of energy that is used as heat or electricity. Environmental burdens from the incineration process inventoried in C3, the recovered energy is declared as energy benefit in module D. This procedure is according to the *PCR Part A*, 5.5.6.

C3 includes the manual separation of the product followed by shredding end recycling of electronics. Metal fractions are recycled and plastics is incinerated with energy recovery. No materials are landfilled in C4. The specific amounts are shown in the scenarios section.

Beyond system boundary (D): According to *EN 15804+A2* module D includes the reuse, recovery and/or recycling potentials, beyond the system boundaries considering secondary material use and energy recovery for product materials and packagings leaving the product system. Any declared benefits and loads from net flows leaving the product system have passed the end-of-waste state are included in module D.

Contributions to module D comes from material recycling or from waste incineration processes in A5 and C3. The specific fractions and net flows are shown in the scenarios section.

3.3 Estimates and assumptions

The following assumptions and estimates were made for the LCA:

- Distance of transports
- Data mapping approaches
- RSL of pumps
- Annual running time of pumps
- Collection rate of the pump at the end of life
- Recovery efficiency of municipal waste incineration

3.4 Cut-off criteria

The LCA takes into account all materials and energies necessary for the production, use and disposal of Wilo-Stratos MAXO. Cut-offs are made in the manufacturing process for administrative activities, operational infrastructure, machinery and equipment, staff travel and disposal.

3.5 Background data

The life cycle assessment database *Ecoinvent* was used for the background data.

3.6 Data quality

Quality of the data to calculate an EPD according to *EN ISO 14044* is used. Generic and specific data should be checked for plausibility according to *EN 15804 + A2.*

Time-related coverage
The quality of the specific data for materials and energy is from 2021 and is rated to be very good. The time period from the generic data is between 2010 and 2019 and is rated to be good.

Geographic coverage
Generic data of global data for mining and extraction of raw materials is rated to be good. The geographical representativeness of specific data is rated very good. For manufacturing in the Wilo internal factory, the “Watergreen, Ökostrom DEW21” from “Dortmunder Energie- und Wasserversorgung GmbH” is used as well as a European natural gas mix for heat. The

geographical representativeness of the specific and generic data of the electricity mix from Dortmund is rated as very good. The geographical representativeness of the specific data of the natural gas mix is rated as very good, the generic data is rated as good. The European electricity mix is used for the operation. The specific data is rated as very good. The geographical representativeness of the generic electricity data is rated as good.

Technology coverage
The product systems in this study represent a glandless pump. The technical representativeness of the generic and specific data is rated as fair to very good.

3.7 Period under review
The LCA data was recorded for the period 2021.

3.8 Allocation
The end-of-life system boundary of the construction product system is set where outputs of the system under study, e.g. materials, products or construction elements, have reached the end-of-waste state. Material that is recycled is considered as an input for the next product system boundary.

Where relevant, module D declares potential loads and benefits beyond the system boundaries considering secondary material use and energy recovery for pump materials and packaging leaving the product system. Module D recognizes the “design for reuse, recycling and recovery” concept for buildings by indicating the potential benefits of avoided future use of primary materials while considering the loads associated with the recycling and recovery processes beyond the system boundary. Following *EN 15804* a net flow analysis is used. The factors per kg material to evaluate the potential benefit are calculated.

3.9 Comparability
Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to *EN 15804* and the building context, respectively the product-specific characteristics of performance, are taken into account.

Software and databases used: *SimaPro, Ecoinvent*

4. LCA: Scenarios and additional technical information

Characteristic product properties
Information on biogenic Carbon
The biogenic carbon content quantifies the amount of biogenic carbon in a construction product leaving the factory gate, and it will be separately declared for the product and for any accompanying packaging, as required from the *PCR Part A*. The Carbon content of Cardboard and Paper is assumed to 0.46 kg C. Overall, there is an amount of 9 weight-% Carbon in the product leaving the factory gate and has to be considered.

Information on describing the biogenic Carbon Content at factory gate

Name	Value	Unit
Biogenic Carbon Content in product	0	kg C
Biogenic Carbon Content in accompanying packaging	0.74	kg C

Transport from the gate to the site (A4)

Name	Value	Unit
Litres of fuel	25	l/100km
Transport distance	200	km
Capacity utilisation (including empty runs)	37	%

Assembly (A5)

Name	Value	Unit
Distance for a technician	80	km
Packaging waste for incineration (cardboard)	1.35	kg
Packaging waste for incineration (Paper)	0.26	kg

An RSL of 10 years can be used to building calculations according to *Appendix 7: EUP Lot 11, Circulators in buildings*

Reference service life

Name	Value	Unit
Life Span according to the manufacturer	10	a

Operational energy use (B6) and Operational water use (B7)

Name	Value	Unit
Electricity consumption, Group 1	149.25	kWh/a
Electricity consumption, Group 2	218.8	kWh/a
Electricity consumption, Group 3	321.15	kWh/a
Average power input, Group 1	0.02985	kW
Average power input, Group 2	0.04376	kW
Average power input, Group 3	0.06423	kW
Running hours (all groups)	5000	h

End of life (C1-C4)

Name	Value	Unit
Reuse	0	kg
Recycling	5.8	kg
Energy recovery	1.2	kg
Landfilling	0	kg

Reuse, recovery and/or recycling potentials (D), relevant scenario information

Name	Value	Unit
Aluminum for recycling (net amount)	0.33	kg
Cast iron for recycling (net amount)	1.23	kg
Plastic for incineration (net amount)	1.01	kg
Steel for recycling (net amount)	0.09	kg

5. LCA: Results

Characterization model: *EN 15804* - 2012+A2 - 2019, PEF. By Decision no. 20170712-n of the IBU SVR, the modules B3, B4, B5 are marked as MNR (module not relevant) as default. The LCA results in module B6 are given on a period of one year, according to *PCR Part B*. To obtain the results from module B6 over the entire life cycle, the LCA results of module B6 must be multiplied by the estimated RSL of 10 years. The indicator results in module B6 are given for Wilo-Stratos Maxo 25/0.5-8 PN10 / PN16. The B6 indicator results for 25/0.5-4/0.5-6/0.5-8 can be obtained by multiplying by the following factors:

Wilo-Stratos Maxo 25/0,5-4 PN10/PN16: **0,46**
Wilo-Stratos Maxo 25/0,5-6 PN10/PN16: **0,68**
Wilo-Stratos Maxo 25/0,5-8 PN10/PN16: **1,00**

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; ND = MODULE OR INDICATOR NOT DECLARED; MNR = MODULE NOT RELEVANT)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
X	X	X	X	X	ND	ND	MNR	MNR	MNR	X	ND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 Pce Stratos MAXO

Core Indicator	Unit	A1-A3	A4	A5	B6	C1	C2	C3	C4	D
GWP-total	[kg CO_2-Eq.]	7.63E+1	2.87E-1	2.68E+1	1.61E+2	2.68E+1	2.95E-1	3.21E+0	0.00E+0	-1.12E+1
GWP-fossil	[kg CO_2-Eq.]	7.30E+1	2.84E-1	2.65E+1	1.48E+2	2.65E+1	2.93E-1	3.21E+0	0.00E+0	-1.10E+1
GWP-biogenic	[kg CO_2-Eq.]	3.06E+0	2.08E-3	2.93E+0	1.22E+1	2.18E-1	2.14E-3	2.42E-3	0.00E+0	-1.79E-1
GWP-luluc	[kg CO_2-Eq.]	2.95E-1	9.54E-5	1.10E-2	1.72E-1	1.10E-2	9.82E-5	2.00E-8	0.00E+0	-2.00E-2
ODP	[kg CFC11-Eq.]	1.44E-5	6.46E-8	4.90E-6	7.44E-6	4.90E-6	6.65E-8	4.48E-11	0.00E+0	-4.33E-7
AP	[mol H^+-Eq.]	9.52E-1	1.14E-3	1.05E-1	8.00E-1	1.05E-1	1.17E-3	9.96E-4	0.00E+0	-5.32E-2
EP-freshwater	[kg PO_4-Eq.]	6.68E-3	2.08E-6	4.09E-4	1.81E-2	4.09E-4	2.14E-6	3.65E-6	0.00E+0	-5.00E-4
EP-marine	[kg N-Eq.]	1.45E-1	3.45E-4	2.42E-2	9.96E-2	2.42E-2	3.55E-4	3.92E-4	0.00E+0	-8.68E-3
EP-terrestrial	[mol N-Eq.]	1.19E+0	3.80E-3	2.70E-1	1.14E+0	2.70E-1	3.92E-3	4.21E-3	0.00E+0	-9.67E-2
POCP	[kg NMVOC-Eq.]	3.63E-1	1.16E-3	9.29E-2	3.16E-1	9.29E-2	1.20E-3	1.06E-3	0.00E+0	-3.43E-2
ADPE	[kg Sb-Eq.]	1.76E-2	9.73E-7	3.50E-4	1.24E-3	3.50E-4	1.00E-6	7.34E-7	0.00E+0	1.32E-5
ADPF	[MJ]	9.56E+2	4.30E+0	3.64E+2	2.89E+3	3.64E+2	4.43E+0	1.10E+0	0.00E+0	-1.13E+2
WDP	[m^3 world-Eq deprived]	4.01E+1	1.17E-2	2.31E+0	3.23E+1	2.31E+0	1.20E-2	4.52E-2	0.00E+0	-5.61E-1

Caption	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; WDP = Water (user) deprivation potential

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 Pce Stratos MAXO

Indicator	Unit	A1-A3	A4	A5	B6	C1	C2	C3	C4	D
PERE	[MJ]	1.61E+2	5.73E-2	2.89E+1	4.46E+2	8.54E+0	5.90E-2	1.03E-1	0.00E+0	-1.02E+1
PERM	[MJ]	2.04E+1	0.00E+0	-2.04E+1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PERT	[MJ]	1.82E+2	5.73E-2	8.54E+0	4.46E+2	8.54E+0	5.90E-2	1.03E-1	0.00E+0	-1.02E+1
PENRE	[MJ]	9.00E+2	4.30E+0	3.64E+2	2.89E+3	3.64E+2	4.43E+0	5.67E+1	0.00E+0	-1.13E+2
PENRM	[MJ]	5.56E+1	0.00E+0	-4.60E-2	0.00E+0	0.00E+0	0.00E+0	-5.56E+1	0.00E+0	0.00E+0
PENRT	[MJ]	9.56E+2	4.30E+0	3.64E+2	2.89E+3	3.64E+2	4.43E+0	1.10E+0	0.00E+0	-1.13E+2
SM	[kg]	2.26E+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	[m^3]	1.79E+0	5.38E-4	8.47E-2	2.18E+0	8.47E-2	5.54E-4	1.87E-3	0.00E+0	-5.09E-2

Caption	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 1 Pce Stratos MAXO

Indicator	Unit	A1-A3	A4	A5	B6	C1	C2	C3	C4	D
HWD	[kg]	1.21E-2	1.12E-5	1.63E-3	2.21E-3	1.63E-3	1.15E-5	2.72E-6	0.00E+0	1.07E-4
NHWD	[kg]	1.48E+1	2.06E-1	9.36E+0	1.03E+1	9.36E+0	2.12E-1	1.14E-1	0.00E+0	-1.35E+0
RWD	[kg]	3.83E-3	2.95E-5	2.18E-3	1.92E-2	2.18E-3	3.03E-5	3.56E-6	0.00E+0	-1.70E-4
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	1.16E+0	0.00E+0	0.00E+0	0.00E+0	5.80E+0	0.00E+0	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	1.00E-3	0.00E+0	0.00E+0	0.00E+0	1.20E+0	0.00E+0	0.00E+0
EEE	[MJ]	0.00E+0	0.00E+0	6.90E-3	0.00E+0	0.00E+0	0.00E+0	8.34E+0	0.00E+0	0.00E+0
EET	[MJ]	0.00E+0	0.00E+0	2.80E-4	0.00E+0	0.00E+0	0.00E+0	1.56E+1	0.00E+0	0.00E+0

Caption	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: 1 Pce Stratos MAXO

Indicator	Unit	A1-A3	A4	A5	B6	C1	C2	C3	C4	D
PM	[Disease Incidence]	4.69E-6	1.96E-8	1.28E-6	2.03E-6	1.28E-6	2.02E-8	6.62E-9	0.00E+0	-6.63E-7
IRP	[kBq U235-Eq.]	3.84E+0	1.89E-2	1.45E+0	1.87E+1	1.45E+0	1.95E-2	4.06E-3	0.00E+0	-1.41E-1
ETP-fw	[CTUe]	7.52E+3	3.27E+0	5.00E+2	1.78E+3	5.00E+2	3.37E+0	-2.18E+2	0.00E+0	-2.29E+2
HTP-c	[CTUh]	2.22E-7	1.16E-10	2.76E-8	5.44E-8	2.76E-8	1.20E-10	6.11E-10	0.00E+0	-2.03E-8
HTP-nc	[CTUh]	3.96E-6	3.33E-9	3.42E-7	1.54E-6	3.42E-7	3.43E-9	2.09E-8	0.00E+0	-2.00E-7
SQP	[-]	4.72E+2	2.96E+0	1.54E+2	4.15E+2	1.54E+2	3.05E+0	3.77E-1	0.00E+0	-2.20E+1

Caption	PM = Potential incidence of disease due to PM emissions; IR = Potential Human exposure efficiency relative to U235; ETP-fw = Potential comparative Toxic Unit for ecosystems; HTP-c = Potential comparative Toxic Unit for humans (cancerogenic); HTP-nc = Potential comparative Toxic Unit for humans (not cancerogenic); SQP = Potential soil quality index

Disclaimer 1 – for the indicator “Potential Human exposure efficiency relative to U235”. 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 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 – for the indicators “abiotic depletion potential for non-fossil resources”, “abiotic depletion potential for fossil resources”, “water (user) deprivation potential, deprivation-weighted water consumption”, “potential comparative toxic unit for ecosystems”, “potential comparative toxic unit for humans – cancerogenic”, “Potential comparative toxic unit for humans - not cancerogenic”, “potential soil quality index”. 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 experience with the indicator.

Disclaimer 3: *JRC Technical Reports, Version 2, 2018* Page 6, for the indicator "EP-freshwater". This indicator has been calculated as “kg P eq” as required in the characterization model EUTREND model, Struijs et al., 2009b, as implemented in ReCiPe;

6. LCA: Interpretation

Main contributions to environmental impacts for the analysed product Stratos MAXO result in the operational energy use followed by the material supply. Further relevant contributions result the installation into the building and the deconstruction phase. Freight logistics and disposal are of minor relevance.

Dominated by the electricity mix of Europe for the operation (one year):

The Global Warming Potential (55%), Abiotic depletion potential for fossil resources (71%) and Eutrophication of freshwater (65%) mainly from lignite and hard coal mining.

Dominated by the raw material supply:

Acidification potential (48%), Eutrophication of marine water (47%) from ferrous metals, Eutrophication of terrestrial (39%), Abiotic depletion potential for non-fossil resources (90%) and water deprivation potential (50%) mainly from ferrous metals.

7. Requisite evidence

Requisite evidence is not required by the *specific PCR Part B*.

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