silentlab

Environmental Product Declaration

In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC:2021 for multiple products:

Acoustic pods (SPARK, SPARK^2, SPARK^4)

Programme:	Czech Environmental Information Agency (CENIA) www.cenia.cz, "National programme of environmental labeling "- CZ
Programme operator:	CENIA, Czech Environmental Information Agency, Executive Body of NPEZ Agency
EPD owner:	SilentLab s.r.o. www.silent-lab.cz
Author:	Envitrail s.r.o.
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General information

Programme information

Accountabilities for PCR, LCA and independent, third-party verification
Product Category Rules (PCR)
CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
Product Category Rules (PCR): *EN 15804:2012+A2:2019 + NPCR 026 - Furniture Part B*
Life Cycle Assessment (LCA)
LCA accountability: *Ing. Eva-Žofie Bergmannová, Envitrail s.r.o., bergmannova@envitrail.com, Ing. Miroslava Česká https://envitrail.com/*
Third-party verification
Independent third-party verification of the declaration and data, according to ISO 14025:2006, via: ☒ EPD verification by individual verifier Third-party verifier: *Doc. Ing. Jan Weinzettel, Ph.D.*
Procedure for follow-up of data during EPD validity involves third party verifier: ☐ Yes ☒ No

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

Company information

Owner of the EPD:
SilentLab s.r.o., Za Zastávkou 373, 111 01 Praha 10 - Dolní Měcholupy, IČO: 04545486

Contact Ing. František Sehnal, email: frantisek.sehnal@silent-lab.cz, +420 731 343 838

Description of the organisation: The Czech company SilentLab is a leader in acoustic solutions, transforming the way workspaces are experienced. With a focus on innovation and maximum functionality, they create products that bring peace and focus to even the most challenging environments. Their comprehensive acoustic services cover everything from design and manufacturing to the implementation of custom solutions, always prioritizing user comfort and design. SilentLab is shaping the future of office acoustics and work environments globally.

Product-related or management system-related certifications: ISO 23351:2020: Acoustics — Measurement of speech level reduction of furniture ensembles and enclosures; CE (LVD & EMC); UL 962: Household and Commercial Furnishings

Name and location of production site: SilentLab - Production site, Řípská 1181/18a, 627 00 Brno - Slatina

Product information

Product name: **SPARK family – SPARK, SPARK^2, SPARK^4**

Product identification: SPARK acoustic pods offer durable, easy-to-maintain solutions for various environments. Made from elegant powder-coated steel, they integrate seamlessly into offices, manufacturing halls, and healthcare facilities. With modern design, compact interiors, and superior acoustic performance, they ensure quiet and privacy with minimal maintenance.

Product description: High-quality powder-coated steel ensures both lasting strength and a sleek, modern finish. Precision engineering and customizable colour options allow them to fit seamlessly into any space, enhancing both style and practicality. SPARK provides excellent sound insulation achieving 32 dB (Class A) according to ISO 23351-1:2020. This top-tier acoustic performance creates an ideal environment for peaceful calls, online meetings, and private conversations, ensuring clarity and privacy in even the busiest settings. Whether you're focusing or collaborating, the enhanced acoustics make every interaction more comfortable and effective. Designed with ideal dimensions SPARK acoustic pods maximize space efficiency without compromising comfort. Their compact size allows them to fit seamlessly into any environment, while the thoughtfully crafted interior ensures excellent ergonomics. Whether sitting or standing, the pod's layout promotes a natural, comfortable posture, making it ideal for both focused work and collaborative tasks.

UN CPC code: 3812
Geographical scope: Global

Table 1: Technical information of products SPARK, SPARK² and SPARK⁴.

Parameter	*SPARK*	SPARK²	SPARK⁴
External dimension	1100 x 2226 x 930 mm	2220 x 2226 x 930 mm	2220 x 2226 x 1850 mm
Internal dimension	850 x 2057 x 864 mm	1968 x 2057 x 864 mm	1968 x 2057 x 1770 mm
Weight	350 kg	695 kg	1150 kg
Door dimension	918 x 2075 mm	853 x 2075 mm	853 x 2075 mm
Lights	LED, chromaticity temperature: 4200 K	LED, chromaticity temperature: 4200 K	LED, chromaticity temperature: 4200 K
Ventilation	Standard air flow: 120 m^3/h Maximum air flow: 341 m^3/h	Standard air flow: 250 m^3/h Maximum air flow: 341 m^3/h	Standard air flow: 400 m^3/h Maximum air flow: 626 m^3/h
Power supply	220-240 V, 50/60 Hz, 10 A	220-240 V, 50/60 Hz, 10 A	220-240 V, 50/60 Hz, 10 A
Electricity consumption	Operation mode: 45 W Stand-by mode: 1 W	Operation mode: 66 W Stand-by mode: 1,5 W	Operation mode: 100 W Stand-by mode: 1,5 W
Equipment	Electrical outlet (1x), ventilation, motion sensor, table desk, LED lighting, control panel for ventilation and lighting, sprinkler preparation.	Electrical outlet (2x), ventilation, motion sensor, LED lighting, ventilation and lighting control panel, preparation for sprinkler	Electrical outlet (3x), ventilation, motion sensor, LED lighting, ventilation and lighting control panel, preparation for sprinkler

LCA information

Declared unit	One piece of SPARK acoustic pod ensuring one place with maximum attenuation of ambient sounds for its lifetime (15 years). One piece of SPARK2 acoustic pod ensuring 2 places with maximum attenuation of ambient sounds for its lifetime (15 years). One piece of SPARK4 acoustic pod ensuring 4 places with maximum attenuation of ambient sounds for its lifetime (15 years).
Reference flow	1 piece of acoustic pod SPARK product line
Reference service life	15 years
Time representativeness	Data collection 04/2023-03/2024 *The data set will be considered valid until there are significant changes to data in the production, technology, supply chain or operational and end of life scenarios.*
Database(s) and LCA software used	OpenLCA ver. 2.1.1., ecoinvent 3.10, cut-off, LCIA methodology EF v. 3.1
Description of system boundaries	Cradle-to-grave and module D *Modules B1, B4, B5, B7 are considered as zero.*
Cut-off rules	Ecoinvent cut-off system model is based on the recycled content or cut-off approach. In this system model, wastes are the producer's responsibility (PPP), and recyclable products are available burden-free (cut-off). Processes and flows with a predicted resulting impact of less than 1% have been excluded from the system.
Allocations	Waste allocation uses the selected Polluter Pays Principle (PPP). The allocation of input materials, consumption of energy and output flows was done through a mass allocation based on a reference flow of declared unit. The mass allocation of the material distribution from the SPARK pod measured values has been used to evaluate the SPARK^2 and SPARK^4 pods (A1-A2).

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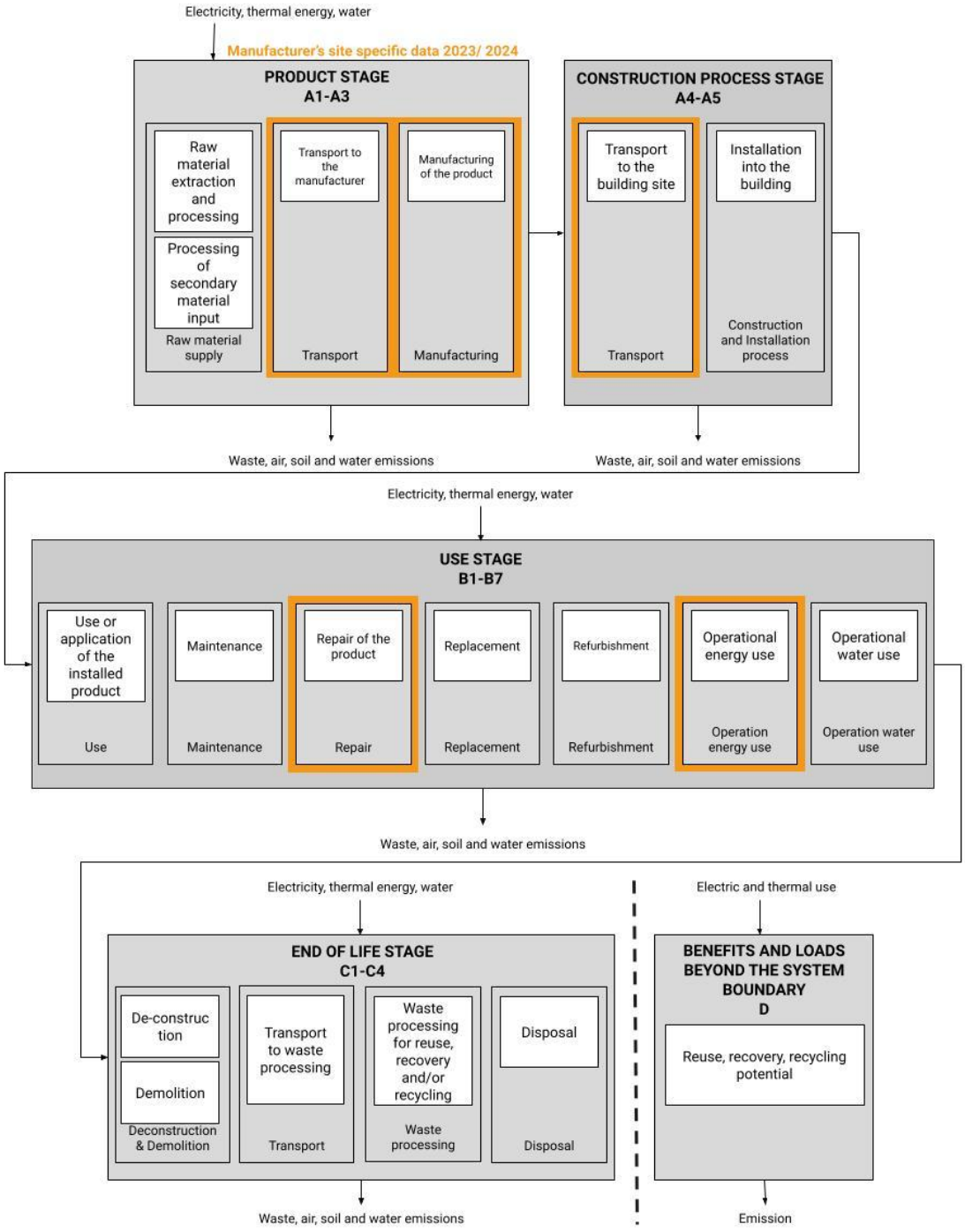
System diagram:



Modules declared

CONSTRUCTION WORKS ASSESSMENT INFORMATION																
CONSTRUCTION WORKS LIFE CYCLE INFORMATION																SUPPLEMENTARY INFORMATION BEYOND CONSTRUCTION WORKS LIFE CYCLE
A1-A3			A4-A5		B1-B7							C1-C4				D
PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material supply	Transport	Manufacturing	Transport	Construction and Installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operation energy use	Operation water use	Deconstruction & Demolition	Transport	Waste processing	Disposal	Reuse, recovery, recycling potencial
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

The product stage includes the following modules:

- **A1 (Raw material supply)** – The product is assembled from components that are manufactured by various suppliers. Primary data was collected by SilentLab s.r.o. company. This module does not include packaging materials production. Material distribution for the products SPARK^2 and SPARK^4 was calculated based on SPARK mass allocation.

- **A2 (Transport)** – Module A2 covers the transportation of the raw materials to the manufacturing site. The materials are transported by a lorry 16-32 t, lorry 3,5 -7,5 t, freight ship and aircraft. Transportation of the input materials for the SPARK^2 and the SPARK^4 was calculated based on A1 mass information and SPARK transportation input data.

- **A3 (Manufacturing)** – This module includes the manufacture of products and packaging. The processing of any waste arising from this stage is also included.

  The manufacturing process is conducted in Brno, Czech Republic, and includes the formatting materials (such as plywood and fibreboards). These are cut and shaped according to the required specifications of each product type. Then, by using the CNC (Computer Numerical Control), further modifications such as machining, drilling, and creating grooves or other openings are carried out.

  In the next step, electrical components are installed, followed by the addition of mechanical components (e.g. screws and nuts). Afterward, internal soundproof panels reinforced with acoustic foam (hardboard) and covered with decorative fabric are installed. This step also includes upholstering the outer panels. The final step involves the dispatch process.

The specific electricity mix for the medium voltage on the production site of SilentLab s.r.o. was used (based on the supplier´s invoice and ERÚ background data). The electricity consumption of SPARK is 179,21 kWh per declared unit. The electric mix comprises 53,60 % fossil, 40,95 % nuclear, and 5,46 % renewable electricity sources.

The waste generated during the production includes waste wood, wastepaper and cardboard, mixed construction and demolition waste, waste plastic and mixed municipal waste. Mass allocation from annual production data to acoustic pods was applied. Environmental impacts related to the infrastructure and capital goods are not considered except for processes included in selected datasets

The construction process stage includes modules:

- **A4 (Transport)** – Module A4 includes transport of the product to the customer, based on the average delivery distance from the production site (Brno) to customers within the Czech Republic, derived from sales records of SPARK acoustic pods. Products are transported by lorry 3,5-7,5 t.

- **A5 (Construction and Installation process)** – This module includes the installation of product, such as the electricity consumption of a screw drill. Drilling is assumed to be 10 seconds per one screw. Packaging materials (MDF, PDP, cartons, and palettes) are assumed to be reused 5 times before entering the waste state.

Use stage includes modules:

- **B1 (Use)** – Use emissions were considered as zero.

- **B2 (Maintenance)** – Maintenance of the product: Five minutes of vacuum cleaning occurring every two weeks during the 15 years was used (based on the assumption).

- **B3 (Repair)** – Data for this module was exported from an internal database. The most common repair activity is door adjustment (manual labour, one per lifetime). The average distance customer-factory was used in the calculation.

- **B4 (Replacement)** – Replacement-related activities were assumed to be zero as there are no regular replacements taking place.

- **B5 (Refurbishment)** – Refurbishment-related activities were assumed to be zero as no regular refurbishments are occurring.

- **B6 (Operational energy use)** – Includes electricity consumption of the lighting and ventilation. As an assumption, there are 4 active hours per 1 working day (252 working days in a year) taken into account. The electricity consumption per lifetime is calculated with the following formula:

$$Electricity\ consumption_{lifetime} = [consumption_{active} * active\ hour(1008h) + consumption_{standby} * standby\ hour\ (7752\ h)] * lifetime\ (15\ years)$$

- **B7 (Operation water use)** – No operational water use occurs during the life cycle of the product.

The end-of-life stage includes modules:

- **C1 (Deconstruction & demolition)** – The acoustic pod's deconstruction is done by manual labour, so it is considered as zero environmental impacts.
- **C2 (Transport)** – This module subscribes to transportation of waste materials to the waste treatment site. The average transportation distance for the Czech Republic is 50,8 km [6].
- **C3 (Waste processing)** – Waste processing was modelled based on data from MilieuDatabase [5]. This database covered the percentage of MRF (material recovery flow – metals (99 % steel) 95 %, electronics 79 %, plastic (PE, PP, rubber) 85 %, glass 70 % and mineral wool 100 %) and ERF (energy recovery flow – wood 95 %). Mass allocation for different acoustic pods was applied. Materials for energy recovery are identified based on the efficiency of energy recovery with a rate higher than 60 % [4].
- **C4 (Disposal)** – Disposal was modelled the same as module C3. C4 details are presented in table 1.

Table 2: Waste disposal: major flows, disposal methods and amounts treated

Waste flow	Percentage of incineration [%]	Percentage of landfill [%]
Metals (99 % steel)	-	5
Polyurethane foam	100	-
Wood	-	5
Electronic	19	2
Plastics (PE, PP, rubber)	5	10
Chemical	-	100
Glass	-	30
Textile	100	-

The benefits and costs beyond the product system in Module D:

Potentially benefits and costs from wastes utilisation are assessed in module D. Waste materials from module C3 are used for the calculation of benefits using secondary materials and waste materials from module C4 are used for the calculation of energy benefits. For calculation of benefits are used also wastes from module A3 (waste from manufacturing) and module A5 (packaging waste).

Sub-module D1 calculates the benefits of using the waste as a secondary material instead of primary raw material. This module was calculated for waste such as metal (steel), plastic, glass, cardboard and electronic. During the incineration of waste (D3), heat and electricity are produced, which can potentially substitute the electricity production mix of the Czech Republic, and the exported thermal energy generated from coal gas (default ecoinvent process).

In module D4, the trace amount of thermal energy generated by burning of landfill gas (based on the literature) has been considered.

Content information

Table 3: Material content in SPARK, SPARK^2 and SPARK^4.

Product components	Weight SPARK [kg]	Weight SPARK^2 [kg]	Weight SPARK^4 [kg]
Metal (99 % steel)	57,56	114,24	188,94
Wood	167,02	329,27	544,58
Plastic (PE, PP, rubber)	16,68	33,61	55,61
PU foam[1]	4,409	8,89	14,71
Chemical	1,87	3,77	6,24
Glass	80,00	161,43	266,99
Carton	0,006	0,012	0,02
Paper	0,002	0,004	0,007
Electronic	11,16	20,59	34,71
Textile	2,59	5,23	8,64
Mineral Wool	8,58	17,31	28,64
TOTAL	**349,9**	**694,4**	**1149,1**

[1]Polyurethane foam is made from recycled materials. It´s 1,26 % of all materials.

Table 4: Material content in packaging materials for SPARK, SPARK[2] and SPARK[4].

Packaging materials	Weight SPARK [kg]	Weight SPARK[2] [kg]	Weight SPARK[4] [kg]	Weight-% (versus the product)
MDFS	5,07	10,23	16,93	1,5 %
PDP	7,88	15,89	26,28	2,3 %
karton	13,48	27,20	44,98	3,9 %
pallet[2]	1 piece	1 piece	1 piece	
TOTAL	**26,42**	**53,32**	**88,19**	**7,7 %**

There are no SVHC substances in the product, or they are below EU regulation limits.

Biogenic carbon

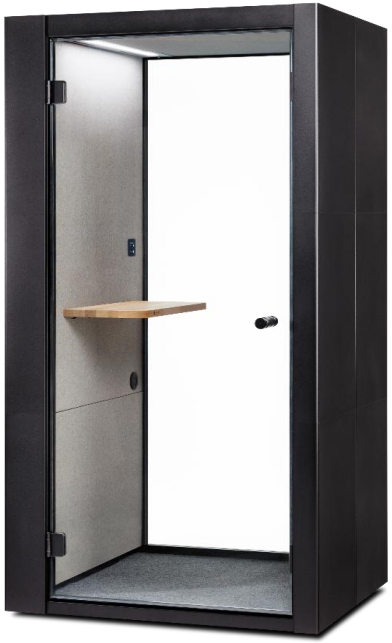
The calculation of the biogenic carbon content and the conversion to carbon dioxide was carried out according to the rules of EN 16449 [2] and it is calculated from inventory results per declared unit of the final product – 1 piece of acoustic pod. The resulting biogenic carbon content for the SPARK product line is shown in Table 5.

Table 5: Biogenic carbon content

Biogenic carbon content	kg C/SPARK	kg C/SPARK[2]	kg C/SPARK[4]
Biogenic carbon content in product	64,72	141,59	234,22
Biogenic carbon content in accompanying packaging	11,20	22,24	36,80
NOTE: 1 kg biogenic carbon is equivalent to 44/12 kg of CO2.			

[2] The weight of the pallet is 25 kg.

SPARK



Results of the environmental performance indicators - SPARK

Table 6: Mandatory impact category indicators according to EN 15804 - SPARK

Impact category	Reference unit	A1 - A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	Module D
AP	mol H+-Eq	8,51E+00	8,71E-02	1,87E-03	0	1,36E-01	3,60E-01	0	0	1,55E+00	0	0	1,22E-02	7,25E-02	2,23E-02	-2,38E+00
GWP_total	kg CO2-Eq	7,79E+02	2,97E+01	1,14E+01	0	2,96E+01	1,06E+02	0	0	3,54E+02	0	0	2,72E+00	2,50E+02	2,61E+01	-3,43E+02
GWP - biogenic	kg CO2-Eq	-1,85E+02	1,90E-02	1,11E+01	0	5,03E-01	-7,22E-02	0	0	4,07E+00	0	0	1,60E-03	2,33E+02	2,95E+00	5,80E-01
GWP - fossil	kg CO2-Eq	9,63E+02	2,97E+01	2,64E-01	0	2,91E+01	1,06E+02	0	0	3,50E+02	0	0	2,72E+00	1,75E+01	2,32E+01	-3,43E+02
GWP - luluc	kg CO2-Eq	1,16E+00	1,14E-02	2,66E-04	0	4,60E-02	4,14E-02	0	0	5,69E-01	0	0	9,23E-04	8,67E-03	4,54E-04	-4,38E-01
ADP - fossil*	MJ	1,43E+04	4,13E+02	3,58E+00	0	5,00E+02	1,38E+03	0	0	6,07E+03	0	0	3,89E+01	1,24E+02	2,19E+01	-5,23E+03
EP - fw	kg P-Eq	7,47E-01	2,37E-03	2,72E-04	0	4,17E-02	1,40E-02	0	0	5,30E-01	0	0	1,87E-04	2,72E-03	2,94E-04	-8,26E-01
EP-marine	kg N-Eq	2,58E+00	2,74E-02	7,90E-04	0	2,82E-02	8,91E-02	0	0	3,36E-01	0	0	4,80E-03	2,47E-02	2,29E-02	-5,78E-01
EP - terrestrial	mol N-Eq	1,45E+01	2,98E-01	7,29E-03	0	2,16E-01	9,67E-01	0	0	2,50E+00	0	0	5,24E-02	2,49E-01	1,13E-01	-6,23E+00
ADP- elements*	kg Sb-Eq	2,38E-02	6,37E-05	4,96E-07	0	1,05E-04	3,86E-04	0	0	8,79E-04	0	0	3,73E-06	6,14E-05	1,38E-06	-2,40E-02
ODP	kg CFC-11-Eq	2,51E-04	5,86E-07	2,37E-09	0	2,37E-07	1,98E-06	0	0	2,52E-06	0	0	5,46E-08	1,33E-07	3,17E-08	-2,00E-06
POCP	kg NMVOC-Eq	4,76E+00	1,32E-01	1,88E-03	0	6,51E-02	4,35E-01	0	0	7,33E-01	0	0	1,88E-02	7,57E-02	2,92E-02	-1,55E+00
WDP*	m3	4,55E+02	2,34E+00	2,95E-01	0	9,56E+00	1,08E+01	0	0	1,15E+02	0	0	1,94E-01	6,30E+00	1,46E+00	-1,01E+02
Acronyms	GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-elements = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption															

***Disclaimer:** The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*
***General disclaimer:** The estimated impact results are only relative statements, which do not indicate the endpoints of the impact categories, exceeding threshold values, safety margins and/or risks.*

Additional mandatory and voluntary impact category indicators

Table 7: Additional mandatory and voluntary impact category indicators according to EN 15804 - SPARK

SPARK																
Indicator	Reference unit	A1 - A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	Module D
Global warming potential (GWP-GHG)	kg CO2-Eq	9,68E+02	2,97E+01	2,65E-01	0	2,93E+01	1,06E+02	0	0	3,50E+02	0	0	2,72E+00	1,76E+01	2,37E+01	-3,43E+02
Acronym	GWP-total = Global Warming Potential total															
This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such, the indicator is identical to GWP-total except that the CF for biogenic CO2 is set to zero.																

Resource use indicators

Table 12: Resources use indicators for SPARK

SPARK																
Indicator	Unit	A1 - A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	Module D
PERE	MJ	5,09E+01	9,91E+00	2,21E-01	0	3,56E+01	3,67E+01	0	0	4,66E+02	0	0	6,72E-01	5,44E-01	2,58E-01	-8,66E+01
PERM	MJ	5,23E+03	4,36E-07	1,57E-07	0	3,30E+00	2,29E-06	0	0	-4,62E-05	0	0	1,14E-07	8,05E+00	1,32E-01	-2,05E+02
PERT	MJ	5,28E+03	9,91E+00	2,21E-01	0	3,89E+01	3,67E+01	0	0	4,66E+02	0	0	6,72E-01	8,60E+00	3,90E-01	-2,92E+02
PENRE	MJ	2,48E+03	4,13E+02	3,58E+00	0	4,63E+02	1,38E+03	0	0	6,07E+03	0	0	3,89E+01	2,19E+01	1,26E+01	-3,00E+03
PENRM	MJ	1,18E+04	2,35E-05	-3,34E-07	0	3,70E+01	-1,92E-04	0	0	-3,10E-05	0	0	0	1,02E+02	9,36E+00	-2,23E+03
PENRT	MJ	1,43E+04	4,13E+02	3,58E+00	0	5,00E+02	1,38E+03	0	0	6,07E+03	0	0	3,89E+01	1,24E+02	2,19E+01	-5,23E+03
SM	kg	4,41E+00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FW	m3	1,19E+01	6,48E-02	3,13E-03	0	3,14E-01	2,78E-01	0	0	3,86E+00	0	0	5,46E-03	6,48E-02	-1,03E-01	-3,12E+00
Acronyms	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 re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water															

Waste indicators

Table 13: Waste indicators for SPARK

SPARK															
Indicator	Unit	A1 - A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Hazardous waste disposed	kg	8,98E+01	4,32E-01	4,42E-02	0	5,35E-01	3,88E+00	0	0	4,92E+00	0	0	4,79E-02	3,80E-02	1,59E+01	9,66E+01
Non-hazardous waste disposed	kg	1,22E+03	5,88E+00	7,75E+00	0	9,16E+00	2,77E+01	0	0	7,45E+01	0	0	1,04E+00	4,14E-01	1,73E+02	-7,19E+01
Radioactive waste disposed	kg	4,08E-02	1,02E-04	8,58E-06	0	1,56E-03	2,85E-04	0	0	2,02E-02	0	0	2,31E-05	6,66E-06	5,38E-05	-1,04E-02

Output flow indicators

Table 14: Output flow indicators for SPARK

SPARK															
Indicator	Unit	A1 - A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Components for re-use	kg	2,64E+01	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Material for recycling	kg	3,66E+00	0	2,70E+00	0	0	0	0	0	0	0	0	1,42E+02	0	0	0
Materials for energy recovery	kg	8,24E+01	0	7,59E+00	0	0	0	0	0	0	0	0	0	0	0	0
Exported energy, electricity	MJ	0	0	0	0	0	0	0	0	0	0	0	3,91E+01	3,00E-03	0	0
Exported energy, thermal	MJ	0	0	0	0	0	0	0	0	0	0	0	7,10E+01	1,70E-03	0	0

SPARK²

Results of the environmental performance indicators – SPARK²

Table 8: Mandatory impact category indicators according to EN 15804 - SPARK²

Impact category	Reference unit	A1 - A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	Module D
AP	mol H+-Eq	1,62E+01	2,21E-01	3,34E-03	0	3,14E-01	4,59E-01	0	0	1,55E+00	0	0	2,43E-02	1,40E-01	4,47E-02	-1,47E+01
GWP_total	kg CO2-Eq	1,38E+03	7,53E+01	2,28E+01	0	6,86E+01	1,35E+02	0	0	3,54E+02	0	0	5,40E+00	4,91E+02	5,16E+01	-7,37E+02
GWP - biogenic	kg CO2-Eq	-3,65E+02	4,80E-02	2,24E+01	0	1,16E+00	-9,20E-02	0	0	4,07E+00	0	0	3,18E-03	4,58E+02	5,93E+00	1,33E+00
GWP - fossil	kg CO2-Eq	1,74E+03	7,52E+01	4,35E-01	0	6,73E+01	1,35E+02	0	0	3,50E+02	0	0	5,40E+00	3,29E+01	4,56E+01	-7,38E+02
GWP - luluc	kg CO2-Eq	2,22E+00	2,88E-02	3,78E-04	0	1,06E-01	5,28E-02	0	0	5,69E-01	0	0	1,83E-03	1,65E-02	9,08E-04	-5,57E-01
ADP - fossil*	MJ	2,57E+04	1,05E+03	5,53E+00	0	1,16E+03	1,75E+03	0	0	6,07E+03	0	0	7,71E+01	2,35E+02	4,39E+01	-1,11E+04
EP - fw	kg P-Eq	1,28E+00	6,00E-03	4,01E-04	0	9,66E-02	1,78E-02	0	0	5,30E-01	0	0	3,71E-04	5,28E-03	5,75E-04	-1,04E+00
EP-marine	kg N-Eq	5,01E+00	6,95E-02	1,50E-03	0	6,52E-02	1,14E-01	0	0	3,36E-01	0	0	9,52E-03	4,81E-02	4,57E-02	-9,74E-01
EP - terrestrial	mol N-Eq	2,75E+01	7,56E-01	1,40E-02	0	5,01E-01	1,23E+00	0	0	2,50E+00	0	0	1,04E-01	4,85E-01	2,27E-01	-1,14E+01
ADP- elements*	kg Sb-Eq	4,62E-02	1,61E-04	7,55E-07	0	2,43E-04	4,92E-04	0	0	8,79E-04	0	0	7,40E-06	1,18E-04	2,75E-06	-4,80E-02
ODP	kg CFC-11-Eq	5,04E-04	1,48E-06	4,08E-09	0	5,48E-07	2,52E-06	0	0	2,52E-06	0	0	1,08E-07	2,53E-07	6,36E-08	-6,21E-06
POCP	kg NMVOC-Eq	9,02E+00	3,35E-01	3,58E-03	0	1,51E-01	5,55E-01	0	0	7,33E-01	0	0	3,73E-02	1,46E-01	5,85E-02	-3,66E+00
WDP*	m3	8.96E+02	8.96E+03	8.96E+04	0	8.96E+05	8.96E+06	0	0	8.96E+07	0	0	8.96E+08	8.96E+09	8.96E+10	8.96E+11
Acronyms	GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-elements = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption															

***Disclaimer:** The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*
***General disclaimer:** The estimated impact results are only relative statements, which do not indicate the endpoints of the impact categories, exceeding threshold values, safety margins and/or risks.*

Additional mandatory and voluntary impact category indicators

Table 9: Additional mandatory and voluntary impact indicators - SPARK²

SPARK²																
Indicator	Reference unit	A1 - A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	Module D
Global warming potential (GWP-GHG)	kg CO2-Eq	1,75E+03	7,53E+01	4,36E-01	0	6,79E+01	1,35E+02	0	0	3,50E+02	0	0	5,40E+00	3,32E+01	4,66E+01	-6,85E+02
Acronym	GWP-total = Global Warming Potential total															
This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such, the indicator is identical to GWP-total except that the CF for biogenic CO2 is set to zero.																

Resource use indicators

Table 15: Resources use indicators for SPARK²

SPARK²																
Indicator	Unit	A1 - A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	Module D
PERE	MJ	5,11E+01	2,51E+01	3,15E-01	0	8,23E+01	4,67E+01	0	0	4,66E+02	0	0	1,33E+00	1,07E+00	5,15E-01	-1,81E+02
PERM	MJ	1,03E+04	1,06E-06	0,00E+00	0	7,64E+00	0,00E+00	0	0	0,00E+00	0	0	1,54E-07	1,54E+01	2,65E-01	-3,78E+02
PERT	MJ	1,03E+04	2,51E+01	3,15E-01	0	9,00E+01	4,67E+01	0	0	4,66E+02	0	0	1,33E+00	1,65E+01	7,80E-01	-5,59E+02
PENRE	MJ	2,55E+03	1,05E+03	5,53E+00	0	1,07E+03	1,75E+03	0	0	6,07E+03	0	0	7,72E+01	4,31E+01	2,52E+01	-6,35E+03
PENRM	MJ	2,31E+04	2,54E-04	2,54E-07	0	8,56E+01	-3,92E-04	0	0	-3,10E-05	0	0	1,06E-06	1,92E+02	1,88E+01	-4,13E+03
PENRT	MJ	2,57E+04	1,05E+03	5,53E+00	0	1,16E+03	1,75E+03	0	0	6,07E+03	0	0	7,72E+01	2,35E+02	4,39E+01	-1,05E+04
SM	kg	8,90E+00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FW	m3	2,30E+01	1,64E-01	5,24E-03	0	7,26E-01	3,54E-01	0	0	3,86E+00	0	0	1,08E-02	1,26E-01	-2,08E-01	-7,68E+00
Acronyms	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 re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water															

Waste indicators

Table 16: Waste indicators for SPARK²

SPARK²															
Indicator	Unit	A1 - A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Hazardous waste disposed	kg	1,75E+02	1,09E+00	8,78E-02	0	1,24E+00	4,95E+00	0	0	4,92E+00	0	0	7,87E-02	7,54E-02	2,95E+01	1,74E+02
Non-hazardous waste disposed	kg	2,34E+03	1,49E+01	1,56E+01	0	2,12E+01	3,53E+01	0	0	7,45E+01	0	0	1,71E+00	8,21E-01	3,41E+02	-1,28E+02
Radioactive waste disposed	kg	7,44E-02	2,58E-04	1,16E-05	0	3,61E-03	3,63E-04	0	0	2,02E-02	0	0	3,80E-05	1,32E-05	1,04E-04	-2,02E-02

Output flow indicators

Table 17: Output flow indicators for SPARK²

SPARK²																
Indicator	Unit	A1 - A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Components for re-use	kg	5,33E+01	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Material for recycling	kg	7,39E+00	0	5,45E+00	0	0	0	0	0	0	0	0	2,84E+02	0	0	0
Materials for energy recovery	kg	1,66E+02	0	1,53E+01	0	0	0	0	0	0	0	0	0	0	0	0
Exported energy, electricity	MJ	0	0	0	0	0	0	0	0	0	0	0	2,18E+01	3,40E-03	0	0
Exported energy, thermal	MJ	0	0	0	0	0	0	0	0	0	0	0	1,42E+02	6,00E-03	0	0

SPARK^4

Results of the environmental performance indicators – SPARK[4]

Table 10: Mandatory impact category indicators according to EN 15804 - SPARK[4]

Impact category	Reference unit	A1 - A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	Module D
AP	mol H+-Eq	2,70E+01	4,30E-01	5,43E-03	0	6,44E-01	5,41E-01	0	0	2,44E+00	0	0	4,02E-02	2,33E-01	7,42E-02	-7,05E+00
GWP_total	kg CO2-Eq	2,30E+03	1,47E+02	3,78E+01	0	1,40E+02	1,59E+02	0	0	5,58E+02	0	0	8,95E+00	8,13E+02	8,58E+01	-9,95E+02
GWP - biogenic	kg CO2-Eq	-6,04E+02	9,36E-02	3,71E+01	0	2,39E+00	-1,09E-01	0	0	6,41E+00	0	0	5,27E-03	7,58E+02	9,80E+00	4,64E+00
GWP - fossil	kg CO2-Eq	2,90E+03	1,47E+02	6,99E-01	0	1,38E+02	1,59E+02	0	0	5,51E+02	0	0	8,94E+00	5,52E+01	7,60E+01	-9,99E+02
GWP - luluc	kg CO2-Eq	3,69E+00	5,62E-02	5,92E-04	0	2,18E-01	6,23E-02	0	0	8,97E-01	0	0	3,03E-03	2,76E-02	1,52E-03	-1,21E+00
ADP - fossil*	MJ	4,27E+04	2,04E+03	8,78E+00	0	2,37E+03	2,07E+03	0	0	9,57E+03	0	0	1,28E+02	3,93E+02	7,30E+01	-1,58E+04
EP - fw	kg P-Eq	2,12E+00	1,17E-02	6,33E-04	0	1,98E-01	2,10E-02	0	0	8,35E-01	0	0	6,14E-04	8,77E-03	9,59E-04	-2,41E+00
EP-marine	kg N-Eq	8,30E+00	1,36E-01	2,46E-03	0	1,34E-01	1,34E-01	0	0	5,30E-01	0	0	1,58E-02	7,99E-02	9,64E-02	-1,73E+00
EP - terrestrial	mol N-Eq	4,57E+01	1,47E+00	2,30E-02	0	1,03E+00	1,45E+00	0	0	3,94E+00	0	0	1,72E-01	8,05E-01	3,76E-01	-1,90E+01
ADP- elements*	kg Sb-Eq	7,70E-02	3,15E-04	1,20E-06	0	4,97E-04	5,80E-04	0	0	1,39E-03	0	0	1,23E-05	1,96E-04	4,57E-06	-7,41E-02
ODP	kg CFC-11-Eq	8,33E-04	2,89E-06	6,60E-09	0	1,12E-06	2,97E-06	0	0	3,97E-06	0	0	1,79E-07	4,23E-07	1,06E-07	-6,90E-06
POCP	kg NMVOC-Eq	1,50E+01	6,54E-01	5,88E-03	0	3,09E-01	6,55E-01	0	0	1,16E+00	0	0	6,17E-02	2,43E-01	9,70E-02	-4,78E+00
WDP*	m3	1,46E+03	1,16E+01	9,26E-01	0	4,53E+01	1,63E+01	0	0	1,82E+02	0	0	6,37E-01	2,05E+01	4,83E+00	-2,88E+02
Acronyms	GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-elements = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption															

***Disclaimer:** The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*
***General disclaimer:** The estimated impact results are only relative statements, which do not indicate the endpoints of the impact categories, exceeding threshold values, safety margins and/or risks.*

Additional mandatory and voluntary impact category indicators

Table 11: Additional mandatory and voluntary impact indicators - SPARK⁴

SPARK⁴																
Indicator	Reference unit	A1 - A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	Module D
Global warming potential (GWP-GHG)	kg CO2-Eq	2,91E+03	1,47E+02	7,00E-01	0	1,39E+02	1,59E+02	0	0	5,52E+02	0	0	8,94E+00	5,57E+01	7,75E+01	-1,00E+03
Acronym	GWP-total = Global Warming Potential total															
This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such, the indicator is identical to GWP-total except that the CF for biogenic CO2 is set to zero.																

Resource use indicators

Table 18: Resources use indicators for SPARK⁴

SPARK⁴																
Indicator	Unit	A1 - A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	Module D
PERE	MJ	8,42E+01	4,90E+01	4,93E-01	0	1,69E+02	5,51E+01	0	0	7,35E+02	0	0	2,21E+00	1,78E+00	8,53E-01	-2,32E+02
PERM	MJ	1,70E+04	2,68E-06	3,41E-07	0	1,57E+01	-3,00E-06	0	0	2,00E-07	0	0	-3,40E-07	2,57E+01	4,47E-01	-7,11E+02
PERT	MJ	1,71E+04	4,90E+01	4,93E-01	0	1,84E+02	5,51E+01	0	0	7,35E+02	0	0	2,21E+00	2,75E+01	1,30E+00	-9,42E+02
PENRE	MJ	4,22E+03	2,04E+03	8,78E+00	0	2,20E+03	2,07E+03	0	0	9,57E+03	0	0	1,28E+02	7,13E+01	4,17E+01	-8,07E+03
PENRM	MJ	3,85E+04	1,52E-04	3,06E-07	0	1,75E+02	-2,41E-04	0	0	1,12E-04	0	0	-4,50E-05	3,22E+02	3,13E+01	-7,73E+03
PENRT	MJ	4,27E+04	2,04E+03	8,78E+00	0	2,37E+03	2,07E+03	0	0	9,57E+03	0	0	1,28E+02	3,93E+02	7,30E+01	-1,58E+04
SM	kg	1,47E+01	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FW	m3	3,81E+01	3,20E-01	8,44E-03	0	1,49E+00	4,17E-01	0	0	6,08E+00	0	0	1,79E-02	2,10E-01	-3,47E-01	-1,01E+01
Acronyms	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 re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water															

Waste indicators

Table 19: Waste indicators for SPARK[4]

SPARK[2]															
Indicator	Unit	A1 - A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Hazardous waste disposed	kg	2,90E+02	2,14E+00	1,45E-01	0	2,54E+00	5,84E+00	0	0	7,75E+00	0	0	1,30E-01	1,25E-01	4,96E+01	2,98E+02
Non-hazardous waste disposed	kg	3,89E+03	2,90E+01	2,58E+01	0	4,34E+01	4,16E+01	0	0	1,17E+02	0	0	2,83E+00	1,36E+00	5,64E+02	-3,55E+02
Radioactive waste disposed	kg	1,23E-01	5,04E-04	1,81E-05	0	7,39E-03	4,28E-04	0	0	3,18E-02	0	0	6,28E-05	2,18E-05	1,73E-04	-2,85E-02

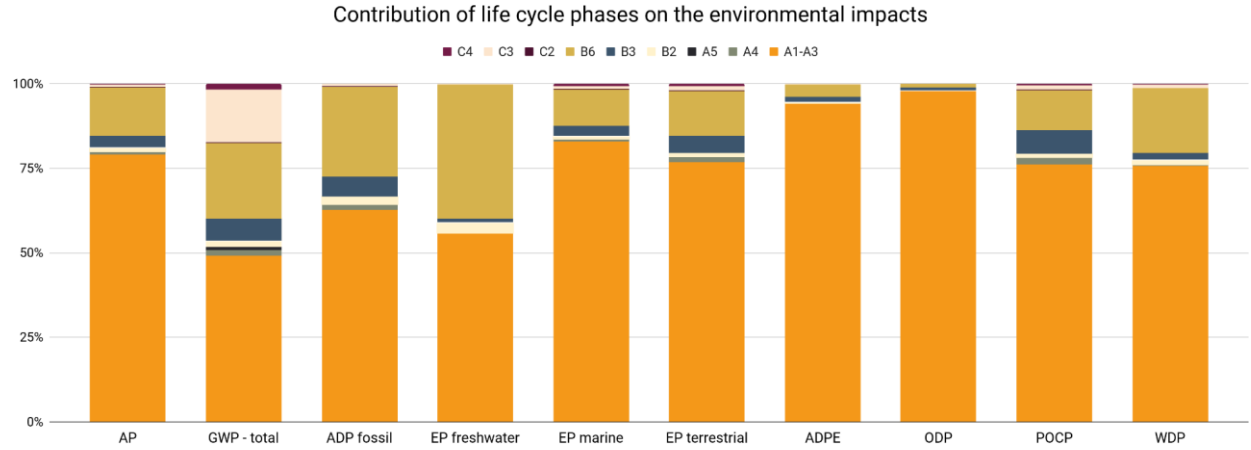
Output flow indicators

Table 20: Output flow indicators for SPARK[4]

SPARK[4]																
Indicator	Unit	A1 - A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Components for re-use	kg	8,82E+01	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Material for recycling	kg	1,22E+01	0	9,01E+00	0	0	0	0	0	0	0	0	4,70E+02	0	0	0
Materials for energy recovery	kg	2,75E+02	0	2,53E+01	0	0	0	0	0	0	0	0	0	0	0	0
Exported energy, electricity	MJ	0	0	0	0	0	0	0	0	0	0	0	3,60E+01	2,03E-02	0	0
Exported energy, thermal	MJ	0	0	0	0	0	0	0	0	0	0	0	2,35E+02	9,90E-03	0	0

The estimated impact results are only relative statements which do not indicate the end points of the impact categories, exceeding threshold values, safety margins or risks. It is not recommended to use the results of modules A1-A3 (A1-A5 for services) without considering the results of module C.

LCA interpretation



Graph 1: Contribution of life cycle phases of acoustic pod SPARK on the environmental impacts.

Based on normalised and weighted results according to the EF ver. 3.1 factors, the two most relevant impact categories (hotspots) are Climate Change and Resource Depletion – metals and minerals.

The production phase (modules A1-A3) and the operation energy use (B6) have the highest environmental impacts in all impact categories through the life cycle of SPARK product line. The third most important phase of the life cycle is module C3 - waste processing.

Environmental performance indicators

Acidification (AP)
Acidification is the process of increasing the acidity of soils, air, or water caused by an elevated concentration of hydrogen ions. An indicator of the impact category of acidification is accumulated exceedance (AE). The result is expressed in mol H+ eq.

Climate change (GWP)
Climate change is divided into three parts: biogenic, fossil, land use and land use transformation. An indicator called global warming potential (GWP100) is used to measure the amount of greenhouse gases contributing to global warming. The results are quantified in kilograms of CO2 eq.

Ozone depletion (ODP)
Ozone layer depletion is the result of emissions of ozone-depleting substances, such as long-lived chlorine and bromine-containing gases (e.g., CFCs, HCFCs, Halons). It is quantified in kg CFC-11 eq., with the ozone depletion potential as its indicator.

Water use (WDP)
Water deprivation potential quantifies the potential of water deprivation to humans or ecosystems. It is quantified in m3 world eq. and helps evaluate the risks associated with water scarcity.

Photochemical oxidant formation (POCP)
The impact category photochemical oxidation formation aggregates substances that contribute to the formation of tropospheric ozone. Category indicator is tropospheric ozone concentration increase expressed in kg NMVOC eq.

Resource use, minerals and metals (ADP)
Resource scarcity and limitations for current and future generations includes depletion of abiotic resources - elements (ADPe), quantified in kg Sb eq. and depletion of abiotic resources - fossil fuels (ADPf), quantified in MJ.

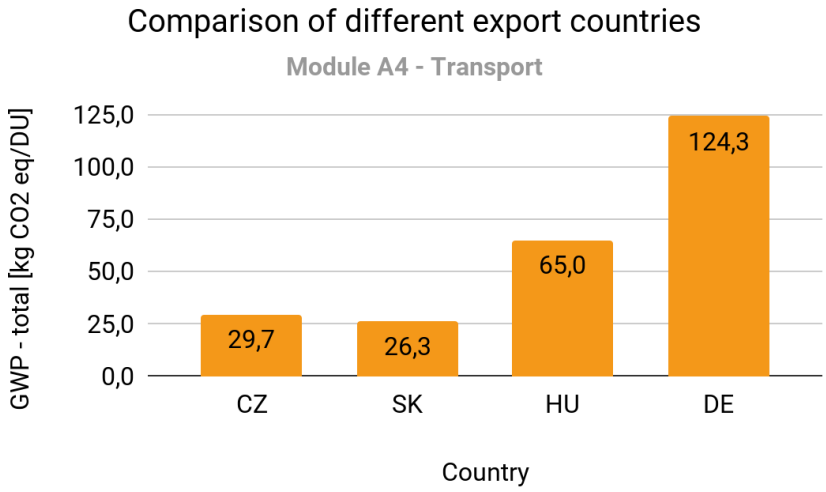
Eutrophication (EP)
Eutrophication enriches the environment with nutrients, impacting land, water, and seas leading to excess plankton and algae growth, harming the water quality. It is categorised into terrestrial (accumulated exceedance expressed in mol N eq.), freshwater (nutrient fraction reaching freshwater end expressed in kg P eq.), and marine impacts (nutrient fraction reaching marine end expressed in kg N eq.

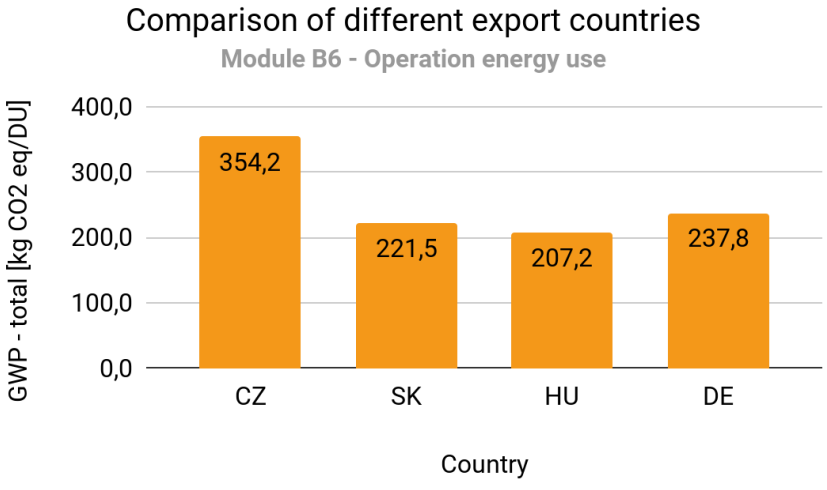
Statement on the requirements for comparability of EPDs, adapted from ISO 14025:
EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

Additional environmental information

Three additional countries of export were evaluated. The climate change impact category was assessed and in the case of module A4 (transport to customers), there is an increase in emissions depending on the transport distance. In module B6, CO_2 eq. emissions change according to the emission factor of the electricity national mix.

Export countries comparison





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