PRODUCT ENVIRONMENTAL PROFILE

In accordance with EN 50693:2019 and ISO 14025:2011 for

SPRECON-E-PANEL AP-2200

from Sprecher Automation GmbH

Programme	PEP Ecopassport association
	www.pep-ecopassport.com
Programme Operator	Association P.E.P
PEP Registration Number	SPRE-00006-V01.01-EN
Publication Date	05/2025
Valid Until	05/2030

www.sprecher-automation.com

1.0 PROGRAMME INFORMATION

PROGRAMME OPERATOR

Association P.E.P
11-17 rue de l'Amiral Hamelin
75016 Paris
France

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

DECLARATION HOLDER

Sprecher Automation GmbH
Franckstraße 51
4020 Linz
Austria

Contact Person: Christian Heinle
Email: christian.heinle@sprecher-automation.com

LCA CONSULTANT

Intertek Deutschland GmbH
Stangenstraße 1
70771
Leinfelden-Echterdingen
Germany

www.intertek.com

2.0 GENERAL INFORMATION

PEP PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	Association P.E.P 11-17 rue de l'Amiral Hamelin 75016 Paris France http://www.pep-ecopassport.org//
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	PCR-ed4-EN-2021 09 06
MANUFACTURER NAME AND ADDRESS	Sprecher Automation GmbH Franckstraße 51 4020 Linz Austria
DECLARATION NUMBER	SPRE-00006-V01.01-EN
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	Optional alarm panel for the SPRECON-E multifunctional automation platform and protection devices, during a service life of 10 years and with a use rate of 100%.
REFERENCE PCR AND VERSION NUMBER	Product category rules for life cycle assessments of electronic and electrical products and systems (PCR-ed4-EN-2021 09 06) SPECIFIC RULES FOR Electrical switchgear and control gear Solutions (PSR-0005-ed4-EN-2023 12 008)
DESCRIPTION OF PRODUCT'S INTENDED APPLICATION AND USE (AS IDENTIFIED WHEN DETERMINING PRODUCT RSL)	The control panel AP-2200 is a local operator interface of the SPRECON-E-devices for control and monitoring of all processes as well as parameter settings.
PRODUCT RSL DESCRIPTION (IF APPL.)	N/A
MARKETS OF APPLICABILITY	Worldwide
DATE OF ISSUE	05/2025
PERIOD OF VALIDITY	05/2030
PEP TYPE	Product Specific
PEP SCOPE	Cradle to Grave
YEAR(S) OF REPORTED MANUFACTURER PRIMARY DATA	2023
LCA SOFTWARE & VERSION NUMBER	SimaPro 9.6.0.1 Multiuser
LCI DATABASE(S) & VERSION NUMBER	Ecoinvent 3.9.1
LCIA METHODOLOGY & VERSION NUMBER	Environmental Footprint 3.1 (adapted) V1.00 / EF 3.1 normalization and weighting set
LIMITATIONS: Environmental declarations from different programs (ISO 14025) may not be comparable. Comparison of the environmental performance of AP-2200 using PEP information shall be based on the product's use and impacts at the installation level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under this PCR. This PEP is not intended to make any comparative assertions.	

Registration number: SPRE-00006-V01.01-EN	Drafting rules: ***"PCR-ed4-EN-2021 09 06" and " PSR-0005-ed3.1-EN-2023 12 08"***
Verifier accreditation number: VH52	Information and reference documents: **www.pep-ecopassport.org**
Date of issue: 05-2025	Validity period: **5 years**
Independent verification of the declaration and data in compliance with ISO 14025: 2006	
Internal: ☐	**External:** ☑
The PCR review was conducted by a panel of experts chaired by Julie Orgelet (DDemain)	
PEPs are compliant with XP C08-100-1:2016 and EN 50693:2019 or NF E38-500 :2022 The components of the present PEP may not be compared with components from any other program.	
Document complies with ISO 14025:2006 "Environmental labels and declarations. Type III environmental declarations"	

3.0 COMPANY INFORMATION

Sprecher Automation is a manufacturer and supplier of products and solutions for energy supply, energy automation and industrial automation. With our know-how, we make critical infrastructures more secure, digitise power grids and optimise complex energy and industrial processes.

The roots of Sprecher Automation date back to the year 1900. Then, for the first time, the name “Sprecher” was introduced to the industrial world by “Sprecher & Schuh”, a factory for electric devices. In 2001, the French owners of the company planned to close the Linz location, 160 employees would have lost their jobs. Today’s CEO Erwin Raffeiner and some of his colleagues in the local management took the brave step to save both the location and the jobs through a management buy-out of the energy automation branch. Hence, Sprecher Automation was founded in 2002 with one location and 160 employees. Today, around 750 people work for Sprecher Automation at the headquarters in Linz/Austria or in one of our other 15 locations in seven countries on two continents (Austria, Germany, Switzerland, the Netherlands, Poland, Slovakia and the United Arab Emirates). Our main markets are Europe and the GCC region.

With more than one hundred years of experience in the field of energy automation, we support our local and international customers such as transmission and distribution system operators, power supply companies, municipal utilities, and infrastructure companies in their daily tasks. Digitising power grids is essential to the success of the energy transition. Our products and solutions help to make today's power grids more sustainable and fit for tomorrow's requirements. In terms of automation and protection, we cover the areas of station control technology, network protection technology, telecontrol technology, network control technology and various applications with a uniform hardware and software platform (SPRECON). For customers in the industrial sector, Sprecher Automation offers process automation, visualisation, scanners and a variety of solutions for wood, steel, pulp & paper and pit & quarry industries as well as environmental systems, and many other sectors.

The philosophy for the products of the Sprecher Automation group has always been to supply high quality, durable and long-lasting products which can stay in operation for a very long time with minor maintenance. Additionally, it is the ultimate goal to support the products for a very long time and reach long life cycles but also to continuously improve the already existing platforms with new, downward compatible features whenever possible. There are no short-lived products in the portfolio of Sprecher Automation. Sprecher Automation pursues the strategy to repair products as long as it is technically feasible instead of discarding defective products right away.

Sprecher Automation closely monitors the used materials, checks them for low CO2 footprint and easy sourcing, to thoroughly monitor material compliance requirements (RoHS, REACH, POP, halogens, etc), to improve the general environmental aspects of the products and to reduce the environmental impact. We examine each and every single material used in the products and also in the production process. There are continuous activities to switch to materials which are easily sourced, have the lowest possible environmental impact and can be easily processed at the end of life. Additionally, there is an ongoing process to switch all materials which contain substances that are SVHC candidates according to the latest candidate list published by ECHA every 6 months (REACH legislation). This way Sprecher Automation makes sure to use only materials which do not harm people, the environment or the atmosphere. But the initiatives do not stop at the legal requirements. It is constantly being researched what kind of effects the used materials have. If materials with undesired effects are detected, the search for substitutes starts immediately and the materials are phased out as soon as possible. The same sustainable approach is taken within the supply chains where it is taken into account where the suppliers are located, how the components and raw materials are sourced and how they are transported.

Sprecher Automation produces exclusively in Linz/Austria and choses local or regional suppliers whenever possible. Our customers appreciate the European quality and standards of our devices and the (cyber) security that comes with it.

This cradle-to-grave Product Environmental Profile (PEP) is for 1 AP-2200 unit. For further information visit https://www.sprecher-automation.com/en/

4.0 PRODUCT INFORMATION

4.1 Product Identification

This PEP covers one unit of AP-2200. The product is considered to fall under the Framework PCR for electrical and electronical products (EN 50693:2019).

The AP-2200 is an optionally available on-site alarm panel for SPRECON-E devices. It offers a wide range of monitoring options.

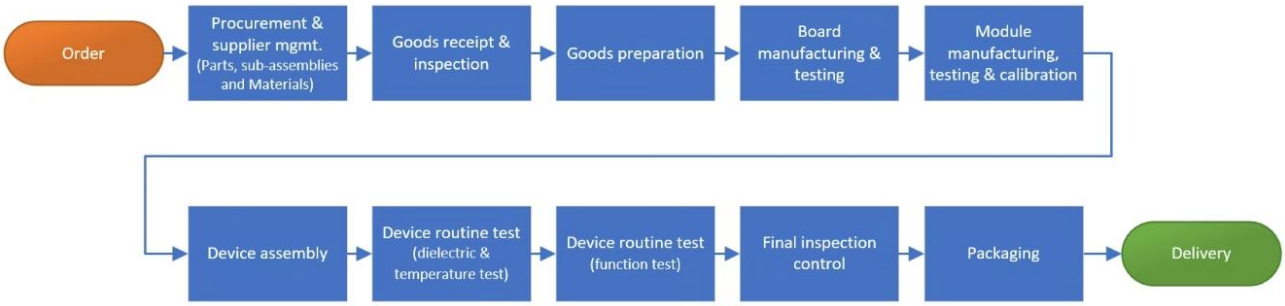
The alarm panel is equipped with 100 freely configurable LEDs, three status LEDs, an acknowledgement button and a freely configurable keylock.

It can be mounted either directly on the SPRECON-E device or in the control cabinet door.

4.2 Application

The control panel AP-2200 is a local operator interface of the SPRECON-E-devices for control and monitoring of all processes as well as parameter settings.

4.3 Process flow chart



The manufacturing process of the product is described in above flow chart.

4.4 Technical Requirements

The technical requirements for the AP-2200-unit result from the applicable legal regulations. In Europe, at least the following legal regulations apply, which are fulfilled by applying the following technical standards:

- DIRECTIVE 2014/35/EU "LVD"
  - EN IEC 61010-1
  - EN IEC 61010-2-030
  - EN IEC 61850-3
  - EN IEC 60870-2-1
  - EN IEC 60255-1
  - EN IEC 60255-27
  - EN IEC 60529
  - EN IEC 62262
- DIRECTIVE 2014/30/EU "EMC"
  - EN IEC 60870-2-1
  - EN IEC 61850-3
  - EN IEC 60255-26
  - CISPR 32 / EN 55032
  - CISPR 11 / EN 55011
  - EN IEC 61000-6-2
  - EN IEC 61000-6-4
  - EN IEC 61000-6-5
- DIRECTIVE 2011/65/EU "RoHS"
  - EN IEC 63000

Among other additional standards and regulations.

4.5 Material Composition

The product consists of different components made of rubber, steel, metal alloys as well as a variety of different plastics.

The raw material composition of the AP-2200 is shown below –

Product alone weight 0.471 kg					
Plastic as % of weight		**Metal as % of weight**		**Other as % of weight**	
PET	2.2%	Steel	11.2%	PCBA	38.3%
ABS	35.8%	Brass	0.6%	Miscellaneous	9.7%
TPS-H	1.7%	Metal Coatings	0.6%		
EPDM	>0.1%				

The outgoing packaging details with the product (per unit of AP-2200) is provided below –

Product alone weight 0.025 kg					
Plastic as % of weight		**Metal as % of weight**		**Other as % of weight**	
LDPE	100.0%				

4.6 Environment and Health during Manufacturing

Parts of the product do contain as intentionally or unintentionally added raw materials substances of very high concern (SVHC) above a limit of 0.1 % w/w according to the candidate list, article 59 (1, 10) European REACH regulation (EC) No. 1907/2006.

The brass spacer sleeves do contain Lead in a concentration of 3% w/w.

4.7 Packaging

The product can be protected with plastic film in form of plastic bags. These packaging materials are included in the scope of this EPD.

4.8 Manufacturing

The manufacturing related inputs have been modelled using a custom dataset based on the electricity mix used by Sprecher Automation GmbH. The breakdown of it is as follows:

Source	Percentage
Electricity, high voltage {AT}| electricity production, hydro, pumped storage | Cut-off, S	0.07%
Electricity, high voltage {AT}| electricity production, hydro, reservoir, alpine region | Cut-off, S	0.21%
Electricity, high voltage {AT}| electricity production, hydro, run-of-river | Cut-off, S	0.64%
Electricity, high voltage {AT}| electricity production, wind, <1MW turbine, onshore | Cut-off, S	0.09%
Electricity, high voltage {AT}| electricity production, wind, >3MW turbine, onshore | Cut-off, S	0.09%

Source	Percentage
Electricity, high voltage {AT}| electricity production, wind, 1-3MW turbine, onshore | Cut-off, S	2.60%
Electricity, high voltage {AT}| heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014 | Cut-off, U (to represent other renewables)	0.28%
Electricity, low voltage {AT}| electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted | Cut-off, U	96.00%

Other fuels, such as Nitrogen, that are used in the manufacturing process are modelled using datasets from EcoInvent 3.11.

4.9 Transportation

Distribution of the product is directly to end-users. The product is shipped by sea and road and the weighted average transportation distance 1273 km by road and 4503 km by sea. The transport by road is using specific datasets for truck transport in Europe and outside of Europe (Transport, freight, lorry 16-32 metric ton, EURO6 {RER}| transport, freight, lorry 16-32 metric ton, EURO6 | Cut-off, U; Transport, freight, lorry 16-32 metric ton, EURO5 {RoW}| transport, freight, lorry 16-32 metric ton, EURO5 | Cut-off, U), transport by sea is using the global average (Transport, freight, sea, container ship {GLO}| transport, freight, sea, container ship | Cut-off, U). This is considered representative from both technological and geographical standpoint.

Additional details for the scenario are provided in section 6.0 of this document.

4.10 Installation

Installation itself is not considered in the study. The installation of the AP-2200 unit requires drilling of four holes into a sheet metal or cabinet door, which is considered to fall under the cut-off criteria according to the PCR. The module covers the disposal of the packaging of the product including its transport to the waste treatment facility. As the product is used in Germany, European truck transport dataset (refer to above section for transport) has been used. The transport distance considered is 1,000 km. The end-of-life treatment processes considered are global for the recycling processes of the individual packaging materials and on rest-of-world level for the portion of the packaging materials that are incinerated and landfilled. This is considered representative from both technological and geographical standpoint. No energy is used directly in this phase of the life cycle of the product.

4.11 Reference Service Life

The reference service life considered is 10 years.

Note, the reference service life (RSL) of 10 years is a theoretical period selected for calculation purposes only. While the products are designed with an intended service life of 20+ years by the manufacturer, for the sake of simplicity in the calculation as a conservative approach and comparability with similar products 10 years reference life is considered. This is not representative for the minimum, average, nor actual service life of the product.

During its service life, the product consumes electricity. The dataset used for this is Electricity, low voltage {DE}| market for electricity, low voltage | Cut-off, U. The amount of consumed electricity is stated below.

Mode of Use	Quantity [Wh]
Standby	33633.7
In Use	52.8

This is considered representative from both technological and geographical standpoint.

4.12 Disposal

Disposal of the product should be in accordance with national, state and local regulations.

The recycling of some parts of the product is possible if a separation of materials by type is guaranteed. The product is subject to treatment according to Directive 2012/19/EU on waste electrical and electronical equipment (WEEE Directive). Sprecher Automation GmbH has developed dismantling instructions according to Article 15 of the above directive. Collection is done by authorized companies according to Directive 2012/19/EU on Waste from electrical and electronic equipment.

The end-of-life calculations in the underlying LCA for the different materials used in the product follow the flow diagram for electronic and electrical products and systems as described in EN 50693:2019 and the table G.4 in Annex G of this standard. As per PCR-ed4-EN-2021 09 06 the transport distance used for calculation is 1,000 km. This is considered representative from both technological and geographical standpoint.

No energy is used directly in this phase of the life cycle of the product.

4.13 Module D

To calculate potential benefits and loads beyond the system boundary for this product, the following approach has been taken:

For metals, 100% of it the recycled material (as per the percentages in Annex D of PCR ed. 4 respectively Annex G of EN 50693) is calculated as the recycling burden, 90% of that is used for the calculation of the recycling credit. The remaining 10% were considered being landfilled and the associated emissions have been calculated for that. For plastics: 100% is getting incinerated and the avoided emissions for generating electricity and heat from this have been calculated.

The datasets used in this module are as regional as possible. The geographical representation varies from global datasets for the copper recycling credit to regional datasets i.e., Austrian steel production dataset as the basis for the recycling burden of steel and German electricity production for the electricity generation credit from the incineration of plastics (Electricity, medium voltage {DE}| market for electricity, medium voltage | Cut-off, U). This is considered representative from both technological and geographical standpoint.

4.14 Further Information

Additional information can be found at https://www.sprecher-automation.com/en/

5.0 LCA INFORMATION

5.1 Functional Unit

In this assessment the cradle to gate life cycle of the product is covered and quantified and the functional unit for the study is defined as:

Item	Value	Unit
Functional unit	***1 unit of AP-2200***	
Equivalent Mass	0.471	kg
Reference service life	10	years

As the reference service life is equal to the rated lifetime, the declared unit is equal to the functional unit in this PEP. This is specified in the equation below.

$$DU = FU$$

5.2 System Boundary

Type of EPD: Cradle-to-Gate with options. The modules considered in the Life Cycle Assessment are:

- A1: Raw materials supply
- A2: Transport to manufacturer
- A3: Manufacturing
- A4: Transport to construction site
- A5: Assembly
- B2: Maintenance
- B6: Operational Energy Use
- C2: Waste transport
- C3: Waste processing
- C4: Disposal
- Module D

The analysis of the product life cycle includes production of the basic materials, transport of the basic materials, manufacture of the product and the packaging materials and is declared in module A1-A3. Transport of the product is declared in module A4. Assembly of the product is included in module A5. Maintenance and the standby energy use of the unit are included appropriately declared in Module B5- B6.

The end-of-life assumptions follow the guidelines for electronic and electrical products and systems given in EN 50693. The average transport distance from the building to landfill site is assumed to be 1000 km, this is accounted in Module C2. The impacts of processing the waste and sorting it are accounted for in Module C3. Waste disposal related impacts due to landfilling of product are accounted in Module C4. Benefits and loads from recycling processes are accounted for in module D.

5.3 Estimations & Assumptions

Assumptions in this study are as follows –

- The VGA TFT display is modelled using the dataset for LCD display.
- The weighted average transport distance from the production site to the client/installation site is assumed to be 1273 km by road and 4503 km by sea.
- Installation of the unit requires the drilling of four holes into a sheet metal (e.g. control cabinet door). This is considered negligible in the overall life-cycle. The same applies for the deinstallation/destruction.
- The average transport distance from the installation to landfill or waste processing site for the disposal is assumed to be 1000 km.
- For waste treatment, shredding is assumed to be the same as sorting.
- A regular keyboard is assumed to be the same as a membrane keyboard.

5.4 Cut Off Rules

In the process of building an LCI it is typical to exclude items considered to have a negligible (aka relatively inconsequential or immaterial) contribution to results. “Criteria for the exclusion of inputs and outputs (cut off rules) in the Life Cycle Assessment and information modules and any additional information are intended to support an efficient calculation procedure.

All known mass and energy flows are reported; the only thing that is considered under the cut-off is the energy required for the installation and respectively deinstallation, as this is considered to be negligible.

5.5 Data Sources

The majority of the data used in the modelling is from primary data from Sprecher Automation GmbH, in cases where it was necessary supplemental datasets from an LCA database (Ecoinvent v3.9.1) were used.

5.6 Data Quality

Data quality was monitored with the use of data quality requirements based on ISO 14044:2006. To ensure the quality of data were sufficient, data quality checks were completed on data quality indicators (DQIs) – Reliability, Representative, Temporal Correlation, Geographical Correlation, & Technological Correlation. Data quality indicators were assessed using a data quality matrix whereby

key data were assigned scores between 1 (best) and 5 (worst). The data quality matrix used in this study was adapted from Weidema et al. (2013) and is available in the background LCA report.

The product is manufactured in Austria using a custom-made dataset for the electricity and considered to be used and disposed of in Germany. For the electricity use, the market dataset for low voltage electricity in Germany (grid mix) was used. This is considered to be sufficiently representative from both technological as well as geographical standpoint.

5.7 Period Under Review

All primary data used in this PEP are based on the 2023 production data for the AP-2200 from Sprecher Automation GmbH in their facility in Austria. Data used for materials used in the products are latest updated 2023.

5.8 Allocation

When multi-output allocation becomes necessary during the data collection phase, a consistent allocation approach for all possible (material and energetically) types of co-products used a decision hierarchy shall be applied.

No allocation was required in this LCA since all inputs and outputs are known specific to the unit under study. In terms of generic data, the main database used, Ecoinvent v3.9.1 (cut-off), defaults to an economic allocation for most processes. However, in some cases a mass-based allocation is used, where there is a direct physical relationship. The allocation approach of specific Ecoinvent modules is documented on their website and method reports (see www.Ecoinvent.org).

In the case of end-of-life allocation of generic data, the Ecoinvent v3.9.1 with a cut-off by classification end-of-life allocation method was used. In this approach, environmental burdens and benefits of recycled/reused materials are given to the product system consuming them, rather than the system providing them, and are quantified based on recycling content of the material under investigation. This is a common approach in LCA for materials where there is a loss in inherent properties during recycling, the supply of recycled material exceeds demand and recycled content of the product is independent of whether it is recycled downstream. It follows the ISO standards on LCA.

6.0 SCENARIOS AND ADDITIONAL TECHNICAL INFORMATION

The following technical information is a basis for the declared modules. The values refer to the functional unit of 1 unit of AP-2200 with a building service life of 10 years (packaging included).

Transport to the customer site (A4)

Sea Freight	
Fuel Type	Heavy fuel oil
Liters of fuel (L/100 km)	1,07E-4 Liters/100 km
Vehicle type	Container Ship
Transport distance	4503 km
Capacity utilization (including empty runs, mass based)	70%
Road in EU	
Fuel Type	Diesel
Liters of fuel (L/100 km)	1.56E-3 Liters/100 km
Vehicle type	16-32 Metric Tons Truck
Transport distance	1030 km
Capacity utilization (including empty runs, mass based)	50%
Road outside of EU	
Fuel Type	Diesel
Liters of fuel (L/100 km)	1.59E-3 Liters/100 km
Vehicle type	16-32 Metric Tons Truck
Transport distance	243 km
Capacity utilization (including empty runs, mass based)	50%

Reference Service Life

Reference Service Life of the products	10 years

Note, the reference service life (RSL) of 10 years is a theoretical period selected for calculation purposes only. While the products are designed with an intended service life of 20+ years by the manufacturer, for the sake of simplicity in the calculation as a conservative approach and comparability with similar products 10 years reference life is considered. This is not representative for the minimum, average, nor actual service life of the product.

End of Life (C1-C4)

The end-of-life stages for the products are modelled according to EN 50693. 20% of the steel, 40% of copper, 40% of the ABS plastic, 50% of the other plastics and PCB components at the end-of-life are considered to go to landfill. From the remaining parts, 100% of steel, copper and PCBs, and 20% of ABS plastic are considered to go to recycling. 100% of the remaining plastic and hazardous waste is considered to go into incineration with energy recovery.

The average transport distance from the building to landfill or recycling site is assumed to be 1000 km. Additional details for this scenario are –

Collection process (collected with mixed construction waste)	0.468 kg
Reuse	0.000 kg
Recycling	0.271 kg
Landfill	0.189 kg
Incineration	0.008 kg
Biogenic carbon content of the packaging	0.000 kg C/ kg product

7.0 ENVIRONMENTAL PERFORMANCE

The following tables display the environmental impacts for the assessed base case functional unit of "1 AP-2200 unit with a building service life of 10 years (packaging included)".

The environmental impact categories reported below are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development, however the PEP users shall not use additional measures for comparative purposes. Additionally, LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. Finally, many factors affect the comparability of EPDs. End users should be extremely cautious when comparing or evaluating PEP data of different PEP publishers. Such comparison or evaluation is only possible if all conditions for comparability listed in ISO 14025 (Section 6.7.2) are met.

Description of the System Boundary (X = Included in LCA)

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	0	X	0	0	0	X	0	0	X	X	X	X

7.1 Environmental indicators

The results are presented for the functional unit of 1 unit of installed AP-2200 and with a service life of 10 years (packaging included).

		Manufacturing	Distribution	Installation	Use			End of Life	Total	Benefits and Loads
Parameter	**Unit**	**A1-A3**	**A4**	**A5**	**Total B1-B7**	**B2**	**B6**	**C1-C4**	**A1-C4**	**D**
Global Life Cycle Impact Results (EF3.1 method)										
GWP-total	kg CO2 eq	1.46E+01	1.43E-01	9.48E-03	1.48E+01	2.32E-02	1.48E+01	2.16E-01	2.98E+01	-2.06E-01
GWP-fossil	kg CO2 eq	1.46E+01	1.43E-01	9.47E-03	1.46E+01	2.29E-02	1.46E+01	2.15E-01	2.95E+01	-2.06E-01
GWP-biogenic	kg CO2 eq	3.85E-02	3.60E-05	1.89E-06	1.91E-01	2.99E-04	1.91E-01	7.49E-05	2.30E-01	1.54E-04
GWP-luluc	kg CO2 eq	2.86E-02	7.91E-05	2.67E-06	2.44E-02	3.82E-05	2.43E-02	8.34E-05	5.31E-02	-2.25E-05
ODP	kg CFC11 eq	6.65E-07	2.30E-09	8.58E-11	1.69E-07	2.66E-10	1.69E-07	2.80E-09	8.39E-07	-5.39E-09
AP	mol H+ eq	1.11E-01	1.07E-03	1.47E-05	4.25E-02	6.66E-05	4.24E-02	3.44E-04	1.55E-01	-6.80E-04
EP-freshwater	kg P eq	1.28E-03	1.20E-06	5.09E-08	2.21E-03	3.47E-06	2.21E-03	1.75E-06	3.50E-03	-1.02E-05
EP-marine	kg N eq	1.71E-02	2.94E-04	4.10E-06	6.70E-03	1.05E-05	6.69E-03	8.80E-05	2.42E-02	-1.72E-04
EP-terrestrial	mol N eq	1.96E-01	3.20E-03	4.29E-05	8.46E-02	1.33E-04	8.44E-02	9.36E-04	2.85E-01	-2.00E-03
POCP	kg NMVOC eq	8.13E-02	1.05E-03	1.92E-05	2.41E-02	3.78E-05	2.41E-02	4.34E-04	1.07E-01	-1.24E-03
ADP-minerals and metals	MJ	1.99E+02	1.98E+00	6.95E-02	2.19E+02	3.43E-01	2.18E+02	1.63E+00	4.21E+02	-2.08E+00
ADP-fossil	kg Sb eq	2.25E-03	4.08E-07	1.59E-08	1.63E-04	2.55E-07	1.62E-04	4.49E-07	2.41E-03	-1.76E-08
WDP	m3 depriv.	3.94E+00	8.05E-03	6.95E-04	1.09E+00	1.70E-03	1.09E+00	1.81E-02	5.05E+00	-5.80E-04

Note - These impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development. However, the PEP users shall not use additional measures for comparative purposes.

Caption: GWP-total = Global Warming Potential total, 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 = Ozone Depletion Potential, AP = Acidification Potential, EP = Eutrophication Potential, POCP = Formation of tropospheric ozone, ADP-minerals and metals = Abiotic Resource depletion potential for non-fossil resources, ADP-fossil = Abiotic Depletion Potential of Non-renewable (fossil) energy resource, WDP = Water (user) deprivation potential, deprivation-weighted water consumption

Additional Environmental indicators (EF3.1 method)

Parameter	Unit	A1-A3	A4	A5	Total B1-B7	B2	B6	C1-C4	A1-C4	D
PM	disease inc.	8.66E-07	1.01E-08	3.79E-10	1.92E-07	3.00E-10	1.91E-07	8.27E-09	1.08E-06	-1.26E-08
IRP	kBq U-235 eq	5.60E-01	7.07E-04	2.56E-05	8.11E-01	1.27E-03	8.10E-01	1.53E-03	1.37E+00	1.21E-03
ETP-fw	CTUe	2.19E+02	1.06E+00	5.62E-02	6.03E+01	9.44E-02	6.02E+01	1.92E+00	2.82E+02	-4.84E-01
HTP-c	CTUh	2.36E-08	6.44E-11	3.49E-12	5.39E-09	8.44E-12	5.38E-09	6.86E-11	2.91E-08	-9.42E-10
HTP-nc	CTUh	6.56E-07	1.30E-09	9.40E-11	2.31E-07	3.61E-10	2.30E-07	3.54E-09	8.92E-07	-3.01E-10
SQP	Pt	8.98E+01	1.04E+00	4.35E-02	5.37E+01	8.41E-02	5.36E+01	9.92E-01	1.46E+02	-2.93E-01
Biogenic C (product)	kg C	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.26E-08
Biogenic C (packaging)	kg C	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.21E-03

Caption: PM = Potential incidence of disease due to PM emissions, IRP = Ionizing Radiation, ETP-fw = Eco-toxicity (freshwater), HTP-c = Human toxicity, cancer effects, HTP-nc = Human toxicity, non-cancer effects, SQP = Land use related impacts/Soil quality

Life Cycle Inventory Results: Resource Use

Parameter	Unit	A1-A3	A4	A5	Total B1-B7	B2	B6	C1-C4	A1-C4	D
RPR_E	MJ	9.22E+00	1.14E-02	4.44E-04	5.45E+01	8.54E-02	5.44E+01	2.21E-02	6.37E+01	4.43E-02
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	2.02E+02	2.10E+00	7.40E-02	2.34E+02	3.67E-01	2.34E+02	1.73E+00	4.40E+02	-2.18E+00
$NRPR_M$	MJ	1.01E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.01E+01	0.00E+00
SM	Kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	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	0.00E+00	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	1.31E-01	2.61E-04	2.06E-05	1.09E-01	1.70E-04	1.08E-01	5.85E-04	2.41E-01	3.38E-04

Caption: RPR_E - Renewable primary resources used as energy carrier (fuel), RPR_M: Renewable primary resources with energy content used as material,

NRPR$_E$: Non-renewable primary resources used as an energy carrier (fuel), NRPR$_M$: Non-renewable primary resources with energy content used as material,
SM: Secondary materials, RSF: Renewable secondary fuels, NRSF: Non-renewable secondary fuels, RE: Recovered energy, FW: Use of net freshwater resources

Life Cycle Inventory Results: Output Flows and Waste Categories

Parameter	Unit	A1-A3	A4	A5	Total B1-B7	B2	B6	C1-C4	A1-C4	D
HWD	kg	1.80E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E-03	4.80E-03	0.00E+00
NHWD	kg	8.36E-02	1.80E-06	1.49E-02	2.58E-04	4.05E-07	2.58E-04	1.99E-01	2.97E-01	1.79E-02
HLRW + ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	1.48E-01	0.00E+00	1.02E-02	0.00E+00	0.00E+00	0.00E+00	2.73E-01	4.31E-01	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Caption: HWD = Hazardous Waste Disposed, NHWD = Non-Hazardous Waste Disposed, HLRW = High Level Radioactive Waste conditioned to final repository,
ILLRW = Intermediate & Low-Level Radioactive Waste conditioned to final repository, CRU = Components for Re-Use, MR = Material for Recycling, MER = Materials for Energy Recovery, EE = Recovered Energy exported from the Product System

8.0 INTERPRETATION

The manufacturing stages have the highest environmental contribution across all indicators reported (16.77% to 93.228% of the total impacts) with highest contribution for Resource use, minerals and metals (93.18%) & lowest for Climate change - Biogenic (16.61%). The contribution towards total climate change from this life cycle stage was 49.04%. The operational energy use of the unit has the second highest environmental impact across the most indicators reported (6.73% to 83.05% of the total impacts) with highest contribution for Climate change - Biogenic (83.05%) & lowest for Resource use, minerals and metals (6.73%). The contribution towards total climate change from this life cycle stage was 49.64%. The assembly of the product has the lowest impact across all categories and contributes about <0.01% to 0.05% of the total impacts with highest contribution for Ecotoxicity, freshwater – part 1 (0.05%) & lowest contribution for Resource use, minerals and metals (<0.01%). The contribution towards total climate change from this life cycle stage was 0.03%. The maintenance of the unit has a significantly lower impact across all categories and contributes 0.01% to 0.13% of the total impacts with highest contribution for Climate Change - biogenic (0.13%) & lowest contribution for Resource use, minerals and metals (<0.01%). The contribution towards total climate change from this life cycle stage was 0.08%. Distribution of the finished product to end users has significantly lower contribution (0.02% to 1.21% of the total impacts) with highest contribution for Eutrophication, marine (1.21%) & lowest contribution for Climate change - Biogenic (0.02%). The contribution towards total climate change from this life cycle stage was 0.48%. the end-of-life processes have significantly lower contribution (0.01% to 1.85% of the total impacts) with highest contribution for Ecotoxicity, freshwater - part 1 (1.85%) & lowest contribution for Resource use, minerals and metals (0.02%). The contribution towards total climate change from this life cycle stage was 0.72%.

The results in this PEP are limited to –

- Assumptions as defined in section 5.3 of this PEP document.
- Data collection period as defined in section 2.0 and section 5.7 of this PEP document.
- Methodologies applied as defined in section 2.0 of this PEP document.
- Cut-off rules as specified in section 5.4 of this PEP document.
- The scope & boundaries as defined in sections 5.1 to 5.2 of this PEP document.
- The data quality as defined in section 5.6 of this PEP document.

9.0 REFERENCES

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FOR MORE INFORMATION

Intertek Deutschland GmbH
Stangenstraße 1
70771
Leinfelden-Echterdingen
Germany

lca@intertek.com

intertek.com

intertek sustainability