PRODUCT ENVIRONMENTAL PROFILE

VERTIV S.r.l.

UNINTERRUPTIBLE POWER SUPPLIES (UPS)
LIEBERT® TRINERGY™ CUBE 2000 kW

GENERAL INFORMATION

Program information	PEP-ecopassport®
Documents	www.pep-ecopaasport.org
Referent company	Vertiv S.r.l. (www.vertiv.com)
Product name	UPS LIEBERT® TRINERGY™ CUBE 2000 kW
Company contacts	Vertiv S.r.l. Via Fornace, 30, 40023 Poggio Piccolo (BO) Michele Venturini Michele.Venturini@vertiv.com

COMPANY

Vertiv is a global leader in designing, building and servicing critical infrastructure that enables vital applications in data centers, telecommunications, commercial and industrial.

With several sites located all over the world, Vertiv can provide global presence for a close partnership, everywhere and across the whole life cycle of the applications.

Vertiv can leverage decades of experience in its reference markets thanks to its lineage, which dates back to 1965, when Liebert(R) corporation was founded.

Vertiv is continuously engaged in research and development, challenging and pushing state-of-the-art with its products.

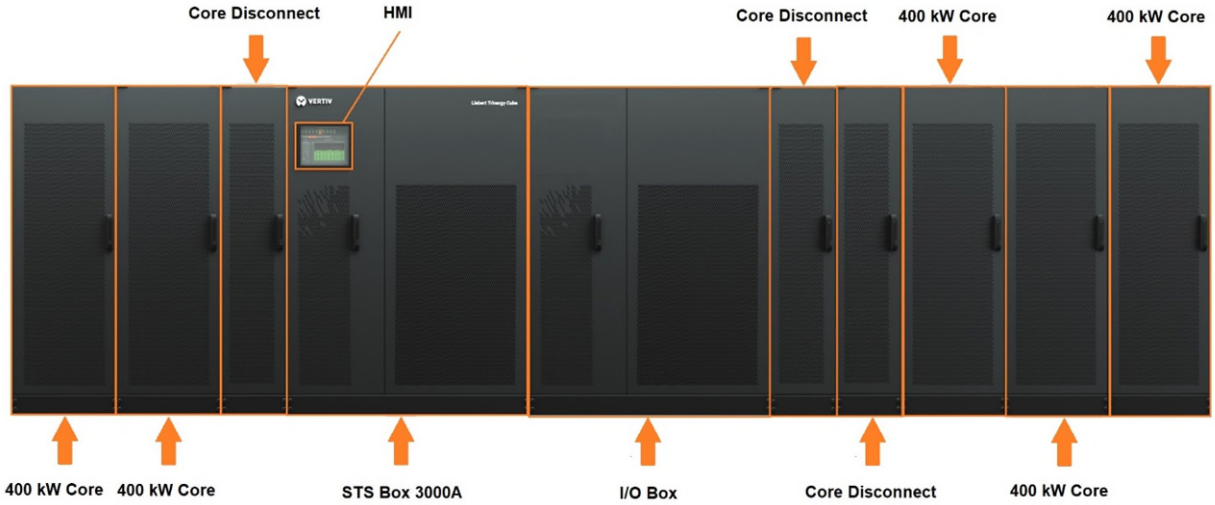
Vertiv's static three-phase UPSs can provide outstanding availability: Liebert(R) EXL S1 and Liebert® Trinergy™ Cube exceed the requirements of a Tier IV data center power chain.

Vertiv's product portfolio covers the entire range of elements that are involved in vital applications such as data centers: UPSs, thermal management systems, air management systems and chillers, power distribution, monitoring solutions, project services, maintenance - all of this also providing integrated, combined turnkey solutions.

Vertiv is committed to advancing the sustainability of its global operations and working with customers to provide sustainable solutions to meet the growing demand of the digital world. Vertiv is committed to reducing the carbon footprint of our operations and mitigating risks associated with climate change.

As part of this commitment, Vertiv decided to perform a life cycle impact assessment (LCA) about one of its products, LIEBERT® TRINERGY™ CUBE in its 2000kVA configuration. The results are part of this report which is also the background report adopted by Vertiv to draft a Product Environmental Profile (PEP).

PRODUCT INFORMATION



Designed around your IT space, Liebert Trinergy Cube is ready to evolve with growing business demands. It offers the highest level of power availability as well as reduced TCO, minimum energy consumption and CO2 emissions.

Liebert Trinergy Cube boasts unparalleled features delivering up to 99% efficiency with dynamic online mode and power density per core running up to 200 kW or 400 kW.

Its optimized efficiency at partial load conditions and hot scalability up to 3.4MW means that Liebert Trinergy Cube delivers adaptability not available anywhere else in the market.

Liebert Trinergy Cube's hot scalability allows it to meet any power system requirement from 150 kW up to 27 MW in parallel.

Liebert Trinergy Cube goes beyond the power revolution, to allow the greatest advantages in terms of availability, capacity and efficiency.

The main features of the UPS are:

- Dynamic online mode for highest availability and up to 99% efficiency
- Hot scalability up to 3.4 MW in a single unit and up to 27MW in a parallel system
- Unprecedented levels of installation flexibility
- Smart capacity - adaptive power rating
- Li-ion battery option to adapt to all scenarios
- Vertiv™ LIFE™ Services Remote Diagnostic and Preventive Monitoring
- Optional integrated backfeed protection

Liebert® Trinergy™ Cube	
Product type	Single UPS with bypass
Model	Liebert® Trinergy™ Cube
Representative product name	Liebert® Trinergy™ Cube 2000 kW
Commercial reference	Liebert® Trinergy™ Cube
Dimensions (mm)	7175 x 1950 x 910
Gross Weight (kg)	6152
Net Weight (kg)	5808
Max Apparent Power (kVA)	2000
Max Active Power (kW)	2000
Product type	Single UPS with bypass
Input Dependency Characteristics	Multimode UPS (VFI, VFD, VI)
Performance classification	VFI SS 111
Years	15

The UPS model Liebert® Trinergy™ Cube 2000 kW includes five cores (each one with three module IR and one module Boost), one right core disconnector, two left core disconnector, one box STS and one box IO.

Module	N° of modules	Total mass (kg)
10B14749GF - Core	5	1304,150
10B14749GI16 - Module Boost	5	465,290
10B14763GD10 - Module IR	15	1508,360
10B14757G1R - Core Disconnector	3	507,405
TCB3VA000010000	1	132,442
10B14758G1 - Box STS	1	1132,910
TCB3VB00A200000	1	51,623
10B14758G202 - Box IO	1	546,406
10B14764K323 – Power cable kit	1	158,408
10H54910P03 – Signal cable	1	1,290
10B14746G1 – Signal cable	1	0,116
Packaging	1	343,111
	TOTAL	6151,511

FUNCTIONAL UNIT

The functional unit of the UPS is defined as follow:

- To protect the load of 2000 kW against input power failure during 15 years and switch to the energy storage system to avoid power outage

The reference flow is represented by the whole mass of the UPS object of the study, equal to 5808,399 kg, also considering the total mass of packaging needed for its distribution, equal to 343,111 kg. Items needed for the maintenance during the use phase of the UPS object of the study are also included, resulting in a total mass of 10,400 kg.

Product category: UPS with P > 10000W.

CONSTITUENT MATERIALS

Material	Incidence
Plastics	**2,4%**
PP	0,9%
Silicon	0,4%
PL	0,4%
PU foam	0,2%
Other plastics	0,5%
Metals	**63,1%**
Steel	38%
Copper	17,9%
Aluminium	7,1%
Other metals	0,1%
Others	**28,9%**
Inductors	13,4%
Capacitors	2,4%
Small electronic parts	2%
Insulators	1,7%
Fans	1,6%
Cables	0,1%
Other electronic parts	7,7%
Packaging	**5,6%**
Wood	3,8%
Carton	1,7%
Steel	0,1%
PE	<0,1%

LIFE CYCLE ASSESSMENT

The system boundaries include all the stages with an approach "from cradle to grave". According to the PCR adopted for this study, sub-modules according to EN 15804:2012+A2:2019 (A1-A3, A4, A5, B1-B7, C1-C4) have been also adopted as reference for results reporting.

B3 (Repair), B4 (Replacement), B5 (Restoration), B6 (Energy requirements during the use stage), B7 (Water requirements during the use stage) are considered with null contribution since they refer to operations not occurring/negligible.

❖ MANUFACTURING STAGE (A1 - A3)

Extraction of raw materials and processing of secondary materials used as inputs: quantities of raw materials (metals, plastics, resins, etc.) used to produce the UPS were provided by the Vertiv Srl purchasing department. This module also includes generation of electricity, heat and auxiliary energy used by the three assembling plants according to the below configuration:

- Novè Mesto (Slovakia): assembling of 10B14749GF – Core, 10B14749GI16 - Module Boost, 10B14763GD10 - Module IR, 10B14757G1R - Core Disconnector
- Ferrara (Italy): assembling of TCB3VA000010000, 10B14758G1 - Box STS, TCB3VB00A200000, 10B14758G202 - Box IO
- Poggio Piccolo (Italy): final assembling of the whole UPS.

Transport: from suppliers first to the assembling plants (Ferrara and Novè Mesto) and then to Vertiv Srl plant (Poggio Piccolo) for the final assembling: according to the purchase volume of the respective suppliers. This module includes transportation (by truck and/or ship) of raw materials and packaging from the place of production to the two intermediate assembling plant (Ferrara and Novè Mesto) and then to the final assembling plant (Poggio Piccolo).
Production: the production of the final product is represented basically by assembling operations performed manually, with a not significant consumption of auxiliaries like lubricants and detergents for the general maintenance of the plant. This module also includes the production of packaging (pallet, label, rivet and pack kit) while wastes, because of their low significance since they are related to minor packaging disposed at the whole plant level, have been excluded (cut-off).
Energy modelling was performed according to the different plant location:

- Nové Mesto (Slovakia): Electricity, medium voltage {SK}| market for | Cut-off, U
- Ferrara and Poggio Piccolo (Italy): Electricity, medium voltage {IT}| market for | Cut-off, U

❖ DISTRIBUTION STAGE (A4)

Distribution to the place of operation: transportation to the market destination involves one single final costumer of the UPS which is placed in France (Paris). A value of 1100 km from the final costumer has been adopted, while the dataset "Transport, freight, lorry, unspecified {RoW}| market for transport, freight, lorry, unspecified | Cut-off, U"

❖ INSTALLATION STAGE (A5)

Installation: this module includes operations (manual and through machine like electrical forklift) required to install the UPS. An electrical forklift operating for 1 hour and modelled with the dataset "Electricity, medium voltage {FR}| market for | Cut-off, U" was assumed for the handling of the UPS

modules through the electrical forklift. Moreover, packaging wastes produced were also considered in this stage.

❖ USE STAGE (B1 - B7)

Use or application of the installed product: UPS average energy consumption during the use phase, according to the RSL of 15 years, has been calculated. The electricity consumption was modelled adopting the dataset "Electricity, medium voltage {FR}| market for | Cut-off, U". The average efficiency used for the calculation is 0,97, while the average energy consumption calculated over the RSL of the equipment is 5.592.713 kWh.

Maintenance: for the UPS object of the study substitution of specific components have been considered together with the specific frequency expected according to primary data from Vertiv Srl. During the RSL of the UPS some components such as capacitors and fans must be replaced several times according to the information in the following table to ensure optimal performances of the UPS.

Component	Frequency (n°)
10H42088P01 - CAPACITOR 275VAC 100UF 80NET	1
10B42052P06 - CAP 4700UF 450VDC ELECTROLYTIC	1
60019845 - CAP 4700UF 450VDC ELECTROLYTIC	1
10H46756P03 - FAN EV1 48VDC 36,48W 5,85A (MOD BOOST)	2
10H46756P03 - FAN EV1 48VDC 36,48W 5,85A (MOD I-R)	2
10B48250P6 - FAN 1PH 230V 200W 1520 R ECOFIT + CAP	2

❖ END-OF-LIFE STAGE (C1 - C4)

Deinstallation: it includes unbolting and disconnecting the cable (manually), as well as moving the UPS modules with an electric forklift. The electricity consumption was modelled adopting the dataset "Electricity, medium voltage {FR}| market for | Cut-off, U".

Transport to the waste treatment site: this module considers the transportation from the installation place to the waste treatment plant. Default local transportation scenario has been considered. Treatment of waste in view of its reuse, recovery and/or recycling: this module includes process involved in separation and preparation of the different UPS material fractions.

Disposal: this module includes landfilling of the residual fractions (not recyclable).The recycling rate is 66% obtained according to IEC/TR 62635:2012.

MAIN METHODOLOGICAL ASPECTS

Software: SimaPro v. 9.3.0.3
Database: Ecoinvent v. 3.8.

Primary data: bill of materials of the UPS (type and quantity); packaging used for the final distribution; location of the main suppliers; location of the three assembling plants; location of the final costumer; list of spare parts needed to ensure the use of the UPS during its service life.

Time representativeness: primary data cover a period of 12 months (January 2020 - December 2020). When general data and existent databases were used, the most recent available versions of them were chosen (not older than 10 years).

Geographical representativeness: data refer as much as possible to the specific geography context. Each electricity consumption is site specific, as well as transportations from many suppliers to the assembling plants and then to the installation site. Moreover, specific national French context was adopted for the downstream modelling.

Technological representativeness: data collected refer to the state of the art of the technologies used to produce materials of the UPS, as well as to perform other operations like transportations, electricity production and waste treatment.

ENVIRONMENTAL IMPACT RESULTS

Impact category	Unit	Manufacturing (A1-A3)	Distribution (A4)	Installation (A5)	Use (B1-B7)	End of life (C1-C4)	TOTAL
GWP-total	kg CO2 eq	1,027E+05	9,373E+02	8,968E+02	4,750E+05	1,246E+03	5,807E+05
GWP-fossil	kg CO2 eq	1,018E+05	9,349E+02	4,434E+02	4,470E+05	1,118E+03	5,514E+05
GWP-biogenic	kg CO2 eq	6,860E+02	1,998E+00	4,534E+02	2,767E+04	1,284E+02	2,894E+04
GWP-luluc	kg CO2 eq	1,575E+02	3,994E-01	4,965E-02	2,465E+02	4,645E-01	4,049E+02
ODP	kg CFC11 eq	5,695E-03	2,072E-04	9,586E-05	4,715E-02	2,426E-04	5,339E-02
AP	mol H+ eq	1,343E+03	5,150E+00	2,814E+00	2,181E+03	6,563E+00	3,538E+03
EP-freshwater	kg P eq	1,411E+02	7,319E-02	8,901E-03	1,096E+02	1,028E-01	2,509E+02
EP-marine	kg N eq	1,507E+02	1,801E+00	1,189E+00	5,750E+02	2,321E+00	7,311E+02
EP-terrestrial	mol N eq	1,688E+03	1,969E+01	1,242E+01	4,279E+03	2,546E+01	6,025E+03
POCP	kg NMVOC eq	6,587E+02	5,655E+00	4,364E+00	1,171E+03	7,745E+00	1,847E+03
ADP-minerals & metals	kg Sb eq	3,795E+01	3,124E-03	4,047E-04	4,469E+00	5,754E-03	4,243E+01
ADP-fossil	MJ	1,314E+06	1,402E+04	6,229E+03	6,455E+07	1,679E+04	6,590E+07
WDP	m3 depriv.	4,845E+04	5,099E+01	6,069E+00	1,528E+05	7,850E+01	2,014E+05

INVENTORY FLOWS INDICATORS

Impact category	Unit	Manufacturing (A1-A3)	Distribution (A4)	Installation (A5)	Use (B1-B7)	End of life (C1-C4)	TOTAL
RESOURSE USE							
Renewable primary energy as energy carrier (PERE)	MJ	1,58E+05	2,06E+02	4,70E+01	4,74E+06	3,59E+02	4,90E+06
Renewable primary energy resources as material utilization (PERM)	MJ	2,56E+04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,56E+04
Total use of renewable primary energy resources (PERT)	MJ	1,84E+05	2,06E+02	4,70E+01	4,74E+06	3,59E+02	4,93E+06
Non renewable primary energy as energy carrier (PENRE)	MJ	1,31E+06	1,40E+04	6,23E+03	6,45E+07	1,68E+04	6,59E+07
Non renewable primary energy as material utilization (PENRM)	MJ	4,44E+03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	4,44E+03
Total use of non renewable primary energy resources (PENRT)	MJ	1,31E+06	1,40E+04	6,23E+03	6,45E+07	1,68E+04	6,59E+07
Use of secondary material (SM)	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Use of renewable secondary fuels (RSF)	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Use of non renewable secondary fuels (NRSF)	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Use of net fresh water (FW)	m3	1,50E+03	1,53E+00	3,44E-01	1,84E+04	2,45E+00	1,99E+04
WASTE CATEGORIES							
Hazardous waste disposed (HWD)	kg	1,06E+01	3,59E-02	1,62E-02	9,46E+00	4,25E-02	2,02E+01
Non hazardous waste disposed (NHWD)	kg	1,89E+04	9,21E+02	2,98E+02	8,37E+04	6,65E+03	1,10E+05
Radioactive waste disposed (RWD)	kg	3,75E+00	9,11E-02	4,53E-02	8,59E+02	1,12E-01	8,63E+02
OUTPUT FLOWS							
Components for re-use (CRU)	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Materials for recycling (MFR)	kg	0,00E+00	0,00E+00	1,18E+02	0,00E+00	3,83E+03	3,95E+03
Materials for energy recovery (MER)	kg	0,00E+00	0,00E+00	7,70E+01	0,00E+00	0,00E+00	7,70E+01
Exported energy (EE)	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

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Independent verification of the declaration and data, in compliance with ISO 14025:2010	
Internal □	External ✓
The PCR review was conducted by a panel of experts chaired by Philippe Osset (SOLINNEN)	
PEP is compliant with XP C08-100-1: 2016 The elements of the present PEP cannot be compared with elements from another program.	
Document in compliance with ISO 14025:2010 «Environmental labels and declarations. Type III environmental declarations»	