

**Jiangsu Sieyuan Hertz Instrument Transformer  
Co., Ltd**



**ENVIRONMENTAL PRODUCT DECLARATION**

**Product Name: Instrument Transformer-Current  
Transformer**

**Site Plant: Rugao, Jiangsu Province, China**

**in compliance with ISO 14025 and EN 15804**

<b>Program Operator</b>	EPD Italy
<b>Publisher</b>	EPD Italy
<b>Declaration Number</b>	QG / SH 17108-A
<b>EPDItaly Registration Number</b>	EPDITALY0216
<b>Issue Date</b>	2021/12/12
<b>Valid to</b>	2026/12/12



# 1. GENERAL INFORMATIONS

EPD OWNER:	Jiangsu Sieyuan Hertz Instrument Transformer Co., Ltd Add: No.5 West Huimin Road Jiangsu Province, 226500 P.R.China
PRODUCT NAME:	Instrument transformer_ Current transformer
PRODUCTION SITE:	No.5 West Huimin Road Jiangsu Province, 226500 P.R.China
FIELD OF APPLICATION:	High Voltage Power station
PROGRAM OPERATOR:	EPDITALY ( <a href="http://www.epditaly.it">www.epditaly.it</a> ) Add: via Gaetano De Castillia n° 10 - 20124 Milano, Italy
CPC CODE:	4622 – “Part of electricity distribution or control apparatus”
COMPANY CONTACT:	Mr. Zhai Yong (zy.91006@sieyuan.com)
EXTERNAL AUDIT:	This declaration has been developed referring to EPDItaly, following the General Program Instruction; further information and the document itself are available at: <a href="http://www.epditaly.it">www.epditaly.it</a> .  Independent verification of the declaration and data, according to EN ISO 14025:2010.  <input type="checkbox"/> INTERNAL <input checked="" type="checkbox"/> EXTERNAL  Third party verifier: ICMQ S.p.A., via Gaetano De Castillia n° 10 - 20124 Milano, Italia. Accredited by Accredia
LCA Consultant	This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:  Ecovane Environmental Co., Ltd ( <a href="http://www.1mi1.org">www.1mi1.org</a> / <a href="http://www.ecovane.cc">www.ecovane.cc</a> )
PRODUCT CATEGORY RULES (PCR):	EPDItaly007: <i>Electronic and electrical products and systems</i> (October, 2020, Revision REV.2)
COMPARABILITY:	EPDs from different programs may not be comparable. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.
LIABILITY:	The owner of the declaration will be responsible for the information and supporting evidence. EPDItaly disclaims any liability regarding the manufacturer's information data.
REFERENCE DOCUMENT:	This declaration is based on the EPDItaly regulation (Regulation EPDItaly rev.5), available on the website <a href="http://www.epditaly.com">www.epditaly.com</a>  The standard EN 50693 :2019 “Product category rules for life cycle assessments of electronic and electrical products and systems” is also used as a reference.
OTHER USEFUL REFERENCE	PCR EPDItaly018 – Power transformers v.3.4 (2021/04/12)

## 2. COMPANY INTRODUCTION

Jiangsu Sieyuan Hertz Instrument Transformer Co., Ltd is a high & new-tech enterprise established in Jiangsu Rugao Economic Development Zone by Sieyuan Electric Co., Ltd (a listed company in Shenzhen Stock Exchange, stock 002028) and Hongkong Hertz Investment company. The company mainly produces all kinds of high-voltage current and voltage transformers (35~1000kV). Now it has more than 500 employees, and 40% engineers and technicians. The company is engaged in the production of various high voltage current and voltage transformers, which are widely used in electric power, metallurgy, petrochemical and traffic departments.

Sieyuan Hertz continues to expand the industrial chain, at present, the group has more than a dozen manufacturing entities, distributing in Shanghai, Rugao, Changzhou, Nanjing, etc. The product is covered in the field of ultra-high voltage, high voltage switchgear, transformer, relay protection and automation system, reactive power compensation device, measuring and monitoring device, power electronics equipment and vehicle electronics.



Figure 1-1 Sieyuan Hertz Instrument Transformer Co., Ltd

## 3. SCOPE AND TYPE OF EPD

### 3.1 Scope of EPD

The entire life cycle stages of the product (type of EPD: « cradle-to-grave ») are considered in the LCA study, which include all stages from extraction of raw materials, manufacturing, transportation and installation, maintenance and end-of-life. Table 3-1 below shows the various stages that are included in this LCA study. The terms of defining life cycle stages from the core PCR, EN15804 and EN50693 are adopted and shown respectively.

Table 3-1 Life Cycle Stages

Include	Life cycle stages according to PCR	Life cycle stages according to EN50693	Included (X) or not declared (ND)	Life cycle stages according to EN15804
d				

	Upstream module	Manufacturing Stage	X	A1	Raw material supply
			X	A2	Transport (to the manufacturer)
	Core module		X	A3	Manufacturing
	Downstream module	Distribution Stage	X	A4	Transport
		Installation Stage	X	A5	Construction - installation process
		Use Stage	X	B1	Use
			ND	B2	Maintenance
			ND	B3	Repair
			ND	B4	Replacement
			ND	B5	Refurbishment
			ND	B6	Operational energy use
		ND	B7	Operational water use	
		De-installation Stage	X	C1	De-construction and demolition
	End-of-life Stage	X	C2	Transport (to waste processing)	
		X	C3	Waste processing	
		X	C4	Disposal	
	<b>Note: X=Declared Module, ND=Module not Declared in this LCA study</b>				

## 3.2 Type of EPD

This EPD is a product specific EPD. The declaration covers in total 11 series of instrument transformer type current transformer, including LVB-31.5, LVB-40.5, LVB-72.5, LVB-126, LVB-145, LVB-170, LVB-245, LVB-300, LVB-363, LVB-420 and LVB-550.

## 3.3 Geographical Validity

The instrument transformers that are analyzed within this study are manufactured in one factory located in Rugao, Jiangsu Province. The reference market is "global".

## 3.4 Database used

In this study, generic data for materials, energy as well as waste disposal and transportation were taken from the LCI-database Ecoinvent 3.7 with adaptation of regional energy and material data by Ecovane.

## 3.5 Software

For the modeling and calculation, the LCA-software SimaPro 9.2 was used.

# 4. DETAILED PRODUCT DESCRIPTION

## 4.1 Description of the Product

Sieyuan Electric produces more than a dozen series of instrument transformer. Within this project, in total there are 11 series of instrument transformer that were analyzed, including LVB-31.5, LVB-40.5, LVB-72.5, LVB-126, LVB-145, LVB-170, LVB-245, LVB-300, LVB-363, LVB-420 and LVB-550.

The Sieyuan Hertz current transformers has the following features:

- Primary coil has a through-type conducting rod structure with good dynamic and thermal stability; its maximum thermal current can be up to 63kA/3s;
- The measurement precision can be up to 0.2s and 0.1s;
- Secondary coil is fixed in a n aluminum shielded-case by casting organic materials, secondary measurement and protection circuits can be safer and reliable;
- Partial discharge test is carried out underpower  $t=f$  frequency test voltage, the result is better than the requirements of IEC;
- Use the automatic vacuum drying treatment system produced by LEYBOLD in Germany. The dielectric dissipation factor of complete product is less than 0.3%;
- The outer insulation is made of high strength porcelain bushing, and the optimized design is combined with the field strength along the surface and the lower internal casing field strength so that the porcelain sleeve is free from explosion;
- The secondary terminal box is overall Aluminum alloy casting molding, sealing structure. Of dustproof and waterproof and breathable.
- The connection between the outer shell of the product is made by argon arc welding, and the whole body is assembled and charged with high pressure nitrogen leak detection, which fundamentally solves the oil leakage problem of the oil immersed

product;

- The aluminum alloy casting shell, base, junction box, stainless steel nameplate expander, all parts will never rust.
- The product is free of maintenance.

## 4.2 Technical Data

Table 4-1 Technical Data

Current transformer	Nominal voltage U(kV)	Highest voltage for Equipment Um (kV)	Nominal voltage/frequency (Hz)	International standard
LVB-31.5	27.5	31.5	50/60	IEC 61869-2
LVB-40.5	35	40.5	50/60	IEC 61869-2
LVB-72.5	66	72.5	50/60	IEC 61869-2
LVB-126	110/115	126	50/60	IEC 61869-2
LVB-145	132/138	145	50/60	IEC 61869-2
LVB-170	150	170	50/60	IEC 61869-2
LVB-245	220/230	245	50/60	IEC 61869-2
LVB-300	275	300	50/60	IEC 61869-2
LVB-363	330	363	50/60	IEC 61869-2
LVB-420	400	420	50/60	IEC 61869-2
LVB-550	500	550	50/60	IEC 61869-2

## 4.3 Material Composition

Table 4-2 Material Composition

	Unit	LVB-31.5	LVB-40.5	LVB-72.5	LVB-126/145	LVB-170	LVB-245	LVB-300	LVB-363	LVB-420	LVB-550
Total weight (packaging excluded)	kg	136	170	200	250	350	500	980	1200	1400	2600
<b>Raw materials</b>											
Bushing	kg	24	32	60	75	135	194	240	425	425	1200
Copper	kg	8	11	10	25.6	28.3	30	90	50	87	110
Paper	kg	19	25	23	30	40	62	100	110	136	150
Transformer oil	kg	28	34	40	45	52	98	120	330	400	550
Silicon steel	kg	26.3	26.7	25.8	29.3	35.4	28.1	268.8	100.8	166.2	200
Cast aluminum	kg	21.7	29	29	29	38	60	110	110	110	250
Stainless steel	kg	3	4.5	4.5	4.5	4.5	6	15	15	20	25
<b>Auxiliary materials</b>											
Dacron cloth	kg	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
Polyester cloth	kg	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Ethanol	kg	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
<b>Packaging materials</b>											
Wood box	kg	50	95	118	150	185	230	245	960	330	1066
Iron nails	kg	1	1	1	1	1	1	1	1	1	1

## 4.4 System boundaries

The instrument transformer products under study includes 11 series models. All of them are manufactured following the same manufacturing processes.

The system boundary considered in this LCA study is from cradle to grave, with the exception of using phase. According to the PCR, the life cycle stage must refer to segmentation in the following three modules:

### 1. Upstream module

The upstream includes the acquisition of raw materials, including waste recycling processes and the production of semi-finished and ancillary products(A1), and transportation of raw materials to the manufacturing company (A2).

### 2. Core module

The core module describes all the activities that are managed directly by the client, whose established reference is located in Rugao city, Jiangsu province. The module includes the manufacturing of the product constituents, including all the stages, product assembly, products packaging and waste recycling processes after the production (A3).

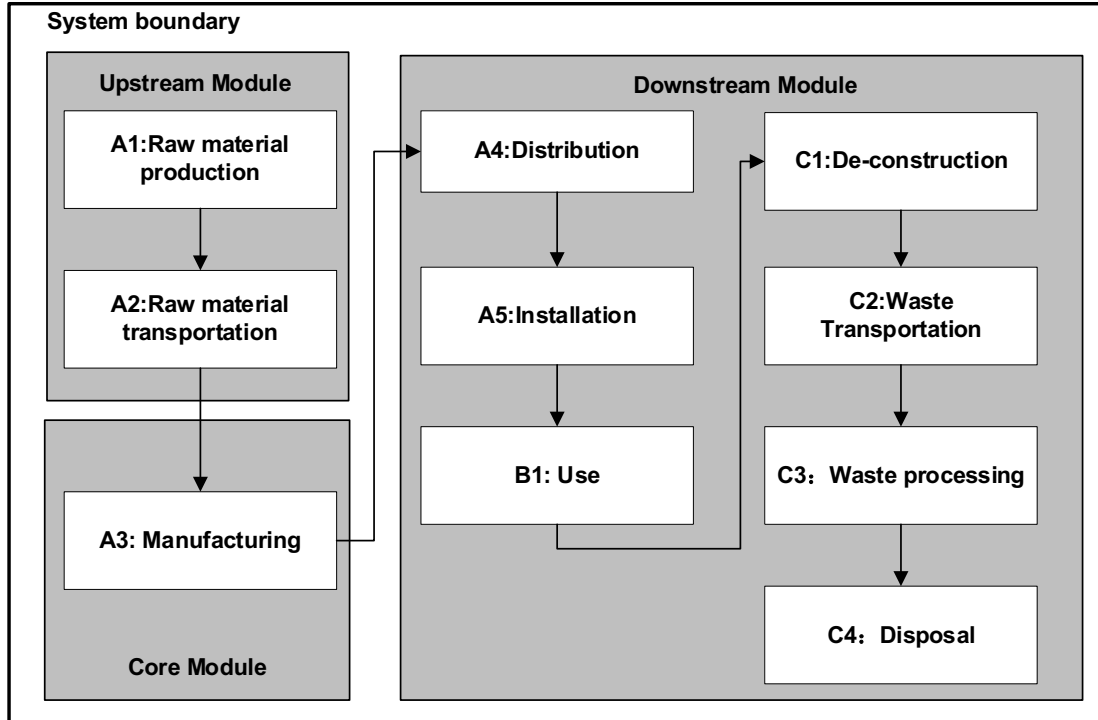
### 3. Downstream module

The downstream module is divided into four phases: distribution stage (A4), installation stage (A5), Use & Maintenance stage (B1-B7) and End-of-life stage (C1-C4). Since it will take 35 years to enter the end-of-life stage for instrument transformer, scenarios have to be developed for end-of-life treatment. For simplification purpose, assumption is made during the modeling of downstream module, see section 6.2 for excluded processes.

Figure 1 below illustrates the system boundaries for Sieyuan Hertz instrument transformer products, including raw material production and transportation, manufacturing, distribution, installation and End-of-life.



Figure 4-1 System boundary



#### 4.5 Distribution

The distribution of instrument transformers is included in the study. The type of transportation and distance are collected and calculated from their real market share.

#### 4.6 Installation

During the installation stage, since there is no primary data, an assumption is made by assuming that the high voltage electrical equipment is installed by a crane with the power of 50kW for 1 hour, thus the power consumption is 50kWh.

#### 4.7 Use & Maintenance

During the operation of its reference service of life, several types of losses occur during its operation. There are generally two kinds of losses considered in this assessment, Load losses, which refers to the losses caused by the winding impedance and vary according to the loading on the transformer. They shall be calculated at rated frequency and temperature; No load losses, which refers to the active power absorbed by the transformer when the machine is energized, and the secondary circuit is open. All the losses specified is computed and calculated according to IEC 60076-1 technical standard. The calculation formula is depicted below:

$$E_d[kWh] = [P_{load} * k_{load} + P_{noload}] * t_{year} * RSL + P_{aux} * f_{aux} * t_{year} * RSL$$

where:

$P_{load}$  is the load loss of the transformer at 75 °C reference temperature at nominal power. It is expressed in kW;

$k_{load}$  represents an average load factor for the equipment. For calculations based on this PCR, 70% of nominal power shall be adopted;

$P_{noload}$  is the power dissipated in case no losses shall occur. It is expressed in kW;

$P_{aux}$  is the power loss due to auxiliary activities at no load (such as cooling), it is expressed in

kW;

$f_{aux}$  represents the fraction of time in which ancillary equipment is operating. It is expressed in % over 1 year;

$t_{year}$  is the total amount of hours during a year. For this calculation, 8 760 hours shall be considered;

RSL represents the Reference Service Life, defined as 35 years for EPDs based on this PCR.

Table 5-10 listed the nominal current and resistance for each product, and  $P_{load}$  is calculated by the following formula:

$$P_{load} = I_1^2 \times R_1 + I_2^2 \times R_2$$

Table 4-3 Nominal current and resistance for each product

Current transformer	$I_1$	$R_1/\Omega$	$I_2$	$R_2/\Omega$	$P_{load}/kW$
LVB-31.5	5	1.24	-	-	0.031
LVB-40.5	5	1.24	-	-	0.031
LVB-72.5	1	25.94	-	-	0.02594
LVB-126/145	5	2.28	-	-	0.057
LVB-170	1	85.41	-	-	0.08541
LVB-245	1	67.02	-	-	0.06702
LVB-300	1	67.02	-	-	0.06702
LVB-363	1	80.63	-	-	0.05532
LVB-420	1	80.15	-	-	0.08015
LVB-550	1	107.88	-	-	0.10788

Table 4-4 Energy losses for each product

Current transformer	$P_{load}/kW$	$P_{noload}/kW$	$P_{aux}/kW$	$E_d/kWh$
LVB-31.5	0.031	0	0	6653
LVB-40.5	0.031	0	0	6653
LVB-72.5	0.02594	0	0	5567
LVB-126/145	0.057	0	0	12233
LVB-170	0.08541	0	0	18331
LVB-245	0.06702	0	0	14384
LVB-300	0.06702	0	0	14384
LVB-363	0.05532	0	0	11873
LVB-420	0.08015	0	0	17202
LVB-550	0.10788	0	0	23153

The table above listed the load losses, no load losses, and the calculated energy losses during the RSL for each product.

## 4.8 Reference Service Life

To ensure the comparability among EPDs of different products, a consistent reference service life shall be adopted to report the environmental impacts generated by the product during its life cycle. According to the PCR, the RSL for instrument transformers is defined as 35 years.

#### 4.9 End-of-life

For the end-of-life stage, De-construction (C1) of the electric products during the end-of-life stage is assumed mainly consuming electricity, and the electricity consumption is assumed the same as the installation stage (A5), 200km transportation distance from facility site to waste treatment site (C2) is assumed, waste processing (C3) stage is modeled using general processing data from Ecoinvent database. For end-of-life disposal treatment process (C4), there is lack of existing data of recycling rate vs. disposal rate for instrument transformer. Thus, this study refers to IEC/TR 62635 guidelines, for steel, stainless steel, aluminum, and copper, the recycling rate is 95% as listed below. Therefore, 5% of the metal components will end up in incineration treatment. As for bushing, it is assumed that all of them will end up in landfill as they are inert materials and the recycling of them has no obvious benefit. As for wastepaper and transformer oil, incineration without energy recovery is assumed in this study.

Table 4-5 End-of-life and treatment scenarios

Components	Recycling rate	Disposal rate	Treatment
Steel	95%	5%	Incineration without energy recovery
Stainless steel	95%	5%	Incineration without energy recovery
Copper	95%	5%	Incineration without energy recovery
Aluminum	95%	5%	Incineration without energy recovery
Paper	80%	20%	Incineration without energy recovery
Transformer oil	0	100%	Incineration without energy recovery
Bushing	0	100%	Land fill

## 5. LCA RESULTS

This LCA follows the requirements of PCR EPDItaly007: Electronic and electrical products and systems and uses the recommended impact analysis method for the calculation. Environmental impact indicators follow the characterization factors as stated in EN 15804:2012+A2:2019.

Table 5-1 LCA Results- Environmental impacts for LVB-31.5

Environmental Impacts	Unit	Upstream		Core	Downstream						
		A1	A2	A3	A4	A5	B1	C1	C2	C3	C4
GWP, t	kg CO2 eq.	6.02E+02	1.52E+01	1.47E+02	9.26E+00	4.15E+01	5.53E+03	4.15E+01	4.57E+00	7.98E+00	8.67E+01
GWP, f	kg CO2 eq.	7.37E+02	1.52E+01	1.48E+02	9.27E+00	4.19E+01	5.57E+03	4.19E+01	4.57E+00	8.09E+00	8.07E+01
GWP, b	kg CO2 eq.	-1.36E+02	-2.15E-02	-1.09E+00	-1.71E-02	-3.33E-01	-4.43E+01	-3.33E-01	-6.13E-03	-1.12E-01	6.00E+00
GWP, luluc	kg CO2 eq.	1.03E+00	4.05E-03	2.90E-03	1.09E-03	8.78E-04	1.17E-01	8.78E-04	8.33E-04	4.40E-04	6.69E-03
ODP	kg CFC-11 eq.	5.68E-05	2.58E-06	2.25E-06	1.63E-06	2.00E-07	2.66E-05	2.00E-07	8.05E-07	1.25E-07	3.05E-07
AP	mol H+ eq.	1.05E+01	4.66E-02	8.00E-01	8.89E-02	2.85E-01	3.79E+01	2.85E-01	1.38E-02	5.16E-02	1.80E-02
EP	kg P eq.	1.47E+00	9.21E-04	1.88E-02	3.88E-04	5.77E-03	7.67E-01	5.77E-03	2.09E-04	1.49E-03	6.67E-03
POCP	kg NMVOC eq.	3.85E+00	3.40E-02	3.52E-01	4.10E-02	1.40E-01	1.86E+01	1.40E-01	1.08E-02	2.42E-02	1.33E-02
ADPE	kg Sb eq.	5.10E-01	1.48E-03	9.57E-04	2.86E-04	3.59E-04	4.77E-02	3.59E-04	2.94E-04	5.81E-04	2.99E-03
ADPF	MJ	8.92E+03	2.16E+02	1.29E+03	1.38E+02	3.16E+02	4.20E+04	3.16E+02	6.65E+01	6.45E+01	2.21E+01
WDP	m3 eq.	3.30E+02	1.18E+00	6.33E+00	7.98E-01	1.69E+00	2.25E+02	1.69E+00	3.65E-01	4.25E-01	-3.25E+00

Table 5-2 LCA Results- Environmental impacts for LVB-40.5

Environmental Impacts	Unit	Upstream		Core	Downstream						
		A1	A2	A3	A4	A5	B1	C1	C2	C3	C4
GWP, t	kg CO2 eq.	6.97E+02	1.99E+01	1.50E+02	1.16E+01	4.15E+01	5.53E+03	4.15E+01	5.71E+00	9.98E+00	1.06E+02
GWP, f	kg CO2 eq.	9.35E+02	2.00E+01	1.52E+02	1.16E+01	4.19E+01	5.57E+03	4.19E+01	5.71E+00	1.01E+01	9.81E+01
GWP, b	kg CO2 eq.	-2.39E+02	-2.81E-02	-1.12E+00	-2.13E-02	-3.33E-01	-4.43E+01	-3.33E-01	-7.67E-03	-1.40E-01	7.90E+00
GWP, luluc	kg CO2 eq.	1.40E+00	5.31E-03	2.98E-03	1.37E-03	8.78E-04	1.17E-01	8.78E-04	1.04E-03	5.50E-04	7.96E-03
ODP	kg CFC-11 eq.	7.61E-05	3.38E-06	2.31E-06	2.04E-06	2.00E-07	2.66E-05	2.00E-07	1.01E-06	1.56E-07	3.79E-07
AP	mol H+ eq.	1.39E+01	6.11E-02	8.20E-01	1.11E-01	2.85E-01	3.79E+01	2.85E-01	1.72E-02	6.45E-02	2.30E-02
EP	kg P eq.	1.99E+00	1.21E-03	1.93E-02	4.85E-04	5.77E-03	7.67E-01	5.77E-03	2.62E-04	1.86E-03	8.32E-03
POCP	kg NMVOC eq.	4.97E+00	4.46E-02	3.61E-01	5.13E-02	1.40E-01	1.86E+01	1.40E-01	1.35E-02	3.03E-02	1.68E-02

ADPE	kg Sb eq.	6.81E-01	1.94E-03	9.81E-04	3.58E-04	3.59E-04	4.77E-02	3.59E-04	3.68E-04	7.26E-04	3.99E-03
ADPF	MJ	1.14E+04	2.84E+02	1.32E+03	1.72E+02	3.16E+02	4.20E+04	3.16E+02	8.31E+01	8.06E+01	2.81E+01
WDP	m3 eq.	4.17E+02	1.55E+00	6.49E+00	9.97E-01	1.69E+00	2.25E+02	1.69E+00	4.56E-01	5.31E-01	-3.87E+00

Table 5-3 LCA Results- Environmental impacts for LVB-72.5

Environmental Impacts	Unit	Upstream		Core	Downstream						
		A1	A2	A3	A4	A5	B1	C1	C2	C3	C4
GWP, t	kg CO2 eq.	7.08E+02	2.49E+01	1.54E+02	1.36E+01	4.15E+01	5.53E+03	4.15E+01	6.71E+00	1.17E+01	1.23E+02
GWP, f	kg CO2 eq.	9.91E+02	2.50E+01	1.55E+02	1.36E+01	4.19E+01	5.57E+03	4.19E+01	6.72E+00	1.19E+01	1.15E+02
GWP, b	kg CO2 eq.	-2.84E+02	-3.49E-02	-1.14E+00	-2.51E-02	-3.33E-01	-4.43E+01	-3.33E-01	-9.02E-03	-1.65E-01	7.26E+00
GWP, luluc	kg CO2 eq.	1.40E+00	6.24E-03	3.05E-03	1.61E-03	8.78E-04	1.17E-01	8.78E-04	1.22E-03	6.48E-04	7.81E-03
ODP	kg CFC-11 eq.	7.63E-05	4.26E-06	2.37E-06	2.40E-06	2.00E-07	2.66E-05	2.00E-07	1.18E-06	1.83E-07	4.65E-07
AP	mol H+ eq.	1.36E+01	7.63E-02	8.41E-01	1.31E-01	2.85E-01	3.79E+01	2.85E-01	2.03E-02	7.59E-02	2.69E-02
EP	kg P eq.	1.84E+00	1.44E-03	1.98E-02	5.70E-04	5.77E-03	7.67E-01	5.77E-03	3.08E-04	2.19E-03	9.33E-03
POCP	kg NMVOC eq.	5.19E+00	5.64E-02	3.70E-01	6.04E-02	1.40E-01	1.86E+01	1.40E-01	1.59E-02	3.56E-02	2.08E-02
ADPE	kg Sb eq.	7.16E-01	2.27E-03	1.01E-03	4.21E-04	3.59E-04	4.77E-02	3.59E-04	4.33E-04	8.55E-04	4.00E-03
ADPF	MJ	1.23E+04	3.56E+02	1.35E+03	2.02E+02	3.16E+02	4.20E+04	3.16E+02	9.78E+01	9.48E+01	3.61E+01
WDP	m3 eq.	4.55E+02	1.95E+00	6.65E+00	1.17E+00	1.69E+00	2.25E+02	1.69E+00	5.36E-01	6.25E-01	-4.46E+00

Table 5-4 LCA Results- Environmental impacts for LVB-126/145

Environmental Impacts	Unit	Upstream		Core	Downstream						
		A1	A2	A3	A4	A5	B1	C1	C2	C3	C4
GWP, t	kg CO2 eq.	8.66E+02	2.98E+01	2.33E+02	1.70E+01	4.15E+01	4.63E+03	4.15E+01	8.39E+00	1.47E+01	1.40E+02
GWP, f	kg CO2 eq.	1.23E+03	2.98E+01	2.35E+02	1.70E+01	4.19E+01	4.66E+03	4.19E+01	8.40E+00	1.49E+01	1.30E+02
GWP, b	kg CO2 eq.	-3.62E+02	-4.15E-02	-1.73E+00	-3.14E-02	-3.33E-01	-3.71E+01	-3.33E-01	-1.13E-02	-2.06E-01	9.47E+00
GWP, luluc	kg CO2 eq.	1.69E+00	7.34E-03	4.61E-03	2.01E-03	8.78E-04	9.78E-02	8.78E-04	1.53E-03	8.09E-04	9.83E-03
ODP	kg CFC-11 eq.	1.06E-04	5.09E-06	3.57E-06	3.00E-06	2.00E-07	2.23E-05	2.00E-07	1.48E-06	2.29E-07	5.71E-07
AP	mol H+ eq.	2.58E+01	9.09E-02	1.27E+00	1.63E-01	2.85E-01	3.17E+01	2.85E-01	2.53E-02	9.48E-02	3.63E-02
EP	kg P eq.	4.42E+00	1.70E-03	2.99E-02	7.13E-04	5.77E-03	6.42E-01	5.77E-03	3.85E-04	2.74E-03	1.27E-02
POCP	kg NMVOC eq.	7.53E+00	6.75E-02	5.59E-01	7.54E-02	1.40E-01	1.56E+01	1.40E-01	1.99E-02	4.45E-02	2.65E-02

ADPE	kg Sb eq.	8.42E-01	2.67E-03	1.52E-03	5.26E-04	3.59E-04	3.99E-02	3.59E-04	5.41E-04	1.07E-03	4.13E-03
ADPF	MJ	1.49E+04	4.26E+02	2.04E+03	2.53E+02	3.16E+02	3.52E+04	3.16E+02	1.22E+02	1.19E+02	4.64E+01
WDP	m3 eq.	5.86E+02	2.33E+00	1.00E+01	1.47E+00	1.69E+00	1.89E+02	1.69E+00	6.70E-01	7.81E-01	-4.84E+00

Table 5-5 LCA Results- Environmental impacts for LVB-170

Environmental Impacts	Unit	Upstream		Core	Downstream						
		A1	A2	A3	A4	A5	B1	C1	C2	C3	C4
GWP, t	kg CO2 eq.	1.06E+03	4.43E+01	2.35E+02	2.38E+01	4.15E+01	1.02E+04	4.15E+01	1.18E+01	2.05E+01	1.64E+02
GWP, f	kg CO2 eq.	1.51E+03	4.43E+01	2.37E+02	2.39E+01	4.19E+01	1.02E+04	4.19E+01	1.18E+01	2.08E+01	1.51E+02
GWP, b	kg CO2 eq.	-4.52E+02	-6.14E-02	-1.75E+00	-4.39E-02	-3.33E-01	-8.15E+01	-3.33E-01	-1.58E-02	-2.88E-01	1.26E+01
GWP, luluc	kg CO2 eq.	2.14E+00	1.05E-02	4.65E-03	2.82E-03	8.78E-04	2.15E-01	8.78E-04	2.14E-03	1.13E-03	1.19E-02
ODP	kg CFC-11 eq.	1.30E-04	7.61E-06	3.60E-06	4.20E-06	2.00E-07	4.89E-05	2.00E-07	2.07E-06	3.21E-07	8.00E-07
AP	mol H+ eq.	2.96E+01	1.35E-01	1.28E+00	2.29E-01	2.85E-01	6.96E+01	2.85E-01	3.55E-02	1.33E-01	4.70E-02
EP	kg P eq.	4.93E+00	2.45E-03	3.01E-02	9.98E-04	5.77E-03	1.41E+00	5.77E-03	5.39E-04	3.83E-03	1.46E-02
POCP	kg NMVOC eq.	8.93E+00	1.01E-01	5.64E-01	1.06E-01	1.40E-01	3.42E+01	1.40E-01	2.78E-02	6.23E-02	3.57E-02
ADPE	kg Sb eq.	1.12E+00	3.81E-03	1.53E-03	7.36E-04	3.59E-04	8.78E-02	3.59E-04	7.57E-04	1.50E-03	5.37E-03
ADPF	MJ	1.83E+04	6.35E+02	2.06E+03	3.54E+02	3.16E+02	7.73E+04	3.16E+02	1.71E+02	1.66E+02	6.61E+01
WDP	m3 eq.	6.99E+02	3.47E+00	1.01E+01	2.05E+00	1.69E+00	4.14E+02	1.69E+00	9.39E-01	1.09E+00	-4.96E+00

Table 5-6 LCA Results- Environmental impacts for LVB-245

Environmental Impacts	Unit	Upstream		Core	Downstream						
		A1	A2	A3	A4	A5	B1	C1	C2	C3	C4
GWP, t	kg CO2 eq.	1.60E+03	6.32E+01	6.59E+02	3.40E+01	4.15E+01	2.39E+04	4.15E+01	1.68E+01	2.93E+01	3.03E+02
GWP, f	kg CO2 eq.	2.18E+03	6.33E+01	6.64E+02	3.41E+01	4.19E+01	2.41E+04	4.19E+01	1.68E+01	2.98E+01	2.83E+02
GWP, b	kg CO2 eq.	-5.82E+02	-8.77E-02	-4.91E+00	-6.27E-02	-3.33E-01	-1.92E+02	-3.33E-01	-2.25E-02	-4.11E-01	1.96E+01
GWP, luluc	kg CO2 eq.	3.09E+00	1.49E-02	1.30E-02	4.02E-03	8.78E-04	5.06E-01	8.78E-04	3.06E-03	1.62E-03	1.36E-02
ODP	kg CFC-11 eq.	1.73E-04	1.09E-05	1.01E-05	6.00E-06	2.00E-07	1.15E-04	2.00E-07	2.96E-06	4.58E-07	1.16E-06
AP	mol H+ eq.	3.55E+01	1.93E-01	3.60E+00	3.27E-01	2.85E-01	1.64E+02	2.85E-01	5.07E-02	1.90E-01	7.05E-02
EP	kg P eq.	5.27E+00	3.49E-03	8.44E-02	1.43E-03	5.77E-03	3.32E+00	5.77E-03	7.70E-04	5.48E-03	2.37E-02
POCP	kg NMVOC eq.	1.23E+01	1.44E-01	1.58E+00	1.51E-01	1.40E-01	8.06E+01	1.40E-01	3.98E-02	8.90E-02	5.57E-02
ADPE	kg Sb eq.	1.64E+00	5.41E-03	4.30E-03	1.05E-03	3.59E-04	2.07E-01	3.59E-04	1.08E-03	2.14E-03	8.36E-03

ADPF	MJ	2.77E+04	9.07E+02	5.79E+03	5.06E+02	3.16E+02	1.82E+05	3.16E+02	2.44E+02	2.37E+02	9.68E+01
WDP	m3 eq.	1.10E+03	4.96E+00	2.84E+01	2.93E+00	1.69E+00	9.76E+02	1.69E+00	1.34E+00	1.56E+00	-1.05E+01

Table 5-7 LCA Results- Environmental impacts for LVB-300

Environmental Impacts	Unit	Upstream		Core	Downstream						
		A1	A2	A3	A4	A5	B1	C1	C2	C3	C4
GWP, t	kg CO2 eq.	4.06E+03	1.09E+02	6.66E+02	6.67E+01	4.15E+01	1.20E+04	4.15E+01	3.29E+01	5.75E+01	3.82E+02
GWP, f	kg CO2 eq.	4.74E+03	1.09E+02	6.71E+02	6.68E+01	4.19E+01	1.20E+04	4.19E+01	3.29E+01	5.83E+01	3.50E+02
GWP, b	kg CO2 eq.	-6.82E+02	-1.52E-01	-4.96E+00	-1.23E-01	-3.33E-01	-9.58E+01	-3.33E-01	-4.42E-02	-8.06E-01	3.16E+01
GWP, luluc	kg CO2 eq.	5.62E+00	2.77E-02	1.32E-02	7.88E-03	8.78E-04	2.53E-01	8.78E-04	6.00E-03	3.17E-03	5.60E-02
ODP	kg CFC-11 eq.	3.95E-04	1.85E-05	1.02E-05	1.18E-05	2.00E-07	5.75E-05	2.00E-07	5.80E-06	8.98E-07	2.23E-06
AP	mol H+ eq.	9.27E+01	3.32E-01	3.64E+00	6.40E-01	2.85E-01	8.19E+01	2.85E-01	9.93E-02	3.72E-01	1.19E-01
EP	kg P eq.	1.60E+01	6.36E-03	8.53E-02	2.80E-03	5.77E-03	1.66E+00	5.77E-03	1.51E-03	1.07E-02	3.78E-02
POCP	kg NMVOC eq.	2.71E+01	2.45E-01	1.60E+00	2.96E-01	1.40E-01	4.03E+01	1.40E-01	7.79E-02	1.74E-01	8.34E-02
ADPE	kg Sb eq.	3.12E+00	1.01E-02	4.35E-03	2.06E-03	3.59E-04	1.03E-01	3.59E-04	2.12E-03	4.19E-03	1.57E-02
ADPF	MJ	5.26E+04	1.55E+03	5.85E+03	9.91E+02	3.16E+02	9.09E+04	3.16E+02	4.79E+02	4.65E+02	1.62E+02
WDP	m3 eq.	1.86E+03	8.48E+00	2.87E+01	5.75E+00	1.69E+00	4.87E+02	1.69E+00	2.63E+00	3.06E+00	-1.14E+01

Table 5-8 LCA Results- Environmental impacts for LVB-363

Environmental Impacts	Unit	Upstream		Core	Downstream						
		A1	A2	A3	A4	A5	B1	C1	C2	C3	C4
GWP, t	kg CO2 eq.	3.38E+03	1.46E+02	7.86E+02	8.17E+01	4.15E+01	9.86E+03	4.15E+01	4.03E+01	7.04E+01	9.83E+02
GWP, f	kg CO2 eq.	5.54E+03	1.47E+02	7.92E+02	8.18E+01	4.19E+01	9.94E+03	4.19E+01	4.03E+01	7.14E+01	9.48E+02
GWP, b	kg CO2 eq.	-2.17E+03	-2.03E-01	-5.86E+00	-1.51E-01	-3.33E-01	-7.91E+01	-3.33E-01	-5.41E-02	-9.88E-01	3.47E+01
GWP, luluc	kg CO2 eq.	6.30E+00	3.48E-02	1.56E-02	9.65E-03	8.78E-04	2.08E-01	8.78E-04	7.35E-03	3.89E-03	3.16E-02
ODP	kg CFC-11 eq.	3.40E-04	2.52E-05	1.20E-05	1.44E-05	2.00E-07	4.75E-05	2.00E-07	7.11E-06	1.10E-06	2.89E-06
AP	mol H+ eq.	7.23E+01	4.47E-01	4.29E+00	7.84E-01	2.85E-01	6.76E+01	2.85E-01	1.22E-01	4.55E-01	1.79E-01
EP	kg P eq.	9.15E+00	8.13E-03	1.01E-01	3.42E-03	5.77E-03	1.37E+00	5.77E-03	1.85E-03	1.31E-02	7.04E-02
POCP	kg NMVOC eq.	3.08E+01	3.34E-01	1.89E+00	3.62E-01	1.40E-01	3.32E+01	1.40E-01	9.54E-02	2.14E-01	1.46E-01
ADPE	kg Sb eq.	3.11E+00	1.26E-02	5.13E-03	2.52E-03	3.59E-04	8.52E-02	3.59E-04	2.60E-03	5.13E-03	1.55E-02
ADPF	MJ	7.51E+04	2.10E+03	6.91E+03	1.21E+03	3.16E+02	7.50E+04	3.16E+02	5.87E+02	5.69E+02	2.36E+02
WDP	m3 eq.	3.10E+03	1.15E+01	3.39E+01	7.04E+00	1.69E+00	4.02E+02	1.69E+00	3.22E+00	3.75E+00	-4.04E+01

Table 5-9 LCA Results- Environmental impacts for LVB-420

Environmental Impacts	Unit	Upstream		Core	Downstream						
		A1	A2	A3	A4	A5	B1	C1	C2	C3	C4
GWP, t	kg CO2 eq.	5.62E+03	1.48E+02	1.13E+03	9.53E+01	4.15E+01	2.51E+03	4.15E+01	4.70E+01	8.22E+01	1.19E+03
GWP, f	kg CO2 eq.	6.53E+03	1.49E+02	1.14E+03	9.54E+01	4.19E+01	2.53E+03	4.19E+01	4.71E+01	8.33E+01	1.15E+03
GWP, b	kg CO2 eq.	-9.14E+02	-2.05E-01	-8.40E+00	-1.76E-01	-3.33E-01	-2.01E+01	-3.33E-01	-6.31E-02	-1.15E+00	4.29E+01
GWP, luluc	kg CO2 eq.	6.13E+00	3.51E-02	2.23E-02	1.13E-02	8.78E-04	5.30E-02	8.78E-04	8.57E-03	4.53E-03	4.42E-02
ODP	kg CFC-11 eq.	3.93E-04	2.55E-05	1.72E-05	1.68E-05	2.00E-07	1.21E-05	2.00E-07	8.29E-06	1.28E-06	3.38E-06
AP	mol H+ eq.	1.04E+02	4.52E-01	6.16E+00	9.15E-01	2.85E-01	1.72E+01	2.85E-01	1.42E-01	5.31E-01	2.17E-01
EP	kg P eq.	1.53E+01	8.21E-03	1.44E-01	3.99E-03	5.77E-03	3.48E-01	5.77E-03	2.16E-03	1.53E-02	8.91E-02
POCP	kg NMVOC eq.	3.81E+01	3.39E-01	2.71E+00	4.23E-01	1.40E-01	8.44E+00	1.40E-01	1.11E-01	2.49E-01	1.72E-01
ADPE	kg Sb eq.	3.36E+00	1.27E-02	7.35E-03	2.95E-03	3.59E-04	2.16E-02	3.59E-04	3.03E-03	5.98E-03	1.59E-02
ADPF	MJ	8.61E+04	2.13E+03	9.91E+03	1.42E+03	3.16E+02	1.91E+04	3.16E+02	6.84E+02	6.64E+02	2.71E+02
WDP	m3 eq.	3.74E+03	1.16E+01	4.86E+01	8.21E+00	1.69E+00	1.02E+02	1.69E+00	3.75E+00	4.37E+00	-5.00E+01

Table 5-10 Environmental impacts for LVB-550

Environmental Impacts	Unit	Upstream		Core	Downstream						
		A1	A2	A3	A4	A5	B1	C1	C2	C3	C4
GWP, t	kg CO2 eq.	8.08E+03	3.33E+02	1.58E+03	1.77E+02	4.15E+01	1.92E+04	4.15E+01	8.73E+01	1.53E+02	1.64E+03
GWP, f	kg CO2 eq.	1.06E+04	3.33E+02	1.59E+03	1.77E+02	4.19E+01	1.94E+04	4.19E+01	8.74E+01	1.55E+02	1.59E+03
GWP, b	kg CO2 eq.	-2.49E+03	-4.58E-01	-1.18E+01	-3.26E-01	-3.33E-01	-1.54E+02	-3.33E-01	-1.17E-01	-2.14E+00	4.73E+01
GWP, luluc	kg CO2 eq.	1.15E+01	7.49E-02	3.13E-02	2.09E-02	8.78E-04	4.07E-01	8.78E-04	1.59E-02	8.42E-03	6.66E-02
ODP	kg CFC-11 eq.	7.23E-04	5.75E-05	2.41E-05	3.12E-05	2.00E-07	9.26E-05	2.00E-07	1.54E-05	2.38E-06	6.40E-06
AP	mol H+ eq.	1.48E+02	1.01E+00	8.63E+00	1.70E+00	2.85E-01	1.32E+02	2.85E-01	2.64E-01	9.86E-01	3.63E-01
EP	kg P eq.	1.99E+01	1.77E-02	2.02E-01	7.42E-03	5.77E-03	2.67E+00	5.77E-03	4.00E-03	2.85E-02	1.23E-01
POCP	kg NMVOC eq.	5.74E+01	7.66E-01	3.79E+00	7.85E-01	1.40E-01	6.48E+01	1.40E-01	2.07E-01	4.63E-01	2.98E-01
ADPE	kg Sb eq.	7.32E+00	2.70E-02	1.03E-02	5.47E-03	3.59E-04	1.66E-01	3.59E-04	5.63E-03	1.11E-02	3.50E-02
ADPF	MJ	1.37E+05	4.79E+03	1.39E+04	2.63E+03	3.16E+02	1.46E+05	3.16E+02	1.27E+03	1.23E+03	5.34E+02
WDP	m3 eq.	5.37E+03	2.62E+01	6.81E+01	1.53E+01	1.69E+00	7.84E+02	1.69E+00	6.97E+00	8.12E+00	-6.12E+01



**Caption**

1E+01 is equal to  $1 \times 10^1$

**GWP, t:** Global Warming Potential total

**GWP, f:** Global Warming Potential total

**GWP, b:** Climate change - biogenic

**GWP, luluc:** Climate change - land use and change in land use

**ODP:** Ozone Depletion

**AP:** Acidification

**EP:** Eutrophication of water

**POCP:** Photochemical ozone formation

**ADPE:** Consumption of abiotic resources - minerals and materials

**ADPF:** Consumption of abiotic resources - fossil resources

**WDP:** Water consumption



PERM	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	0.00E+00
PENRT	MJ	1.47E+04	2.84E+02	3.46E+03	1.73E+02	5.22E+02	6.95E+04	5.22E+02	8.26E+01	1.20E+02	2.89E+01
PERT	MJ	4.36E+03	4.01E+00	1.47E+02	2.85E+00	6.47E+01	8.61E+03	6.47E+01	1.03E+00	1.41E+01	2.20E+00
FW	m3	9.93E+00	3.81E-02	8.55E+00	2.54E-02	4.02E-02	5.35E+00	4.02E-02	1.14E-02	1.25E-02	-8.95E-02
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	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	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	0.00E+00
HWD	kg	0.00E+00	0.00E+00	1.02E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.80E+00
NHWD	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	4.10E+01
RWD	kg	0.00E+00	0.00E+00	3.74E-09	0.00E+00	5.87E-08	0.00E+00	5.87E-08	0.00E+00	0.00E+00	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	0.00E+00
MRF	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	1.22E+02
CRU	kg	0.00E+00	0.00E+00	0.00E+00	9.50E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ETE	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	0.00E+00
EEE	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	0.00E+00

Table 5-13 LCA Results – Resource use and waste production of LVB-72.5

Resource use/waste production	Unit	Upstream		Core	Downstream						
		A1	A2	A3	A4	A5	B1	C1	C2	C3	C4
PENRE	MJ	1.31E+04	3.57E+02	3.46E+03	2.03E+02	5.22E+02	6.95E+04	5.22E+02	9.72E+01	1.41E+02	3.72E+01
PERE	MJ	4.86E+03	4.92E+00	1.47E+02	3.35E+00	6.47E+01	8.61E+03	6.47E+01	1.22E+00	1.66E+01	2.44E+00
PENRM	MJ	2.68E+03	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
PERM	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	0.00E+00
PENRT	MJ	1.58E+04	3.57E+02	3.46E+03	2.03E+02	5.22E+02	6.95E+04	5.22E+02	9.72E+01	1.41E+02	3.72E+01
PERT	MJ	4.86E+03	4.92E+00	1.47E+02	3.35E+00	6.47E+01	8.61E+03	6.47E+01	1.22E+00	1.66E+01	2.44E+00
FW	m3	1.08E+01	4.80E-02	8.55E+00	2.98E-02	4.02E-02	5.35E+00	4.02E-02	1.34E-02	1.47E-02	-1.03E-01
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	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	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	0.00E+00
HWD	kg	0.00E+00	0.00E+00	1.02E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.00E+00
NHWD	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	6.85E+01
RWD	kg	0.00E+00	0.00E+00	3.74E-09	0.00E+00	5.87E-08	0.00E+00	5.87E-08	0.00E+00	0.00E+00	0.00E+00



Table 5-15 LCA Results – Resource use and waste production of LVB-170

Resource use/waste production	Unit	Upstream		Core	Downstream						
		A1	A2	A3	A4	A5	B1	C1	C2	C3	C4
PENRE	MJ	1.98E+04	6.35E+02	3.46E+03	3.56E+02	5.22E+02	1.28E+05	5.22E+02	1.70E+02	2.47E+02	6.88E+01
PERE	MJ	7.83E+03	8.59E+00	1.47E+02	5.87E+00	6.47E+01	1.58E+04	6.47E+01	2.13E+00	2.91E+01	4.34E+00
PENRM	MJ	3.92E+03	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
PERM	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	0.00E+00
PENRT	MJ	2.37E+04	6.35E+02	3.46E+03	3.56E+02	5.22E+02	1.28E+05	5.22E+02	1.70E+02	2.47E+02	6.88E+01
PERT	MJ	7.83E+03	8.59E+00	1.47E+02	5.87E+00	6.47E+01	1.58E+04	6.47E+01	2.13E+00	2.91E+01	4.34E+00
FW	m3	1.66E+01	8.58E-02	8.55E+00	5.22E-02	4.02E-02	9.83E+00	4.02E-02	2.34E-02	2.57E-02	-1.14E-01
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	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	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	0.00E+00
HWD	kg	0.00E+00	0.00E+00	1.02E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E+01
NHWD	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	1.49E+02
RWD	kg	0.00E+00	0.00E+00	3.74E-09	0.00E+00	5.87E-08	0.00E+00	5.87E-08	0.00E+00	0.00E+00	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	0.00E+00
MRF	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	1.90E+02
CRU	kg	0.00E+00	0.00E+00	0.00E+00	1.85E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ETE	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	0.00E+00
EEE	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	0.00E+00

Table 5-16 LCA Results – Resource use and waste production of LVB-245

Resource use/waste production	Unit	Upstream		Core	Downstream						
		A1	A2	A3	A4	A5	B1	C1	C2	C3	C4
PENRE	MJ	2.91E+04	9.07E+02	3.46E+03	5.09E+02	5.22E+02	3.01E+05	5.22E+02	2.43E+02	3.52E+02	1.02E+02
PERE	MJ	1.04E+04	1.23E+01	1.47E+02	8.38E+00	6.47E+01	3.73E+04	6.47E+01	3.04E+00	4.16E+01	5.91E+00
PENRM	MJ	6.02E+03	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
PERM	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	0.00E+00
PENRT	MJ	3.51E+04	9.07E+02	3.46E+03	5.09E+02	5.22E+02	3.01E+05	5.22E+02	2.43E+02	3.52E+02	1.02E+02











**Caption:**

1E+01 is equal to  $1 \times 10$

PENRE: Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material

PERE: Use of renewable primary energy excluding renewable primary energy resources used as raw material

PENRM: Use of non-renewable primary energy resources used as raw material

PERM: Use of renewable primary energy resources used as raw material

PENRT: Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)

PERT: Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)

FW: Net use of fresh water

SM: Use of secondary raw materials

RSF: Use of renewable secondary fuels

NRSF: Use of non-renewable secondary fuels

HWD: Hazardous landfill waste

NHWD: Non-hazardous waste disposed

RWD: Radioactive waste disposed

MER: Materials for energy recovery

MRF: Materials for energy recovery

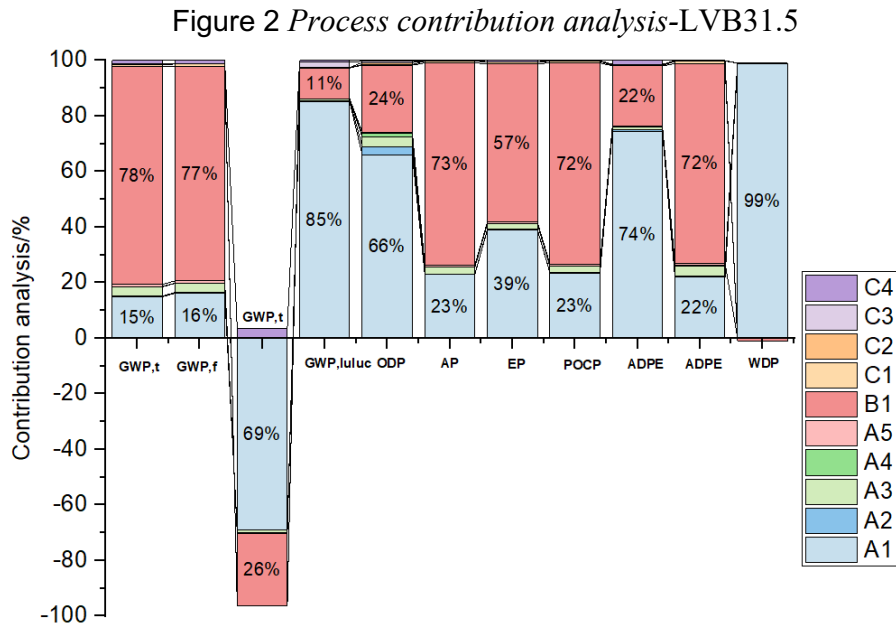
CRU: Components for reuse

ETE: Exported thermal energy

EEE: Exported electricity energy

## 6. Interpretation of the results

To analyze the contribution of processes to the environmental impact, an LCIA was conducted by using EN 15804 method. Since all the instrument transformers share similar components, an example of instrument transformer is chosen for the contribution analysis. In this case, the LVB-31.5 is chosen for representing the product type of current transformer. The process and main life cycle stage contribution results are demonstrated in the following figure.



From the contribution analysis of LVB series, it can be concluded that the use stage (B1) has the largest impact, followed by raw material production stage (A1). The high contribution of impacts from B1 stage is due to electricity consumption of the equipment operation during its service of life.

### 6.1 Declared unit

The single instrument transformer is chosen as the declared unit (UD).

### 6.2 Exclusion from the system boundaries

The following steps/stages are not included in the system boundary due to the reason that the elements below are considered irrelevant or not within the boundary to the LCA study of instrument transformer products :

- Production and disposal of the infrastructure and capital equipment (buildings, machines, transport media, roads, etc.) during instrument transformer products manufacturing, installation, and maintenance.
- Auxiliary materials such as clean agents during the manufacturing process as the consumption is extremely low.
- Emissions during the installation and operation due to no obvious emission observable;
- Storage phases and sales of electric products due to no observable impact.
- Product losses due to abnormal damage such as natural disasters or fire accidents. These

- losses would mostly be accidental.
- The recycling process of defective products as it is reused internally for manufacturing process.
  - Handling operations at the distribution center and retail outlet due to small contribution and negligible impact.
  - The scrap and general waste during the installation stage due to no observable impact.

### 6.3 Cut-off

The following procedure was followed for the inclusion and exclusion of inputs and outputs:

- All inputs and outputs to a (unit) process will be included in the calculation for which data is available. Data gaps may be filled by conservative assumptions with average or generic data. Any assumptions for such choices will be documented;
- According to PCR, data for elementary flows to and from the product system contributing to a minimum of 99% of the declared environmental impacts shall be included. Therefore, the cut off criteria was set to 1% in this study. The neglected flow is demonstrated in table 6-1.

Table 6-1 Cut off flows

Flow name	Process stage	Mass %	Criteria to cut off
Production, use and disposal of the packaging of components and semi-finished intermediates;	A3	N/A	Specified in PCR
Devices external to the product itself required for installation	A5	N/A	Cut off due to small impact according to PCR
Any extraordinary maintenance done on transformer	B	N/A	The transformer is designed not to be tampered with or modified in any way during its service life.
Inspection during operation	B	N/A	Cut off due to small impact
Water consumption	A3	N/A	Cut-off because water consumption is not related to production
Total cut off mass % estimated			<1%

## 6.4 Data quality and source

The present study was mainly based on primary data provided by the client. The primary data used in the study concerns the following information: material, weight, origin and way of transport for each component from upstream phase; energy and water consumption and waste produced in the core phase; energy dissipated in the use phase. Secondary data were modeled by using Ecoinvent 3.7 database with SimaPro9.2 software.

The data quality requirements for this study were as follows:

- Existing LCI data were, at most, 10 years old. Newly collected LCI data were current or up to 3 years old;
- The LCI data related to the geographical locations where the processes took place, e.g. electricity and transportation data from China were utilized;
- The scenarios represented the average technologies at the time of data collection.

## 6.5 Allocations

Allocation refers to partitioning of input or output flows of a process or a product system between the product systems under study and one or more other product systems. In this study, there are two types of allocation procedures considered following EN50693 specifications:

### Allocation between co-products

In the production of different series of transformer, the consumption of energy and water during manufacturing is equally allocated to via production volume as different types of the products in each series are produced in the same production line following same procedure. No other by products are produced from the production, hence there is no need to allocate the energy or water consumption with other products.

### Allocation for recovery operations

For the allocation of reuse, recycling and recovery, polluter pays principle (PPP) is followed in this report. This means that the waste transportation to the treatment site and the waste processing

(mainly shredding) is considered in this report, while the the benefit, the load from waste treatment for recycling purpose such as de-pollution and crushing and etc., is allocated to the next life cycle of substituted products, but not the primary producers, hence no burden or benefit will be allocated to the primary producer of the electric products (cut off approach).

## 6.6 Time reference

All the data relating to the core phase, which is pertinent to the Rugao production site, is refer to the annal production from Jan. 2020 to Dec. 2020.

## 6.7 Hazardous substances

The instrument transformers declared in this EPD do not contain any hazardous substances restricted by RoHS directive (2011/65/EU).

## 7 Reference

### **EPDItaly**

Regulations of the EPDItaly Programme, version 5.0

EPDItaly PCR EPDItaly018 Electronic and Electrical Products and Systems -Power transformers; rev. 3.4 of 12/04/2021;

EPDItaly PCR EPDItaly007 Electronic and Electrical Products and Systems; rev. 2 of 21/10/2020;

### **SUSTAINABILITY REPORTING STANDARDS**

European Standards. (2019). EN 15804:2012+A2:2019 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products.

European Standards. (2019). EN 50693:2019 Product category rules for life cycle assessments of electronic and electrical products and systems

ISO. (2006). ISO 14044: Environmental management - Life cycle assessment - Requirements and guidelines.

ISO. (2009). ISO 14040: Environmental management - Life cycle assessment - principles and frameworks.

ISO. (2011). ISO 14025: Environmental labels and declarations - Type III environmental declarations - principles and procedures.

IEC/TR 62635: Guidelines for end-of-life information provided by manufacturers and recyclers and for recyclability rate calculation of electrical and electronic equipment

### **LCA report**

Life cycle assessment (LCA) of Instrument Transformer (report number: PJ-SIEYUANRG-21001), by Ecovane Environmental Co., Ltd, November 2021

## 8 Contact Information

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