# Product Carbon Footprint Report

Product Name : Smart PCS

Product Model : LUNA2000-200KTL-H0

Report Number : SYBH(G-L)10094264

**Reliability Laboratory of Huawei Technologies Co., Ltd.**

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| General information | |
|---|---|
| **Report Number** | SYBH(G-L)10094264 |
| **Report Traceability** | First report |
| **Applicant** | Huawei Technologies Co., Ltd. |
| **Address** | Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.C |
| **Reference Standards** | ISO 14040 Life Cycle Assessment (LCA) –Principle and Framework<br>ISO 14044 Life Cycle Assessment (LCA) –Requirements and Guidelines<br>ETSI ES 203 199 V1.2.1 (2014-10) Environmental Engineering (EE); Methodology for environmental Life Cycle Assessment (LCA) of Information and Communication Technology (ICT) goods, networks and services |
| **Product Name** | Smart PCS |
| **Product Model** | LUNA2000-200KTL-H0 |
| **Product Description** | The Smart PCS is a modular energy storage controller that converts the DC power generated by the batteries into AC power, and then feeds that AC power into the power grid. In addition, it converts AC power from the grid to DC power and stores the DC power in the batteries. |
| **Output Power** | 340 kWh |
| **Energy Efficiency** | 98.8% |
| **Weight** | 95 kg (without packaging) |
| **Functional Unit** | The usage of one LUNA2000-200KTL-H0 for 25 years |
| **Product picture** |  |
| **Boundary** | Cradle to grave |
| **Environmental Impact Categories** | Climate Change (CC) according to ReCiPe 2016 Midpoint (H) Version 1.03 |
| **Cut off Criteria** | Raw Materials which constitute <1wt% of product weight and/or >95% of product weight included |

| | |
|---|---|
| **Software Tool** | SimaPro 9.2 |
| **Database** | ecoinvent 3.7 |
| **Method** | IPCC 2013 GWP 100a |
| **Abbreviations** | CC: Climate Change<br>GHG: Greenhouse Gas<br>PCB: Printed Circuit Board<br>PCBA: Printed Circuit Board Assembly<br>IC: Integrated Circuit<br>GWP: Global warming potential |
| **Reason for Carrying The Study** | Market requirements |
| **Target Audience(S)** | Client |
| **Result and Interpretation** | |
| **GWP Emissions** | 3622.9 kg $CO_{2\ eq}$ |
| **Identification of Hot Spots** | Raw materials acquisition and production stage |
| **Conclusion** | Raw materials acquisition and production stage contributes 80.5% of CC (more details see chapter 4). |

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|---|---|---|---|
| **Prepared by:** | 2022-06-28 | Li Yeshuang | |
| | Date | Name | Signature |
| **Approved by Senior Engineer:** | 2022-06-28 | Zhang Jiaojiao | |
| | Date | Name | Signature |

# Content

# 1 Goal and Scope Definition

## 1.1 Goal definition

HUAWEI aims to carry out a Carbon Footprint assessment on LUNA2000-200KTL-H0. Through this Carbon Footprint assessment, HUAWEI can use the results to find out what the most important contributors are within the upstreaming, manufacturing and downstreaming process chain of LUNA2000-200KTL-H0.

Furthermore, the parameters of the process chain that can potentially be improved in the future can be identified through this investigation.

The goal of this report is to estimate an indicator for Climate Change (CC) mid-point impact category of LUNA2000-200KTL-H0 used in Sweden during its lifetime.

## 1.2 Scope definition

### 1.2.1 Function Unit

The Smart PCS is a modular energy storage controller that converts the DC power generated by the batteries into AC power, and then feeds that AC power into the power grid. In addition, it converts AC power from the grid to DC power and stores the DC power in the batteries. The applicable functional unit is the usage of one LUNA2000-200KTL-H0 for 25 years. All results below are based on an estimated lifetime of 25 years.

### 1.2.2 System Boundary

The studied product system is one LUNA2000-200KTL-H0 used in Sweden. To evaluate the life cycle greenhouse gas (GHG) emissions in relative scale to GWP100, in kilograms (kg) of carbon dioxide equivalents ($CO_{2\ eq}$) of LUNA2000-200KTL-H0. The lifetime of the product is assumed to be 10 years. The product is transported from Dongguan, China to Sweden.

The system boundary of this evaluation is set to include following life cycle stages:
– Raw Materials Acquisition (RMA) and Production
– Distribution
– Use
– End of Life

The system boundary is shown in Figure 1.

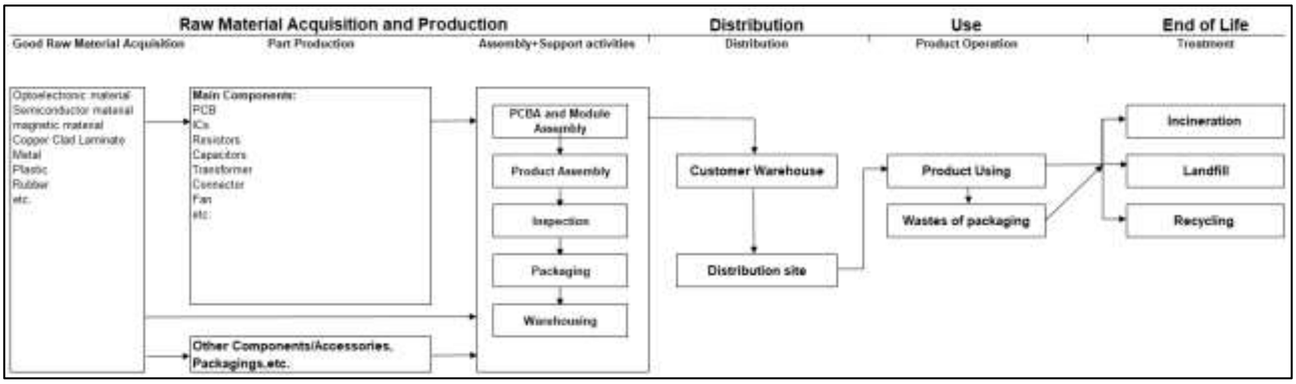


Figure 1 The Life Cycle Process Map of LUNA2000-200KTL-H0

This LUNA2000-200KTL-H0 system boundary includes all of the life cycle stages of the product, including raw material acquisition (RMA), part production, assembly and support activities (including testing, packaging, etc.), main distribution processes, use stage and end of life (disposal/recycling) stage.

The capital goods (e.g. machinery equipment and buildings, used in the life cycle of products) that are not directly associated with the production of this product are excluded.

# 2 Life Cycle Inventory

## 2.1 Data collection

### 2.1.1 Raw material acquisition and Production

The raw material acquisition and production stage mainly includes the acquisition of raw materials, production of parts/components, assembling and support activities of finished products, as follows.

The raw materials stage includes:
- Raw material (e.g. semiconductor material, magnetic material, copper clad laminate, metal, plastic, etc.) extraction of product component/part.
- Production/generation of energy used for raw material manufacturing.
The packaging of raw material is not included in the system boundary.

The production of component/part includes:
-Transportation of raw materials to manufacturing sites of component/part (e.g. electronic components, fans, cables, etc.).
- Manufacturing of product component/part and the generation of associated process waste and its treatment.
- Production/generation of energy used for component/part manufacturing.
The packaging material of component/part is not included in the system boundary.

The assembling and support activities stage includes:
- Transportation of product component/part to product assembly.
- Module assembly (PCBA, cable bundle, high efficiency rectifier, fan assembly etc.), final

product assembly, final product packaging and the generation of associated process waste and its treatment.
- Production/generation of energy used for product manufacturing.
The internal transportation is not included in the system boundary.

Most of the basic data required for the development of the assessment for the product were obtained from direct measurement of the size and mass of each component or technical data sheets of each component of the system. For the final product assembly processes, site-specific data (primary data) is collected from the relevant processes. Secondary data is used where primary data is not available, or may exist quality issues (e.g. when appropriate measurement are not available).

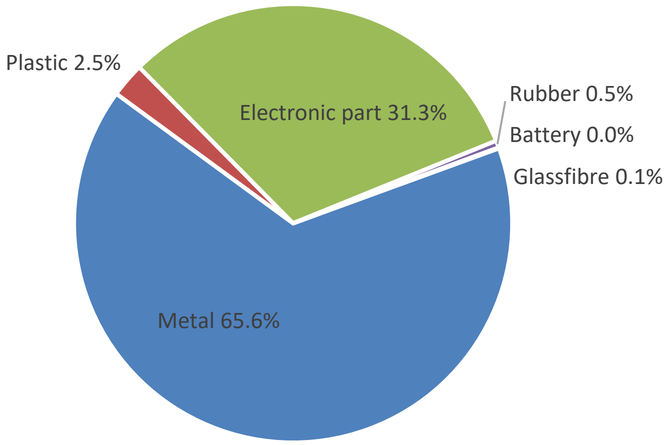


Figure 2 Main constitutive raw materials and parts of LUNA2000-200KTL-H0

*Note: "0.0" represents less than 0.1% of the proportion, similarly hereinafter.*

Raw material GHG emission data for all electronic parts and electrical components, structural parts, including their packaging material, the process energy, waste treatment and distribution are collected from the latest applicable ecoinvent database. Secondary data of the power grid emission factor released by the Ministry of Ecology and Environment (China) in 2022 is used for manufacturing process.

### 2.1.2 Distribution

The distribution stage includes:
- The transportation process from the Dongguan assembly factory to the Shenzhen port. The distance is about 70 km by truck.
- The transportation process from Shenzhen port to Trieste port. The distance is about 14150 km by ship.
- The transportation process from Trieste port to Budapest, Hungary. The distance is about 550 km by truck.
- The transportation process from Budapest to Stockholm (representative of Sweden). The distance is about 1950 km by truck.

- The transportation process from Stockholm to customer location refers to the average freight distance in Sweden. The distance is about 41 km by truck.

Secondary data collected from the latest applicable ecoinvent database embedded an average load factor and empty return trips is used for the transportation distance and the calculation of the GHG emissions. Land transportation distances data is from Google Maps. Maritime transportation distances data is obtained from http://www.searates.com/services/. The data of overall national road freight transport in Sweden is obtained from Eurostat, *Road freight transport by journey characteristics (2021)*.

### 2.1.3 Use

This section refers to the use of LUNA2000-200KTL-H0 by customers, excluding installation, commissioning, and maintenance processes. The primary data of these processes having a negligible contribution of environmental impacts is difficult to obtain and is then cut off.

The function of Smart PCS is to converts the DC power generated by the batteries into AC power, and then feeds that AC power into the power grid. In addition, it converts AC power from the grid to DC power and stores the DC power in the batteries. Here we assume that the Smart PCS works with an energy storage system for about 2 hours a day. The amount of electricity used by LUNA2000-200KTL-H0 can be calculated by the following equation:

$$\text{The Energy consumption} = \text{the output power} \times \frac{1 - \text{Efficiency}}{\text{Efficiency}} \times \text{operating time per year} \times \text{life time}$$

$$= 340\ \text{kWh} \times \frac{1 - 98.8\%}{98.8\%} \times 2\ \text{hours} \times 365\ \text{days} \times 25\ \text{years} = 75364.4\ \text{kWh}$$

The evaluation model of the use stage is based on the assumption that the product is used in Sweden, secondary data of electric emission factor in ecoinvent database is used for the calculation.

### 2.1.4 End-of-life

The GHG calculation is based on databases, and the assumed waste treatment mode is as below:

– 90% of the metal parts of the product can be recycled and 10% are sent to landfills.
– 60% of plastic parts can be recycled, and 40% incinerated.
– 65% of the electronic parts (PCB, transformer, etc.) are recycled, 10% are incinerated, and 25% are sent to landfills.
– 100% of rubber is incinerated.
– 70% of batteries of the product can be recycled and 30% are sent to landfills.
– 65% of the other parts are recycled, 10% are incinerated, and 25% are sent to landfills.

According to the assumption described, the detail waste treatment mode of material and component is explained as below:

**Table1 the detail waste treatment mode of material and component**

| Material / Component Component | Weight percent | Dispose mode |
|---|---|---|
| Metal | 65.6% | 90% recycling, 10% landfill |
| Plastic | 2.5% | 60% recycling, 40% incineration |
| Electronic part | 31.3% | 65% recycling, 10% incineration, 25% landfill |

| | | |
|---|---|---|
| Rubber | 0.5% | 100% incineration |
| Battery | 0.0% | 70% recycling, 30% landfill |
| Glassfibre | 0.1% | 65% recycling, 10% incineration, 25% landfill |

All incineration processes are calculated without energy recovery. Secondary data is used for the calculation of the GHG emissions directly. The database uses a cut-off approach. For the material recycling in the end of life and manufacturing process, the scrap don't be considered as an input, all recyclable waste is disposed through open-loop recycling, and the recycling benefit is allocated to the production as recycled materials which may use produce other products instead of LUNA2000-200KTL-H0.

## 2.2 Product Carbon Footprint Data Calculation

The collected primary data of the manufacturing of LUNA2000-200KTL-H0 includes raw material consumption, process energy consumption, transportation information, use stage power consumption and total processes output flows. Most of the process data is collected in the year 2022. The secondary data used in the SimaPro 9.2 for the GHG emission calculation is selected from the ecoinvent database as geographically representative and time-sensitive as possible. The used datasets are selected timely and reflect consistent production data.

The life cycle model in SimaPro 9.2 and GHG emissions calculation results are as follows.

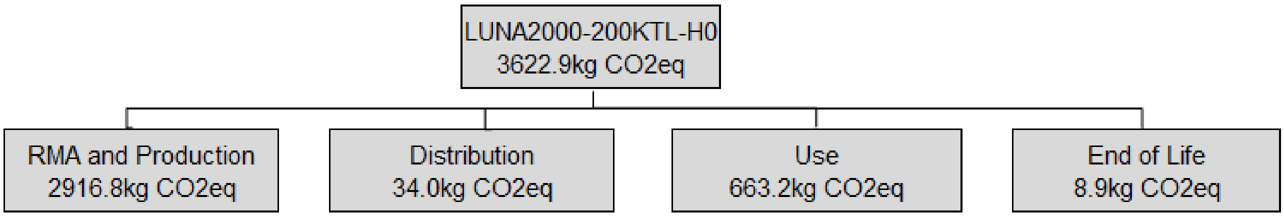


Figure 3 Life cycle model of the GHG emission calculation in SimaPro

# 3 Life Cycle Impact Assessment

Based on the methodology, assumptions and modeling described in this report, the resulting GHG emissions in relative scale to GWP100 of LUNA2000-200KTL-H0 are 3622.9 kg $CO_{2\ eq}$.

In terms of life cycle stages, the result can be shown as Figure 4. It shows that the highest emission stage is RMA and production stage, which is 80.5% of the whole life cycle GHG emissions.

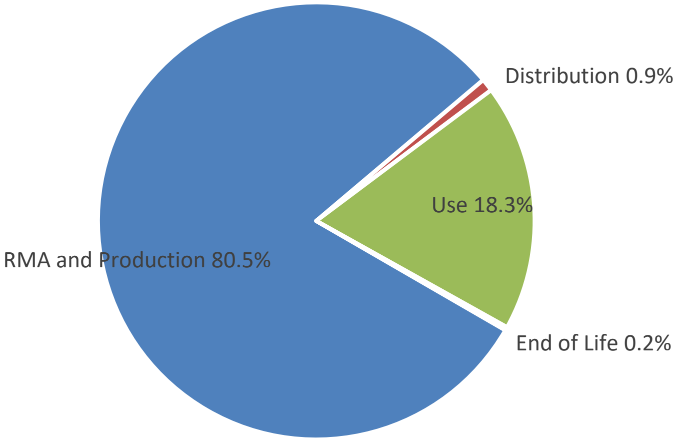


Figure 4 Product Carbon footprint analysis by all life stages

Figure 5 shows the shares of total $CO_{2\ eq}$ emissions for different parts or processes in RMA and production stage. Electronic parts have the largest share at 67.1%.

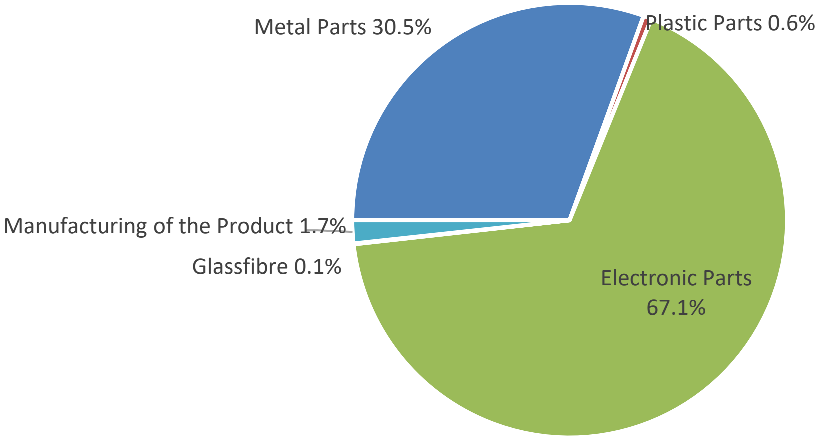


Figure 5 Product Carbon footprint analysis by manufacturing process

# 4 Life Cycle Interpretation

The main interpretations and conclusions of this evaluation are described hereinafter:

The results for different stages and manufacturing process, please see section 3.

The highest impact of LUNA2000-200KTL-H0 GHG emissions occurs from the RMA and production stage (80.5% of the anticipated life cycle GHG emissions associated). As shown in figure 5, GHG emissions of electronic parts accounts for the largest proportion (67.1%) in this stage. Although the mass proportion of electronic parts is not the highest (31.3%), the impact per unit mass of these components is relatively high due to the high energy consumption, waste and emissions in the manufacturing process. The GHG emissions related to electronic parts can be reduced by minimizing material usage, using recycled materials or low-carbon materials and optimizing manufacturing processes when design those parts.

The second impact occurs from the use stage (18.3% of the anticipated life cycle GHG emissions associated). For use stage, the GHG emissions are mainly caused by the electric energy consumption of the product (details please see section 2.1.3), which is mainly affected by the electric power consumption of product and the source of electricity. The GHG emissions can be reduced by improving the product energy efficiency or using greener energy.

The distribution stage and end of life stage have no significant impacts on GHG emissions.