# ENVIRONMENTAL PRODUCT DECLARATION

IN ACCORDANCE WITH EN 15804+A2 & ISO 14025

## Philips - MASTER LEDtube Mains T8 COMF-7950860

Signify N.V.

**EPD HUB, HUB-6061**

Published on 17.04.2026, last updated on 17.04.2026, valid until 17.04.2031

## MANUFACTURER AND SITE

| | |
|---|---|
| Manufacturer | Signify N.V. |
| Address | High Tech Campus 48, 5656 AE Eindhoven, The Netherlands |
| Contact details | sustainability@signify.com |
| Website | https://www.signify.com/global |
| Place of production | HENGDIAN, CHINA |
| Place(s) of raw material origin | APAC |
| Place(s) of installation and use | CHINA |
| Period for data | Calendar Year 2026 |

## EPD STANDARDS, SCOPE AND VERIFICATION

| | |
|---|---|
| Program operator | EPD Hub, hub@epdhub.com |
| Reference standard | EN 15804:2012+A2:2019/AC:2021 and ISO 14025 |
| PCR | EPD Hub Core PCR version 1.2, 24 Mar 2025 |
| Sector | Electrical product |
| Category of EPD | Third party verified EPD |
| Scope of the EPD | Cradle to gate with options, A4-A5, B6, and modules C1-C4, D |
| EPD author | Signify / Sustainability |
| EPD verification | Independent verification of this EPD and data, according to ISO 14025:<br>☐ Internal verification ☑ External verification |
| EPD verifier | Imane Uald Lamkaddam as an authorized verifier for EPD Hub |

## PRODUCT SPECIFICATION

| | |
|---|---|
| Product name | Philips - MASTER LEDtube Mains T8 COMF-7950860 |
| Product number / reference | 929001826408 / MAS LEDtube Spectrum 1200mm 1500lm |
| GTIN (Global Trade Item Number) | Not applicable |
| NOBB (Norwegian Building Product Database) | Not applicable |
| A1-A3 Specific data (%) | 10.9 |

## PRODUCT DESCRIPTION

The Philips specialty LEDtube is an indoor lighting solution. It fits in luminaires operation on mains power connection. It offers efficacy of up to 110lm/W, available in 2200K, all versions provide CRI>50 and with lifetime at 50,000 hours . It is designed for 500nm radiation power<0.5% of total spectrum. This specialty LEDtube is suitable for applications such as semiconductor cleanroom and production factory.

This EPD is intended for business-to-business and/or business-to-consumer communication. Life Cycle Assessment study has been performed in accordance with the requirements of EN 15804, EPD Hub PCR version 1.2 (24 Mar 2025) and JRC characterization factors EF 3.1. The manufacturer has the sole ownership, liability, and responsibility for the EPD. EPDs within the same product category but from different programs may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804 and if they are not compared in a building context.

## PRODUCT CLASSIFICATION

| | |
|---|---|
| Declared operating voltage, Volt | 100-277 |
| Light source colour temperature, Kelvin | 2200 |
| Protection index for water and dust (IP) | IP20 |
| Impact resistance index (IK) | Not applicable |
| Luminous flux, Lumens | 1500 |
| Electrical power, Watt | 14 |
| Luminous efficiency, Lm/W | 107 |
| Additional characteristic | Not applicable |

## ABOUT THE MANUFACTURER

Signify is the world leader in lighting for professionals, consumers and lighting for the Internet of Things. Our energy efficient lighting products, systems and services enable our customers to enjoy a superior quality of light, and make people's lives safer and more comfortable, businesses more productive and cities more liveable.

For more information, please visit: https://www.signify.com/global

## PRODUCT RAW MATERIAL MAIN COMPOSITION

| Raw material category | Amount, mass- % | Material origin |
|---|---|---|
| Metals | 46.75 | APAC |
| Minerals | 0 | |
| Fossil materials | 53.25 | APAC |
| Bio-based materials | 0 | |

## BIOGENIC CARBON CONTENT

Product's biogenic carbon content at the factory gate

| | |
|---|---|
| Biogenic carbon content in product, kg C | 0 |
| Biogenic carbon content in packaging, kg C | 0.01 |

## ENVIRONMENTAL DATA SUMMARY

| | |
|---|---|
| Declared unit | 1 unit |
| Declared unit mass, kg | 0.246 |
| Mass of packaging, kg | 0.024 |
| Functional unit (from PEP PSR0014) | Provide lighting that delivers an outgoing artificial luminous flux of 1000 lumens during a reference lifetime of 35000 hours |
| Reference service life (years) | 12 |
| Assigned lifetime (hours) | 50000 |
| GWP-total, A1-A3 (kg $CO_2e$) | 5.16 |
| GWP-fossil, A1-A3 (kg $CO_2e$) | 5.19 |
| Secondary material, inputs (%) | 6.79 |
| Secondary material, outputs (%) | 28.8 |
| Total energy use, A1-A3 (kWh) | 18.2 |
| Net freshwater use, A1-A3 ($m^3$) | 3.64E-02 |

# LIFE CYCLE ASSESSMENT

## SYSTEM BOUNDARY

This EPD covers the life-cycle modules listed in the following table.

| Product stage | | | Installation stage | | Use stage | | | | | | | End of life stage | | | | Beyond the system |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | A2 | A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
| X | X | X | X | X | ND | ND | ND | ND | ND | X | ND | X | X | X | X | X |
| Raw materials | Transport | Manufacturing | Transport | Installation | Use | Maintenance | Repair | Replacement | Refurbishment | Operational energy use | Operational water use | Deconstr./demo. | Transport | Waste processing | Disposal | Reuse, Recovery, Recycling |

*Modules not declared = ND.*

## CUT - OFF CRITERIA

The study does not exclude any modules or processes which are stated mandatory in the reference standard and the applied PCR. The study does not exclude any hazardous materials or substances. There is no neglected unit process more than 1% of total mass or energy flows. The module-specific total neglected input and output flows also do not exceed 5% of energy usage or mass.

The production of capital equipment, construction activities, and infrastructure, maintenance and operation of capital equipment, personnel-related activities, energy and water use related to company management and sales activities are excluded.

## VALIDATION OF DATA

Data collection for production, transport, and packaging was conducted using time and site-specific information, as defined in the general information section on page 1 and 2. Upstream process calculations rely on generic data as defined in the Bibliography section. Manufacturer-provided specific and generic data were used for the product's manufacturing stage. The analysis was performed in One Click LCA EPD Generator, with the 'Cut-Off, EN 15804+A2' allocation method, and characterization factors according to EN 15804:2012+A2:2019/AC:2021 and JRC EF 3.1.

## ALLOCATION, ESTIMATES AND ASSUMPTIONS

Allocation is required if some material, energy, and waste data cannot be measured separately for the product under investigation. All allocations are done as per the reference standards and the applied PCR. In this study, ancillary materials, energy & water consumption, material loss and waste generation at the manufacturing site are attributed to the bill of materials of the products, therefore, they are allocated by partitioning the quantities on the base of the total production in kg throughout the year. Thus, allocation has been done in the following ways:

| Data type | Allocation |
|---|---|
| Raw materials | No allocation |
| Packaging materials | No allocation |
| Ancillary materials | Allocated by mass |
| Manufacturing energy and waste | Allocated by mass |

Proxy data is used for certain materials due to their unavailability in the database. Conservative choices have been adopted when exact information was missing. Regarding module C1-C4: EOL scenarios are based on default values from EN 50693. For stages description please refer to section Product life cycle in this EPD report.

## LCA SOFTWARE AND BIBLIOGRAPHY

This EPD has been created using One Click LCA Luminaire EPD Generator v2.2.7. The LCA and EPD have been prepared according to the reference standards, EN 50693, and ISO 14040/14044. Ecoinvent v 3.10.1 and One Click LCA databases were used as sources of environmental data. Allocation used in Ecoinvent 3.10.1 environmental data sources follow the methodology 'allocation, cut-off, EN 15804+A2'.

No other sources were used in the modelling of this EPD.

## PRODUCT & MANUFACTURING SITES GROUPING

| | |
|---|---|
| Type of grouping | No grouping |
| Grouping method | Not applicable |
| Variation in GWP-fossil for A1-A3, % | - |

## SUBSTANCES, REACH - VERY HIGH CONCERN

The product does not contain any REACH SVHC substances in amounts greater than 0,1 % (1000 ppm).

# PRODUCT LIFE CYCLE

## MANUFACTURING AND PACKAGING (A1-A3)

The environmental impacts considered for the product stage cover the manufacturing of raw materials used in the production. The material losses occurring during the manufacturing processes are treated as per the waste handling practices in the factory, while scenario assumptions are made in the absence of exact data. The study also considers the fuels used by machines as well as losses during electricity transmission.

The product is made of metals, plastics, and electronic components. All components are transported to the production facility, where the main manufacturing processes primarily are associated with assembly. A2 transport distances are calculated always taking the capital city of component country of origin as a starting point and exact manufacturing location as destination. The finished product can be packaged with polyethylene, cardboard, and/or paper as packaging material before shipment to customers. Manufacturing loss, ancillaries and wastes are calculated according to the data that each manufacturing site is sharing with Signify. The total annual amount of waste in kg is allocated to the total annual production in kg at the specific manufacturing site responsible to produce the studied product. Thus, it is possible to allocate it according to the weight of the product analysed in this study.

Co-product allocation is neglected as revenue of co-product is very low, hence, the waste undergoes a conservative waste treatment.

## TRANSPORT AND INSTALLATION (A4-A5)

A4 transport distances are calculated always taking the exact manufacturing location to customer location. If the customer's location is defined as a country or its capital city, the calculation is made to the respective capital city. If the customer's location is specified as a region, the distance is calculated to the capital city of the best-performing sales country within that region. The transportation method is a combination of lorry and container ship where needed. To be conservative, empty returns are included in this study as implemented through an average load factor in the Ecoinvent transport datapoints. Environmental impacts from installation include waste packaging materials (A5). The packaging waste treatment is assumed to be conservative with incineration without energy recovery. The impacts of energy consumption and the used ancillary materials during installation are considered negligible.

## PRODUCT USE AND MAINTENANCE (B1-B7)

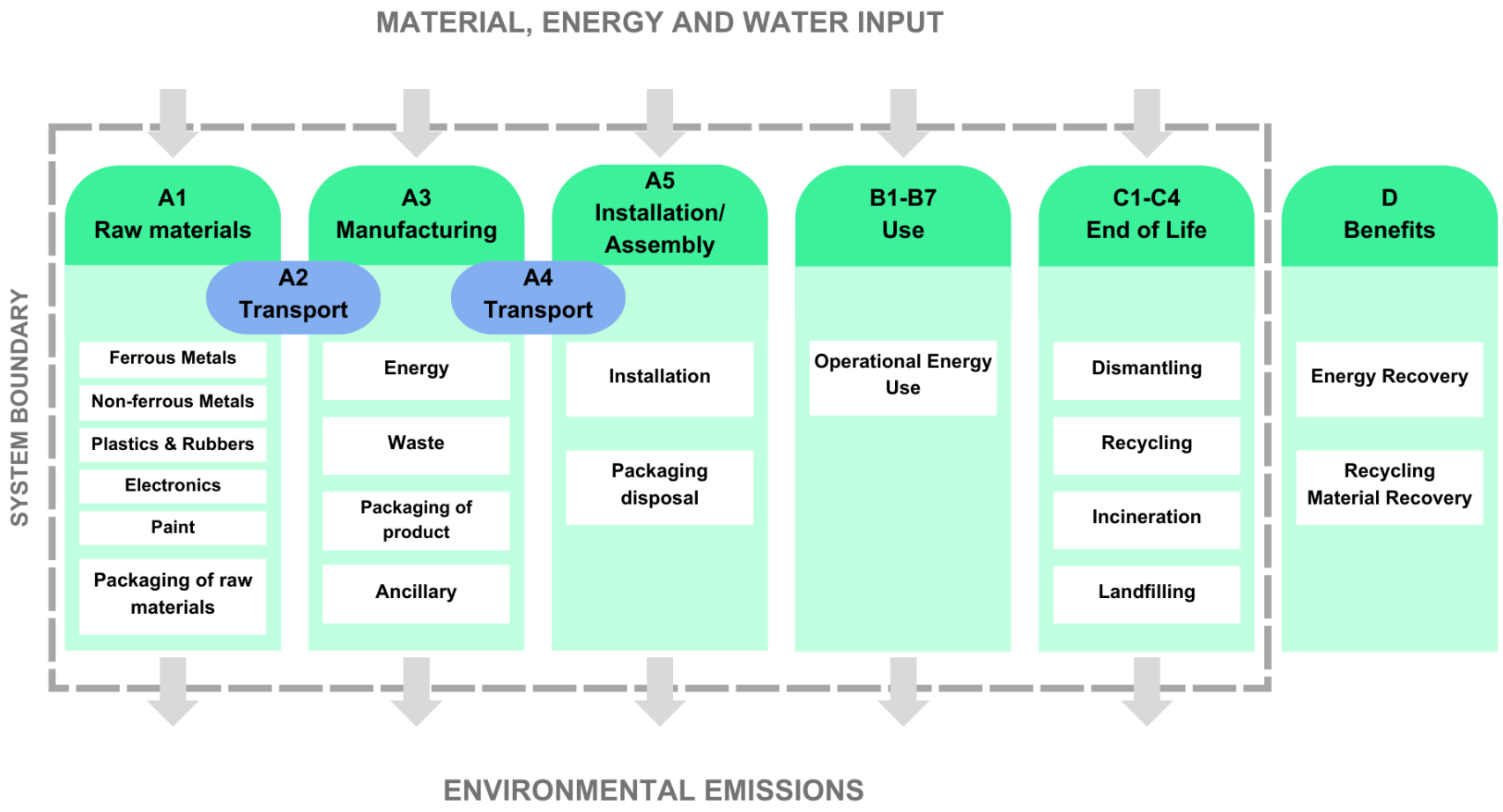
During the use phase, the product consumes electricity (B6), which is calculated multiplying the Wattage x Assigned lifetime (hours) x Country energy mix factor. To know which Country energy mix was used in this EPD, please refer to Annex 2.

The Reference service life in years is calculated according to the main application type of the product, based on annual operating hours. Impacts due to electricity production include direct emissions to air, transformation, and transmission losses.

## PRODUCT END OF LIFE (C1-C4, D)

Consumption of energy and natural resources in demolition process is assumed to be negligible. It is assumed that the waste is collected separately and transported to the waste treatment centre. The transport distance is 150 km while the transportation method is assumed to be lorry (C2). According to EN 50693:2019, the sequence of treatment operations occurring to the product shall include de-pollution, fractions separation and preparation (dismantling, crushing, shredding, sorting), recycling, other material recovery, energy recovery and disposal. In this study, the default values from table G.4 of EN 50693 is used for treating materials in different waste treatment methods. Due to the material and energy recovery potential of parts in the lighting system, the end-of-life product is converted into recycled raw materials, while the energy recovered from incineration displaces electricity and heat production (D). The benefits and loads of incineration and recycling are included in Module D.

# LIFE CYCLE FLOW DIAGRAM - SYSTEM BOUNDARY



# ENVIRONMENTAL IMPACT DATA, RESULTS PER DECLARED UNIT

*The estimated impact results are only relative statements which do not indicate the end points of the impact categories, exceeding threshold values, safety margins or risks.*

## CORE ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, EF 3.1

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GWP – total[1)] | kg $CO_2$e | 4.86E+00 | 3.80E-02 | 2.68E-01 | 5.16E+00 | 4.20E-02 | 3.72E-02 | ND | ND | ND | ND | ND | 7.12E+02 | ND | 0.00E+00 | 7.22E-03 | 1.52E-01 | 7.72E-02 | -1.47E+00 |
| GWP – fossil | kg $CO_2$e | 4.87E+00 | 3.80E-02 | 2.84E-01 | 5.19E+00 | 4.20E-02 | 1.50E-03 | ND | ND | ND | ND | ND | 7.11E+02 | ND | 0.00E+00 | 7.21E-03 | 1.52E-01 | 7.72E-02 | -1.47E+00 |
| GWP – biogenic | kg $CO_2$e | -1.34E-02 | 8.61E-06 | -1.73E-02 | -3.07E-02 | 9.51E-06 | 3.57E-02 | ND | ND | ND | ND | ND | 1.08E-01 | ND | 0.00E+00 | 1.57E-06 | -2.07E-05 | -8.01E-06 | -5.94E-04 |
| GWP – LULUC | kg $CO_2$e | 7.03E-03 | 1.70E-05 | 7.85E-04 | 7.83E-03 | 1.88E-05 | 5.55E-07 | ND | ND | ND | ND | ND | 2.48E-01 | ND | 0.00E+00 | 3.19E-06 | 9.96E-06 | 2.51E-06 | -6.35E-04 |
| Ozone depletion pot. | kg $CFC_{-11}$e | 3.77E-07 | 5.61E-10 | 3.12E-09 | 3.81E-07 | 6.20E-10 | 2.07E-11 | ND | ND | ND | ND | ND | 1.55E-06 | ND | 0.00E+00 | 1.01E-10 | 9.51E-11 | 5.64E-11 | -5.99E-09 |
| Acidification potential | mol $H^+$e | 3.90E-02 | 1.30E-04 | 1.58E-03 | 4.07E-02 | 1.43E-04 | 8.94E-06 | ND | ND | ND | ND | ND | 3.89E+00 | ND | 0.00E+00 | 2.40E-05 | 6.96E-05 | 2.66E-05 | -1.84E-02 |
| EP-freshwater[2)] | kg Pe | 2.72E-03 | 2.96E-06 | 7.08E-05 | 2.80E-03 | 3.27E-06 | 1.51E-07 | ND | ND | ND | ND | ND | 1.42E-01 | ND | 0.00E+00 | 5.61E-07 | 2.95E-06 | 4.38E-07 | -1.00E-03 |
| EP-marine | kg Ne | 5.77E-03 | 4.26E-05 | 2.67E-04 | 6.08E-03 | 4.71E-05 | 4.17E-06 | ND | ND | ND | ND | ND | 8.07E-01 | ND | 0.00E+00 | 7.79E-06 | 2.63E-05 | 7.72E-05 | -1.96E-03 |
| EP-terrestrial | mol Ne | 6.12E-02 | 4.63E-04 | 2.53E-03 | 6.42E-02 | 5.12E-04 | 3.80E-05 | ND | ND | ND | ND | ND | 8.62E+00 | ND | 0.00E+00 | 8.47E-05 | 2.42E-04 | 1.22E-04 | -2.08E-02 |
| POCP ("smog")[3)] | kg NMVOCe | 2.09E-02 | 1.91E-04 | 8.58E-04 | 2.20E-02 | 2.11E-04 | 1.08E-05 | ND | ND | ND | ND | ND | 2.29E+00 | ND | 0.00E+00 | 3.35E-05 | 6.38E-05 | 3.40E-05 | -6.25E-03 |
| ADP-minerals & metals[4)] | kg Sbe | 3.88E-04 | 1.06E-07 | 4.51E-07 | 3.89E-04 | 1.17E-07 | 4.47E-09 | ND | ND | ND | ND | ND | 2.84E-03 | ND | 0.00E+00 | 2.37E-08 | 1.33E-07 | 9.00E-09 | -8.20E-05 |
| ADP-fossil resources | MJ | 6.00E+01 | 5.52E-01 | 3.34E+00 | 6.39E+01 | 6.10E-01 | 1.56E-02 | ND | ND | ND | ND | ND | 6.73E+03 | ND | 0.00E+00 | 1.01E-01 | 9.30E-02 | 4.05E-02 | -1.53E+01 |
| Water use[5)] | $m^3$e depr. | 1.25E+00 | 2.72E-03 | 1.68E+00 | 2.94E+00 | 3.01E-03 | 1.80E-03 | ND | ND | ND | ND | ND | 8.44E+01 | ND | 0.00E+00 | 4.69E-04 | 1.08E-02 | 5.14E-03 | -1.62E-01 |

*1) GWP = Global Warming Potential. 2) EP = Eutrophication potential. Required characterisation method and data are in kg P-eq. Multiply by 3,07 to get PO4e. 3) POCP = Photochemical ozone formation. 4) ADP = Abiotic depletion potential. 5) EN 15804+A2 disclaimer for Abiotic depletion and Water use and optional indicators except Particulate matter and Ionizing radiation, human health. The results of these environmental impact indicators shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.*

## ADDITIONAL (OPTIONAL) ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, EF 3.1

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Particulate matter | Incidence | 3.53E-07 | 3.81E-09 | 1.12E-08 | 3.68E-07 | 4.21E-09 | 1.11E-10 | ND | ND | ND | ND | ND | 5.30E-05 | ND | 0.00E+00 | 5.72E-10 | 5.81E-10 | 2.88E-10 | -8.47E-08 |
| Ionizing radiation[6)] | kBq U235e | 2.77E-01 | 4.80E-04 | 6.84E-03 | 2.85E-01 | 5.31E-04 | 1.88E-05 | ND | ND | ND | ND | ND | 2.41E+01 | ND | 0.00E+00 | 8.19E-05 | 5.87E-04 | 6.05E-05 | -9.56E-02 |
| Ecotoxicity (freshwater) | CTUe | 6.76E+01 | 7.80E-02 | 8.55E-01 | 6.85E+01 | 8.62E-02 | 4.30E-02 | ND | ND | ND | ND | ND | 2.10E+03 | ND | 0.00E+00 | 1.60E-02 | 3.10E-01 | 3.38E+00 | -7.15E+00 |
| Human toxicity, cancer | CTUh | 4.51E-09 | 6.27E-12 | 6.03E-11 | 4.57E-09 | 6.93E-12 | 2.07E-12 | ND | ND | ND | ND | ND | 8.74E-08 | ND | 0.00E+00 | 1.23E-12 | 1.50E-11 | 8.94E-12 | -1.07E-09 |
| Human tox. non-cancer | CTUh | 1.08E-07 | 3.57E-10 | 2.04E-09 | 1.10E-07 | 3.95E-10 | 8.46E-11 | ND | ND | ND | ND | ND | 5.64E-06 | ND | 0.00E+00 | 6.33E-11 | 6.28E-10 | 4.37E-10 | -7.73E-08 |
| SQP[7)] | - | 1.87E+01 | 5.56E-01 | 4.71E+00 | 2.40E+01 | 6.14E-01 | 7.61E-03 | ND | ND | ND | ND | ND | 1.62E+03 | ND | 0.00E+00 | 6.04E-02 | 5.62E-02 | 4.90E-02 | -4.34E+00 |

## USE OF NATURAL RESOURCES

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Renew. PER as energy[8)] | MJ | 5.13E+00 | 7.56E-03 | 5.98E-01 | 5.73E+00 | 8.35E-03 | -4.26E-01 | ND | ND | ND | ND | ND | 7.49E+02 | ND | 0.00E+00 | 1.39E-03 | 1.06E-02 | 1.14E-03 | -6.84E-01 |
| Renew. PER as material | MJ | 1.86E-01 | 0.00E+00 | 1.57E-01 | 3.42E-01 | 0.00E+00 | -3.30E-01 | ND | ND | ND | ND | ND | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | -4.25E-03 | -7.89E-03 | 0.00E+00 |
| Total use of renew. PER | MJ | 5.31E+00 | 7.56E-03 | 7.55E-01 | 6.08E+00 | 8.35E-03 | -7.56E-01 | ND | ND | ND | ND | ND | 7.49E+02 | ND | 0.00E+00 | 1.39E-03 | 6.34E-03 | -6.75E-03 | -6.84E-01 |
| Non-re. PER as energy | MJ | 5.59E+01 | 5.52E-01 | 3.11E+00 | 5.96E+01 | 6.10E-01 | 1.56E-02 | ND | ND | ND | ND | ND | 6.74E+03 | ND | 0.00E+00 | 1.01E-01 | -2.14E+00 | -2.20E+00 | -1.53E+01 |
| Non-re. PER as material | MJ | 3.68E+00 | 0.00E+00 | -1.27E-01 | 3.56E+00 | 0.00E+00 | -8.55E-03 | ND | ND | ND | ND | ND | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | -1.77E+00 | -1.78E+00 | 0.00E+00 |
| Total use of non-re. PER | MJ | 5.96E+01 | 5.52E-01 | 2.98E+00 | 6.32E+01 | 6.10E-01 | 7.00E-03 | ND | ND | ND | ND | ND | 6.74E+03 | ND | 0.00E+00 | 1.01E-01 | -3.91E+00 | -3.98E+00 | -1.53E+01 |
| Secondary materials | kg | 1.67E-02 | 0.00E+00 | 0.00E+00 | 1.67E-02 | 0.00E+00 | 0.00E+00 | ND | ND | ND | ND | ND | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Renew. secondary fuels | MJ | 2.43E-03 | 2.98E-06 | 2.53E-04 | 2.69E-03 | 3.30E-06 | 1.94E-07 | ND | ND | ND | ND | ND | 6.98E-03 | ND | 0.00E+00 | 5.79E-07 | 3.87E-06 | 7.33E-07 | -6.87E-05 |
| Non-ren. secondary fuels | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | ND | ND | ND | ND | ND | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Use of net fresh water | $m^3$ | 3.18E-02 | 8.16E-05 | 4.56E-03 | 3.64E-02 | 9.01E-05 | 2.92E-05 | ND | ND | ND | ND | ND | 2.03E+00 | ND | 0.00E+00 | 1.34E-05 | 1.98E-04 | -9.01E-05 | -6.79E-03 |

*8) PER = Primary energy resources.*

## END OF LIFE – WASTE

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hazardous waste | kg | 7.13E-01 | 9.35E-04 | 6.54E-03 | 7.20E-01 | 1.03E-03 | 4.73E-04 | ND | ND | ND | ND | ND | 8.76E+01 | ND | 0.00E+00 | 1.76E-04 | 2.99E-03 | 6.04E-03 | -2.87E-01 |
| Non-hazardous waste | kg | 1.25E+01 | 1.73E-02 | 3.46E-01 | 1.28E+01 | 1.91E-02 | 2.56E-02 | ND | ND | ND | ND | ND | 6.75E+02 | ND | 0.00E+00 | 3.31E-03 | 8.02E-02 | 3.27E-01 | -4.25E+00 |
| Radioactive waste | kg | 6.86E-05 | 1.18E-07 | 1.42E-06 | 7.01E-05 | 1.30E-07 | 4.72E-09 | ND | ND | ND | ND | ND | 5.84E-03 | ND | 0.00E+00 | 2.01E-08 | 1.44E-07 | 1.51E-08 | -2.31E-05 |

## END OF LIFE – OUTPUT FLOWS

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Components for reuse | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | ND | ND | ND | ND | ND | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Materials for recycling | kg | 0.00E+00 | 0.00E+00 | 5.17E-03 | 5.17E-03 | 0.00E+00 | 0.00E+00 | ND | ND | ND | ND | ND | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 7.08E-02 | 0.00E+00 | 0.00E+00 |
| Materials for energy rec | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | ND | ND | ND | ND | ND | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Exported energy | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | ND | ND | ND | ND | ND | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 7.02E-01 | 0.00E+00 | 0.00E+00 |
| Exported energy – Electricity | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | ND | ND | ND | ND | ND | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 2.95E-01 | 0.00E+00 | 0.00E+00 |
| Exported energy – Heat | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | ND | ND | ND | ND | ND | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 4.06E-01 | 0.00E+00 | 0.00E+00 |

## ENVIRONMENTAL IMPACTS – EN 15804+A1, CML

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Global Warming Pot. | kg $CO_2$e | 4.87E+00 | 3.78E-02 | 2.85E-01 | 5.20E+00 | 4.18E-02 | 1.49E-03 | ND | ND | ND | ND | ND | 7.05E+02 | ND | 0.00E+00 | 7.17E-03 | 1.52E-01 | 7.70E-02 | -1.46E+00 |
| Ozone depletion Pot. | kg $CFC_{-11}$e | 2.67E-07 | 4.48E-10 | 2.61E-09 | 2.70E-07 | 4.95E-10 | 1.76E-11 | ND | ND | ND | ND | ND | 1.59E-06 | ND | 0.00E+00 | 8.06E-11 | 8.28E-11 | 4.76E-11 | -5.46E-09 |
| Acidification | kg $SO_2$e | 3.29E-02 | 9.90E-05 | 1.34E-03 | 3.43E-02 | 1.09E-04 | 6.57E-06 | ND | ND | ND | ND | ND | 3.20E+00 | ND | 0.00E+00 | 1.84E-05 | 5.32E-05 | 1.91E-05 | -1.59E-02 |
| Eutrophication | kg $PO_4^3$e | 8.84E-03 | 2.41E-05 | 3.13E-04 | 9.18E-03 | 2.66E-05 | 2.04E-06 | ND | ND | ND | ND | ND | 3.34E-01 | ND | 0.00E+00 | 4.48E-06 | 1.26E-05 | 1.00E-05 | -9.44E-04 |
| POCP (“smog”) | kg $C_2H_4$e | 2.75E-03 | 8.82E-06 | 9.66E-05 | 2.85E-03 | 9.75E-06 | 5.00E-07 | ND | ND | ND | ND | ND | 1.77E-01 | ND | 0.00E+00 | 1.65E-06 | 3.25E-06 | 1.80E-06 | -8.66E-04 |
| ADP-elements | kg Sbe | 3.87E-04 | 1.03E-07 | 4.30E-07 | 3.88E-04 | 1.14E-07 | 3.74E-09 | ND | ND | ND | ND | ND | 2.83E-03 | ND | 0.00E+00 | 2.31E-08 | 1.29E-07 | 7.24E-09 | -8.18E-05 |
| ADP-fossil | MJ | 5.56E+01 | 5.44E-01 | 3.26E+00 | 5.94E+01 | 6.01E-01 | 1.53E-02 | ND | ND | ND | ND | ND | 6.32E+03 | ND | 0.00E+00 | 9.99E-02 | 8.36E-02 | 3.95E-02 | -1.38E+01 |

## ADDITIONAL INDICATOR – GWP-GHG

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GWP-GHG 9) | kg CO2e | 4.87E+00 | 3.80E-02 | 2.85E-01 | 5.20E+00 | 4.20E-02 | 1.50E-03 | ND | ND | ND | ND | ND | 7.12E+02 | ND | 0.00E+00 | 7.21E-03 | 1.52E-01 | 7.72E-02 | -1.47E+00 |

*9) This indicator includes all greenhouse gases excluding biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. In addition, the characterisation factors for the flows - CH4 fossil, CH4 biogenic and Dinitrogen monoxide - were updated. This indicator is identical to the GWP-total of EN 15804:2012+A2:2019 except that the characterization factor for biogenic CO2 is set to zero.*

# ENVIRONMENTAL IMPACT DATA, RESULTS PER FUNCTIONAL UNIT

*The estimated impact results are only relative statements which do not indicate the end points of the impact categories, exceeding threshold values, safety margins or risks.*

## CORE ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, EF 3.1

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GWP – total[1)] | kg $CO_2$ éq/FU | 2.27E+00 | 1.78E-02 | 1.25E-01 | 2.41E+00 | 1.96E-02 | 1.73E-02 | ND | ND | ND | ND | ND | 3.32E+02 | ND | 0.00E+00 | 3.37E-03 | 7.08E-02 | 3.60E-02 | -6.88E-01 |
| GWP – fossil | kg $CO_2$ éq/FU | 2.27E+00 | 1.77E-02 | 1.33E-01 | 2.42E+00 | 1.96E-02 | 7.02E-04 | ND | ND | ND | ND | ND | 3.32E+02 | ND | 0.00E+00 | 3.37E-03 | 7.08E-02 | 3.60E-02 | -6.87E-01 |
| GWP – biogenic | kg $CO_2$ éq/FU | -6.26E-03 | 4.02E-06 | -8.08E-03 | -1.43E-02 | 4.44E-06 | 1.66E-02 | ND | ND | ND | ND | ND | 5.03E-02 | ND | 0.00E+00 | 7.35E-07 | -9.64E-06 | -3.74E-06 | -2.77E-04 |
| GWP – LULUC | kg $CO_2$ éq/FU | 3.28E-03 | 7.94E-06 | 3.67E-04 | 3.65E-03 | 8.77E-06 | 2.59E-07 | ND | ND | ND | ND | ND | 1.16E-01 | ND | 0.00E+00 | 1.49E-06 | 4.65E-06 | 1.17E-06 | -2.96E-04 |
| Ozone depletion pot. | kg $CFC_{11}$e/FU | 1.76E-07 | 2.62E-10 | 1.45E-09 | 1.78E-07 | 2.89E-10 | 9.65E-12 | ND | ND | ND | ND | ND | 7.24E-07 | ND | 0.00E+00 | 4.71E-11 | 4.44E-11 | 2.63E-11 | -2.80E-09 |
| Acidification potential | mole $H^+$e/FU | 1.82E-02 | 6.05E-05 | 7.39E-04 | 1.90E-02 | 6.68E-05 | 4.17E-06 | ND | ND | ND | ND | ND | 1.82E+00 | ND | 0.00E+00 | 1.12E-05 | 3.25E-05 | 1.24E-05 | -8.59E-03 |
| EP-freshwater[2)] | kg Pe/FU | 1.27E-03 | 1.38E-06 | 3.31E-05 | 1.31E-03 | 1.53E-06 | 7.05E-08 | ND | ND | ND | ND | ND | 6.63E-02 | ND | 0.00E+00 | 2.62E-07 | 1.38E-06 | 2.04E-07 | -4.67E-04 |
| EP-marine | kg Ne/FU | 2.69E-03 | 1.99E-05 | 1.24E-04 | 2.84E-03 | 2.20E-05 | 1.95E-06 | ND | ND | ND | ND | ND | 3.77E-01 | ND | 0.00E+00 | 3.63E-06 | 1.23E-05 | 3.60E-05 | -9.13E-04 |
| EP-terrestrial | mol Ne/FU | 2.86E-02 | 2.16E-04 | 1.18E-03 | 2.99E-02 | 2.39E-04 | 1.78E-05 | ND | ND | ND | ND | ND | 4.02E+00 | ND | 0.00E+00 | 3.95E-05 | 1.13E-04 | 5.70E-05 | -9.71E-03 |
| POCP ("smog")[3)] | kg NMVOCe/ | 9.76E-03 | 8.92E-05 | 4.00E-04 | 1.02E-02 | 9.85E-05 | 5.05E-06 | ND | ND | ND | ND | ND | 1.07E+00 | ND | 0.00E+00 | 1.56E-05 | 2.98E-05 | 1.59E-05 | -2.92E-03 |
| ADP-minerals & metals[4)] | kg Sbe/FU | 1.81E-04 | 4.95E-08 | 2.10E-07 | 1.81E-04 | 5.47E-08 | 2.09E-09 | ND | ND | ND | ND | ND | 1.32E-03 | ND | 0.00E+00 | 1.11E-08 | 6.20E-08 | 4.20E-09 | -3.82E-05 |
| ADP-fossil resources | MJ/FU | 2.80E+01 | 2.57E-01 | 1.56E+00 | 2.98E+01 | 2.84E-01 | 7.26E-03 | ND | ND | ND | ND | ND | 3.14E+03 | ND | 0.00E+00 | 4.72E-02 | 4.34E-02 | 1.89E-02 | -7.15E+00 |
| Water use[5)] | $m^3$e priv. /FU | 5.85E-01 | 1.27E-03 | 7.85E-01 | 1.37E+00 | 1.41E-03 | 8.40E-04 | ND | ND | ND | ND | ND | 3.94E+01 | ND | 0.00E+00 | 2.19E-04 | 5.05E-03 | 2.40E-03 | -7.57E-02 |

*1) GWP = Global Warming Potential. 2) EP = Eutrophication potential. Required characterisation method and data are in kg P-eq. Multiply by 3,07 to get PO4e. 3) POCP = Photochemical ozone formation. 4) ADP = Abiotic depletion potential. 5) EN 15804+A2 disclaimer for Abiotic depletion and Water use and optional indicators except Particulate matter and Ionizing radiation, human health. The results of these environmental impact indicators shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.*

## ADDITIONAL (OPTIONAL) ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, EF 3.1

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Particulate matter | Incidence /FU | 1.65E-07 | 1.78E-09 | 5.22E-09 | 1.72E-07 | 1.96E-09 | 5.20E-11 | ND | ND | ND | ND | ND | 2.47E-05 | ND | 0.00E+00 | 2.67E-10 | 2.71E-10 | 1.34E-10 | -3.95E-08 |
| Ionizing radiation[6)] | kBq U235e/FU | 1.29E-01 | 2.24E-04 | 3.19E-03 | 1.33E-01 | 2.48E-04 | 8.79E-06 | ND | ND | ND | ND | ND | 1.13E+01 | ND | 0.00E+00 | 3.82E-05 | 2.74E-04 | 2.82E-05 | -4.46E-02 |
| Ecotoxicity (freshwater) | CTUe/FU | 3.16E+01 | 3.64E-02 | 3.99E-01 | 3.20E+01 | 4.02E-02 | 2.01E-02 | ND | ND | ND | ND | ND | 9.79E+02 | ND | 0.00E+00 | 7.47E-03 | 1.45E-01 | 1.58E+00 | -3.34E+00 |
| Human toxicity, cancer | CTUh/FU | 2.10E-09 | 2.93E-12 | 2.82E-11 | 2.13E-09 | 3.24E-12 | 9.68E-13 | ND | ND | ND | ND | ND | 4.08E-08 | ND | 0.00E+00 | 5.72E-13 | 6.98E-12 | 4.17E-12 | -5.01E-10 |
| Human tox. non-cancer | CTUh/FU | 5.04E-08 | 1.67E-10 | 9.53E-10 | 5.15E-08 | 1.84E-10 | 3.95E-11 | ND | ND | ND | ND | ND | 2.63E-06 | ND | 0.00E+00 | 2.95E-11 | 2.93E-10 | 2.04E-10 | -3.61E-08 |
| SQP[7)] | -/FU | 8.72E+00 | 2.59E-01 | 2.20E+00 | 1.12E+01 | 2.86E-01 | 3.55E-03 | ND | ND | ND | ND | ND | 7.54E+02 | ND | 0.00E+00 | 2.82E-02 | 2.62E-02 | 2.29E-02 | -2.03E+00 |

## USE OF NATURAL RESOURCES

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Renew. PER as energy[8)] | MJ/FU | 2.39E+00 | 3.53E-03 | 2.79E-01 | 2.68E+00 | 3.90E-03 | -1.99E-01 | ND | ND | ND | ND | ND | 3.50E+02 | ND | 0.00E+00 | 6.47E-04 | 4.94E-03 | 5.31E-04 | -3.19E-01 |
| Renew. PER as material | MJ/FU | 8.66E-02 | 0.00E+00 | 7.31E-02 | 1.60E-01 | 0.00E+00 | -1.54E-01 | ND | ND | ND | ND | ND | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | -1.98E-03 | -3.68E-03 | 0.00E+00 |
| Total use of renew. PER | MJ/FU | 2.48E+00 | 3.53E-03 | 3.52E-01 | 2.84E+00 | 3.90E-03 | -3.53E-01 | ND | ND | ND | ND | ND | 3.50E+02 | ND | 0.00E+00 | 6.47E-04 | 2.96E-03 | -3.15E-03 | -3.19E-01 |
| Non-re. PER as energy | MJ/FU | 2.61E+01 | 2.57E-01 | 1.45E+00 | 2.78E+01 | 2.84E-01 | 7.26E-03 | ND | ND | ND | ND | ND | 3.14E+03 | ND | 0.00E+00 | 4.72E-02 | -1.00E+00 | -1.03E+00 | -7.15E+00 |
| Non-re. PER as material | MJ/FU | 1.72E+00 | 0.00E+00 | -5.92E-02 | 1.66E+00 | 0.00E+00 | -3.99E-03 | ND | ND | ND | ND | ND | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | -8.24E-01 | -8.31E-01 | 0.00E+00 |
| Total use of non-re. PER | MJ/FU | 2.78E+01 | 2.57E-01 | 1.39E+00 | 2.95E+01 | 2.84E-01 | 3.27E-03 | ND | ND | ND | ND | ND | 3.14E+03 | ND | 0.00E+00 | 4.72E-02 | -1.82E+00 | -1.86E+00 | -7.15E+00 |
| Secondary materials | kg/FU | 7.79E-03 | 0.00E+00 | 0.00E+00 | 7.79E-03 | 0.00E+00 | 0.00E+00 | ND | ND | ND | ND | ND | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Renew. secondary fuels | MJ/FU | 1.14E-03 | 1.39E-06 | 1.18E-04 | 1.26E-03 | 1.54E-06 | 9.03E-08 | ND | ND | ND | ND | ND | 3.26E-03 | ND | 0.00E+00 | 2.70E-07 | 1.81E-06 | 3.42E-07 | -3.20E-05 |
| Non-ren. secondary fuels | MJ/FU | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | ND | ND | ND | ND | ND | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Use of net fresh water | $m^3$/FU | 1.48E-02 | 3.81E-05 | 2.13E-03 | 1.70E-02 | 4.21E-05 | 1.36E-05 | ND | ND | ND | ND | ND | 9.46E-01 | ND | 0.00E+00 | 6.25E-06 | 9.26E-05 | -4.21E-05 | -3.17E-03 |

*8) PER = Primary energy resources.*

## END OF LIFE – WASTE

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hazardous waste | kg/FU | 3.33E-01 | 4.36E-04 | 3.05E-03 | 3.36E-01 | 4.82E-04 | 2.21E-04 | ND | ND | ND | ND | ND | 4.09E+01 | ND | 0.00E+00 | 8.23E-05 | 1.40E-03 | 2.82E-03 | -1.34E-01 |
| Non-hazardous waste | kg/FU | 5.83E+00 | 8.07E-03 | 1.61E-01 | 5.99E+00 | 8.92E-03 | 1.20E-02 | ND | ND | ND | ND | ND | 3.15E+02 | ND | 0.00E+00 | 1.54E-03 | 3.74E-02 | 1.52E-01 | -1.99E+00 |
| Radioactive waste | kg/FU | 3.20E-05 | 5.49E-08 | 6.62E-07 | 3.27E-05 | 6.06E-08 | 2.20E-09 | ND | ND | ND | ND | ND | 2.72E-03 | ND | 0.00E+00 | 9.36E-09 | 6.73E-08 | 7.03E-09 | -1.08E-05 |

## END OF LIFE – OUTPUT FLOWS

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Components for reuse | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | ND | ND | ND | ND | ND | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Materials for recycling | kg | 0.00E+00 | 0.00E+00 | 2.41E-03 | 2.41E-03 | 0.00E+00 | 0.00E+00 | ND | ND | ND | ND | ND | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 3.30E-02 | 0.00E+00 | 0.00E+00 |
| Materials for energy rec | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | ND | ND | ND | ND | ND | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Exported energy | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | ND | ND | ND | ND | ND | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 3.27E-01 | 0.00E+00 | 0.00E+00 |
| Exported energy – Electricity | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | ND | ND | ND | ND | ND | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 1.38E-01 | 0.00E+00 | 0.00E+00 |
| Exported energy – Heat | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | ND | ND | ND | ND | ND | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 1.90E-01 | 0.00E+00 | 0.00E+00 |

## ENVIRONMENTAL IMPACTS – EN 15804+A1, CML

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Global Warming Pot. | kg $CO_2$ éq./FU | 2.27E+00 | 1.76E-02 | 1.33E-01 | 2.42E+00 | 1.95E-02 | 6.96E-04 | ND | ND | ND | ND | ND | 3.29E+02 | ND | 0.00E+00 | 3.35E-03 | 7.07E-02 | 3.60E-02 | -6.83E-01 |
| Ozone depletion Pot. | kg $CFC_{11}$e/FU | 1.25E-07 | 2.09E-10 | 1.22E-09 | 1.26E-07 | 2.31E-10 | 8.20E-12 | ND | ND | ND | ND | ND | 7.40E-07 | ND | 0.00E+00 | 3.76E-11 | 3.86E-11 | 2.22E-11 | -2.55E-09 |
| Acidification | kg $SO_2$e/FU | 1.53E-02 | 4.62E-05 | 6.23E-04 | 1.60E-02 | 5.10E-05 | 3.06E-06 | ND | ND | ND | ND | ND | 1.49E+00 | ND | 0.00E+00 | 8.59E-06 | 2.48E-05 | 8.91E-06 | -7.44E-03 |
| Eutrophication | kg $PO_4^3$e/FU | 4.13E-03 | 1.13E-05 | 1.46E-04 | 4.28E-03 | 1.24E-05 | 9.52E-07 | ND | ND | ND | ND | ND | 1.56E-01 | ND | 0.00E+00 | 2.09E-06 | 5.86E-06 | 4.68E-06 | -4.41E-04 |
| POCP (“smog”) | kg $C_2H_4$e/FU | 1.28E-03 | 4.12E-06 | 4.51E-05 | 1.33E-03 | 4.55E-06 | 2.33E-07 | ND | ND | ND | ND | ND | 8.24E-02 | ND | 0.00E+00 | 7.69E-07 | 1.52E-06 | 8.40E-07 | -4.04E-04 |
| ADP-elements | kg Sbe/FU | 1.81E-04 | 4.83E-08 | 2.01E-07 | 1.81E-04 | 5.33E-08 | 1.74E-09 | ND | ND | ND | ND | ND | 1.32E-03 | ND | 0.00E+00 | 1.08E-08 | 6.03E-08 | 3.38E-09 | -3.82E-05 |
| ADP-fossil | MJ/FU | 2.59E+01 | 2.54E-01 | 1.52E+00 | 2.77E+01 | 2.81E-01 | 7.12E-03 | ND | ND | ND | ND | ND | 2.95E+03 | ND | 0.00E+00 | 4.66E-02 | 3.90E-02 | 1.85E-02 | -6.43E+00 |

## ADDITIONAL INDICATOR – GWP-GHG

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GWP-GHG [9)] | kg $CO_2$e/FU | 2.27E+00 | 1.77E-02 | 1.33E-01 | 2.42E+00 | 1.96E-02 | 7.02E-04 | ND | ND | ND | ND | ND | 3.32E+02 | ND | 0.00E+00 | 3.37E-03 | 7.08E-02 | 3.60E-02 | -6.88E-01 |

*9) This indicator includes all greenhouse gases excluding biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. In addition, the characterisation factors for the flows - CH4 fossil, CH4 biogenic and Dinitrogen monoxide - were updated. This indicator is identical to the GWP-total of EN 15804:2012+A2:2019 except that the characterization factor for biogenic CO2 is set to zero.*

## SCENARIO DOCUMENTATION

## DATA SOURCES

**Manufacturing energy scenario documentation – A3 (Energy data source)**

1. Electricity, Electricity, consumption mix w/o renewables, China, 2022, China, LCA study for country specific consumption mixes, OneClickLCA 2025, 1.15 kgCO2e/kWh
2. Energy supply, electricity production, co-generation oil and gas, Heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical, World, ecoinvent 3.10.1, 0.0307 kgCO2e/MJ
3. Construction, specialized activities, demolition and site preparation, Market for diesel, burned in building machine, World, ecoinvent 3.10.1, 0.10 kgCO2e/MJ

**Transport scenario documentation - A4**

1. Transport, freight, lorry >32 metric ton, EURO5, 1445.29 km
2. Transport, freight, sea, container ship, 0.0 km

**Installation scenario documentation - A5 (Waste materials data source)**

1. Market for printed paper, offset, 0.024 kg

**Use stages scenario documentation - B6-B7 (Energy data source)**

1. Energy supply, electricity transformation and distribution, distribution low voltage, Market group for electricity, low voltage, China, 700.0 kWh

## TRANSPORT SCENARIO DOCUMENTATION - A4

| Scenario parameter | Value |
|---|---|
| Capacity utilization (including empty return) % | 50 % |
| Bulk density of transported products / kg/m3 | 2.64E+02 |
| Volume capacity utilization factor (factor: =1 or <1 or ≥1 for compressed or nested packaged products) | 1 |

## INSTALLATION SCENARIO DOCUMENTATION - A5

| Scenario parameter | Value |
|---|---|
| Ancillary materials for installation (specified by material) / kg or other units as appropriate | 0 |
| Water use / m³ | 0 |
| Other resource use / kg | 0 |
| Direct emissions to ambient air, soil and water / kg | 0 |

## USE STAGES SCENARIO DOCUMENTATION - B6-B7 USE OF ENERGY AND WATER

| Scenario information | Value |
|---|---|
| Ancillary materials specified by material / kg or units as appropriate | Not applicable |
| Net fresh water consumption / $m^3$ | 0 |
| Power output of equipment / kW | 14 |
| Characteristic performance, e.g., energy efficiency, emissions, variation of performance with capacity utilization, etc. / Units as appropriate | For more details see product classification table and product description. |
| Further assumptions for scenario development, e.g., frequency and period of use, number of occupants / Units as appropriate | For more details see product classification table and product description. |

## END OF LIFE SCENARIO DOCUMENTATION

| Scenario information | Value |
|---|---|
| Collection process – kg collected separately | 0.246 |
| Collection process – kg collected with mixed waste | 0 |
| Recovery process – kg for re-use | 0 |
| Recovery process – kg for recycling | 7.08E-02 |
| Recovery process – kg for energy recovery | 0 |
| Disposal (total) – kg for final deposition | 1.14E-01 |
| Scenario assumptions e.g. transportation | Lorry, 16-32 metric ton, EURO5; 150 km |

# THIRD-PARTY VERIFICATION STATEMENT

EPD Hub declares that this EPD is verified in accordance with ISO 14025 by an independent, third-party verifier. The project report on the Life Cycle Assessment and the report(s) on features of environmental relevance are filed at EPD Hub. EPD Hub PCR and ECO Platform verification checklist are used.

EPD Hub is not able to identify any unjustified deviations from the PCR and EN 15804+A2 in the Environmental Product Declaration and its project report.

EPD Hub maintains its independence as a third-party body; it was not involved in the execution of the LCA or in the development of the declaration and has no conflicts of interest regarding this verification.

The company-specific data and upstream and downstream data have been examined as regards plausibility and consistency. The publisher is responsible for ensuring the factual integrity and legal compliance of this declaration.

Program assistant: Xinyuan Zhang

The software used in creation of this LCA and EPD is verified by EPD Hub to conform to the procedural and methodological requirements outlined in ISO 14025:2010, ISO 14040/14044, EN 15804+A2, and EPD Hub Core Product Category Rules and General Program Instructions.

Verified tools
Tool verifier: Hai Ha Nguyen
Tool verification validity: 28 March 2025 - 27 March 2028

# APPENDIX 1

## MATERIAL COMPOSITION

The product material composition is illustrated in the table below. The material weight is given in grams and in percentage on total product weight.

**Table 1: Material composition**

| Material | Weight (g) | Weight-% |
|---|---|---|
| Aluminium | 65 | 26.4 |
| Copper | 1.1 | 0.45 |
| Other Plastics | 123.1 | 50 |
| PCB Alu | 32.79 | 13.32 |
| PCB Copper | 6.39 | 2.6 |
| PCB Iron | 1.71 | 0.7 |
| PCB Non-ferrous metal | 6.78 | 2.76 |
| PCB Support | 8.01 | 3.25 |
| PCB Tin | 1.31 | 0.53 |

# APPENDIX 2

## USE PHASE (B6) VALUES FOR DIFFERENT COUNTRY MIX

In this EPD the B6 impact has been calculated using the energy mix of **(APAC**). The table in this appendix is useful for conversion and comparison of B6 values with other country energy mix. The Global Warming Potential Total (GWP tot) value is illustrated for each country. The value refers to 1 kwh.

Example on how to use the table:

If for example this EPD was done according to EU energy mix and you want to see how the GWP total changes according to a Finland country energy mix, you can take the original value in the results table here highlighed in yellow:

### ENVIRONMENTAL IMPACT DATA, RESULTS PER DECLARED UNIT

*The estimated impact results are only relative statements which do not indicate the end points of the impact categories, exceeding threshold values, safety margins or risks.*

#### CORE ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, EF 3.1

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GWP – total[1] | kg $CO_2$e | 1.08E+01 | 2.33E-01 | 5.06E-01 | 1.15E+01 | 3.27E+00 | 1.68E+00 | ND | ND | ND | ND | ND | 4.06E-02 | ND | 0.00E+00 | 2.88E-02 | 5.13E-01 | 2.80E-01 | -9.88E-01 |

Divide that value according to the EU value from the following table (EU = 3.30E-01) and then multilplying for the Finland value from the same table (FINLAND = 1.54E-01).

Thus, the calculation of this example would be:

New B6 GWP tot for Finland = (4.06E-02 / 3.30E-01) x 1.54E-01 = 1.89E-02.

| Country | GWP tot (kg CO2 eq. per kwh) | | |
|---|---|---|---|
| AFRICA | 7.30E-01 | INDIA | 1.50E+00 |
| APAC | 9.50E-01 | ITALY | 3.50E-01 |
| AUSTRALIA | 8.40E-01 | LATAM | 3.90E-01 |
| AUSTRIA | 2.30E-01 | NAM | 4.50E-01 |
| BELGIUM | 2.00E-01 | NETHERLANDS | 3.90E-01 |
| CHINA | 1.02E+00 | NORWAY | 4.50E-02 |
| DENMARK | 1.60E-01 | ROW | 7.30E-01 |
| EU | 3.30E-01 | SPAIN | 2.10E-01 |
| FINLAND | 1.54E-01 | SWEDEN | 3.70E-02 |
| FRANCE | 8.70E-02 | UK | 2.60E-01 |
| | | GERMANY | 3.90E-01 |

Source Ecoinvent 3.10.1

# APPENDIX 3 - EPD HUB ALIGNED

This section represents the scaling method for the **B6 module**, following the PEP EcoPassport PSR for luminaries (PSR-0014-ed2.0-EN-2023 07 13). The GWP results were scaled from a reference variant of a product family, based on various light management scenarios and power inputs of the luminaires within the same product familiy.

To calculate the Scaled Impact (*SI*), we have followed the below methods:

1. Calculate the power scaling factor (PSF), which is the ratio of the power input of the variant in questions $P_{in}$ and the power input of the base variant $P_{base}$.

$$PSF = \frac{P_{in}}{P_{base}}$$

2. Calculate the Total Scaling factor by multiplying the PSF by the control scaling factor (CSF), where the CSF is determined according the relevant control factor scenario (e.g. if the luminaire has a presence detection system). The presented controls factors values in Table A1 are based on BS EN 15193-1:2017. Please refer to this publication or contact Signify directly for more information.

$$TSF = PSF * CSF$$

**Table 1: Light management function (PEP EcoPassport aligned)**

| Scenario | Abbrev. | CSF |
|---|---|---|
| No control | NC | 1 |
| Daylight dependency factor | DD | 0.75 |
| Presence sensing | PS | 0.75 |
| Daylight dependency and presence sensing | DD+PS | 0.55 |

3. Lastly, the GWP of the base variant is then scaled by the TSF.

$$Scaled\ Impact = GWP_{case} * TSF$$

The following list of product configurations is not exhaustive. Please use the formula defined in point 1 above to calculate the exact power scaling factor (PSF) for any specific configuration.

**Table 2: GWP per scaling factor (EPD Hub aligned)**

| | 12NC or Product Family Code | Description | Flux [Lm] | Power [W] | Efficacy [L/W] | PSF | Total Scaling Factor (TSF) | | | | Scaled Impacts (GWP100 B6 - kg CO2eq.) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | NC | DD | PS | DD+PS | NC | DD | PS | DD+PS |
| 1 | 929001826408 | MAS LEDtube Spectrum 1200mm 1500lm | 1500 | 14.0 | 107.1 | 1.000 | 1.000 | 0.750 | 0.750 | 0.550 | 714.0 | 535.5 | 535.5 | 392.7 |
| 2 | 929003145310 | MAS LEDtube Spectrum 1200mm 20W | 2200 | 20.0 | 110.0 | 1.429 | 1.429 | 1.071 | 1.071 | 0.786 | 1020.0 | 765.0 | 765.0 | 561.0 |
| 3 | 929003145410 | MAS LEDtube Spectrum 1050mm 20W | 2200 | 20.0 | 110.0 | 1.429 | 1.429 | 1.071 | 1.071 | 0.786 | 1020.0 | 765.0 | 765.0 | 561.0 |

# PEP ECOPASSPORT ALIGNED

This section represents the scaling method for the **B6 module**, following the PEP EcoPassport PSR for luminaries (PSR-0014-ed2.0-EN-2023 07 13). The GWP results were scaled from a refernce variant of a product family, based on various light management functions, the lumen output ($O_{lum}$) and reference service life (*RSL*) of each product within the same product familiy.

To calculate the Scaled Impact ($SI_{pep}$), we have followed the below methods:

1. Calculate the power scaling factor (PSF), which is the ratio of the power input of the variant in questions $P_{in}$ and the power input of the base variant $P_{base}$.

$$PSF = \frac{P_{in}}{P_{base}}$$

2. Using this scaled GWP, we then can apply the PEP Ecopassport method for calculating the environmental impact of the functional unit for a luminary (1000 lumens over 35000 hours), applied to B6, where the Functional Unit application considers the lumen output (Olum) and reference service lifetime (RSL) of the product to estimate the final environmental impact. The scaled impact (SIpep) is presented in Table A4.

$$GSF = \frac{FU_{pep}}{FU_p} = \frac{1{,}000}{O_{lum}} * \frac{35{,}000}{RSL}$$

3. Calculate the GWP scaling factor (P*GSF*), by multiplying the PSF by the GSF.

$$PGSF = PSF * GSF$$

4. Calculate the Total Scaling factor by multiplying the PSF by the control scaling factor (CSF), where the CSF is determined according the relevant control factor scenario (e.g. if the luminaire has a presence detection system), as presented in Table A1.

$$TSF = PGSF * CSF$$

**Table 3: Light management functions (PEP EcoPassport aligned)**

| Scenario | Abbrev. | CSF |
|---|---|---|
| No control | NC | 1 |
| Daylight dependency factor | DD | 0.75 |
| Presence sensing | PS | 0.75 |
| Daylight dependency and presence sensing | DD+PS | 0.55 |

5. Lastly, the GWP of the base variant is then scaled by the TSF.

$$Scaled\ GWP = GWP_{case} * TSF$$

**Table 4: Impact per scaling factor (PEP EcoPassport aligned)**

| | 12NC or Product Family Code | Description | Flux [Lm] | Power [W] | Efficacy [L/W] | PSF | Total Scaling Factor (TSF) | | | | Scaled Impacts (GWP100 B6 - kg CO2eq.) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | NC | DD | PS | DD+PS | NC | DD | PS | DD+PS |
| 1 | 929001826408 | MAS LEDtube Spectrum 1200mm 1500lm | 1500 | 14.0 | 107.1 | 1.000 | 0.467 | 0.350 | 0.350 | 0.257 | 333.2 | 249.9 | 249.9 | 183.3 |
| 2 | 929003145310 | MAS LEDtube Spectrum 1200mm 20W | 2200 | 20.0 | 110.0 | 1.429 | 0.455 | 0.341 | 0.341 | 0.250 | 324.5 | 243.4 | 243.4 | 178.5 |
| 3 | 929003145410 | MAS LEDtube Spectrum 1050mm 20W | 2200 | 20.0 | 110.0 | 1.429 | 0.455 | 0.341 | 0.341 | 0.250 | 324.5 | 243.4 | 243.4 | 178.5 |