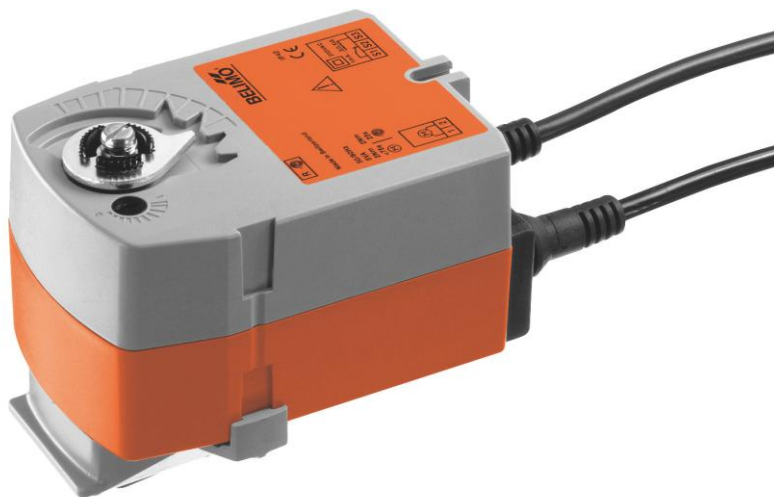


# Environmental Product Declaration

## Type III Environmental Declaration



In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC:2021 for:

## Valve Actuators

Covered products:

**TRF..**

All products are specified on page 3

from

**Belimo Automation AG**



|                          |                                                                                           |
|--------------------------|-------------------------------------------------------------------------------------------|
| <b>Program:</b>          | The International EPD® System, <a href="http://www.environdec.com">www.environdec.com</a> |
| <b>Program operator:</b> | EPD International AB                                                                      |
| <b>Version date:</b>     | 2026-09-16                                                                                |
| <b>Validity date:</b>    | 2031-09-15                                                                                |
| <b>Version:</b>          | 1.0 (original version of the EPD)                                                         |
| <b>EPD reg. number:</b>  | EPD-IES-0034847:001                                                                       |
| <b>EPD type:</b>         | EPD of multiple products, based on worst-case results of product group                    |

## GENERAL INFORMATION

| Program Information |                                                                     |
|---------------------|---------------------------------------------------------------------|
| <b>Program:</b>     | The International EPD® System                                       |
| <b>Address:</b>     | EPD International AB<br>Box 210 60<br>SE-100 31 Stockholm<br>Sweden |
| <b>Website:</b>     | www.environdec.com                                                  |
| <b>E-mail:</b>      | support@environdec.com                                              |

| Product Category Rules (PCR)                                                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CEN standard EN 15804 serves as the Core Product Category Rules (PCR)</b>                                                                                                                                                                                                                                                                                          |
| <b>Product Category Rules (PCR):</b> <i>PCR 2019:14 Construction Products, Version 2.0.1, 2025-06-05 (valid until 2030-04-07)</i>                                                                                                                                                                                                                                     |
| PCR review was conducted by The Technical Committee of the International EPD System. See <a href="http://www.environdec.com">www.environdec.com</a> for a list of members. Review chair: Rob Rouwette (chair), Noa Meron (co-chair). The review panel may be contacted via the Secretariat <a href="http://www.environdec.com/contact">www.environdec.com/contact</a> |

| Third-party Verification                                                                                                                                                                                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Independent third-party verification of the declaration and data, according to ISO 14025:2006, via:                                                                                                                              |
| <input checked="" type="checkbox"/> <b>Individual EPD verification without a pre-verified LCA/EPD tool</b><br>Third-party verifier: <i>Prof. Ing. Silvia Vilčeková, SILCERT, s.r.o.</i><br>Approved by: International EPD System |
| Procedure for follow-up of data during EPD validity involves third party verifier:<br><br><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No                                                                    |

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

EPDs within the same product category but published in different EPD programs, may not be comparable. For two EPDs to be comparable, they shall be based on the same PCR (including the same first-digit version number) or be based on fully aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have identical scope in terms of included life-cycle stages (unless the excluded life-cycle stage is demonstrated to be insignificant); apply identical impact assessment methods (including the same version of characterization factors); and be valid at the time of comparison.

For further information about comparability, see EN 15804 and ISO 14025.

**Version history:**

Version 1, 2026-09-16, Original version of the EPD

**INFORMATION ABOUT THE DECLARANT****Owner of Declaration:**

Belimo Automation AG

**Address:**

Brunnenbachstrasse 1  
8340 Hinwil  
Switzerland

**Contact:**

Website: [www.belimo.com](http://www.belimo.com)  
E-mail: [info@belimo.ch](mailto:info@belimo.ch)  
Tel.: (+41) 43 843 61 11

**LCA practitioner:**

Stefan Emil Danielsson  
LCA/EPD Specialist

**Description of the organization:**

Belimo develops, produces, and markets field devices for the energy-efficient control of heating, ventilation, and air-conditioning (HVAC) systems worldwide. The focus of its core business is on damper actuators, control valves, sensors and meters. Belimo actuators control air dampers and valve positioning in HVAC systems, ensuring precise airflow and temperature control. The Company provides a wide range of control valves (e.g., pressure-independent valves) used for heating and cooling systems. Its sensors monitor air quality, temperature, humidity, and pressure, and are crucial for modern building automation. With decades of experience, Belimo is recognized as a leading innovator in HVAC control solutions with numerous patents and several industry-first proprietary technologies introduced to the market over the past 50 years. Belimo's product portfolio is designed to improve energy efficiency and longevity and is continuously optimized to this end.

Belimo's main markets are: Americas, EMEA (Europe, Middle East, and Africa) and Asia-Pacific.

**Product / management system-related certifications:**

Belimo is committed to maintaining its certifications in accordance with the international standards for environmental management (ISO 14001), quality management (ISO 9001), and occupational health and safety (ISO 45001). Belimo sites undergo regular audits from the Swiss Association for Quality and Management Systems (SQS) and the China Quality Certification Center (CQC) in China.

**PRODUCT INFORMATION**Product name:

This Environmental Declaration contains information for the **worst-case** representative of models from the **TRF..** product family, including the following (the declared product is in bold):

|                 |            |
|-----------------|------------|
| TRF230          | TRF24-2-O  |
| TRF230-O        | TRF24-O    |
| <b>TRF230-S</b> | TRF24-S    |
| TRF230-S-O      | TRF24-S-O  |
| TRF24           | TRF24-SR   |
| TRF24-2         | TRF24-SR-O |

Image of product:

TRF.. product family members are similar in physical appearance. Example of a model from the product family:

Product description:

The Belimo product portfolio comprises a comprehensive range of actuators designed for the precise positioning and control of valves in HVAC and building automation systems. These actuators are used in heating and cooling applications to ensure reliable system operation and accurate control under a wide range of operating conditions.

All actuators are engineered for long service life, low power consumption, and maintenance-free functionality. Their design enables precise and reliable valve positioning, contributing to enhanced system stability, responsiveness, and energy-efficient system operation.

Manufactured in accordance with applicable industry and environmental standards, Belimo actuators deliver consistent, high-quality performance. They support the requirements of all relevant stakeholders by enabling reliable and efficient control of HVAC applications.

More information about the product can be found on our website [www.belimo.com](http://www.belimo.com) and the belonging [technical data sheets](#).

Name and location of production site(s):

Belimo Switzerland in Hinwil, Switzerland

## CONTENT DECLARATION

The mass (weight) of one unit of a product, as purchased or per declared unit:

656 g

Content of the product in the form of a list of materials and substances, and their mass:

| Product content                      | Mass, g      | Post-consumer recycled material, mass-% of product | Biogenic material, mass-% of product | Biogenic material, g C/product or declared unit |
|--------------------------------------|--------------|----------------------------------------------------|--------------------------------------|-------------------------------------------------|
| Brass                                | 6.0          | 0.0                                                | 0.0                                  | 0.0                                             |
| Cable                                | 129.2        | 0.0                                                | 0.0                                  | 0.0                                             |
| Electronics                          | 6.0          | 0.0                                                | 0.0                                  | 0.0                                             |
| Electronics (PCBA)                   | 2.0          | 0.0                                                | 0.0                                  | 0.0                                             |
| Motor                                | 49.0         | 0.0                                                | 0.0                                  | 0.0                                             |
| Paper                                | 0.3          | 0.0                                                | 0.0                                  | 0.0                                             |
| Plastic (other)                      | 4.0          | 0.0                                                | 0.0                                  | 0.0                                             |
| Plastic (PA)                         | 3.7          | 0.0                                                | 0.0                                  | 0.0                                             |
| Plastic (PA), glass-fiber reinforced | 10.0         | 0.0                                                | 0.0                                  | 0.0                                             |
| Plastic (PC)                         | 65.0         | 0.0                                                | 0.0                                  | 0.0                                             |
| Plastic (PC), glass-fiber reinforced | 132.0        | 0.0                                                | 0.0                                  | 0.0                                             |
| Plastic (PET)                        | 0.7          | 0.0                                                | 0.0                                  | 0.0                                             |
| Plastic (POM)                        | 11.9         | 0.0                                                | 0.0                                  | 0.0                                             |
| Plastic (PS)                         | 0.2          | 0.0                                                | 0.0                                  | 0.0                                             |
| Rubber (natural)                     | 1.0          | 0.0                                                | 0.0                                  | 0.0                                             |
| Steel (carbon)                       | 139.9        | 0.0                                                | 0.0                                  | 0.0                                             |
| Steel (sintered)                     | 22.0         | 0.0                                                | 0.0                                  | 0.0                                             |
| Steel (spring)                       | 3.0          | 0.0                                                | 0.0                                  | 0.0                                             |
| Steel (stainless)                    | 30.3         | 0.0                                                | 0.0                                  | 0.0                                             |
| Steel (unalloyed)                    | 18.3         | 0.0                                                | 0.0                                  | 0.0                                             |
| (blank)                              | 21.0         | 0.0                                                | 0.0                                  | 0.0                                             |
| <b>Total</b>                         | <b>655.5</b> | <b>0.0</b>                                         | <b>0.0</b>                           | <b>0.0</b>                                      |

| Packaging materials | Mass, g     | Mass-% (versus the product) | Biogenic material, g C/product or declared unit |
|---------------------|-------------|-----------------------------|-------------------------------------------------|
| Cardboard box       | 52.0        | 7.9                         | 26.0                                            |
| Kraft paper         | 15.6        | 2.4                         | 7.8                                             |
| PE pallet           | 8.6         | 1.3                         | 0.0                                             |
| <b>Total</b>        | <b>76.2</b> | <b>11.6</b>                 | <b>33.8</b>                                     |

1 kg biogenic carbon in the product/packaging is equivalent to the uptake of 44/12 kg of CO<sub>2</sub>.

## CONTENT DECLARATION

### The mass and the content of distribution and/or consumer packaging:

Displayed on the table above. The pallet is a one-way pallet as it is unknown where it ends downstream. Therefore, it is modelled as a single use in the LCA. It is assumed that 270 kg of products are transported on a 3.6 kg pallet.

### The declared share of biogenic/recycled materials

There is no biogenic content in the product. The product packaging is made of virtually 100% biogenic material neglecting the minor amount of tape and label. The packaging consists of corrugated cardboard box and kraft paper filler. There is no biogenic content in the plastic pallet. The biogenic content is declared in the content declaration table below.

Regarding the metals used in the product, no documentation on recycled content was possible to obtain from suppliers.

The content declaration applies for the average product which includes all relevant materials representative for the entire product group.

### Information on the environmental and hazardous/toxic properties of substances contained in the product:

No substances in the candidate list of Substances of Very High Concern (SVHCs), contained in the product exceed the limits for registration with the European Chemicals Agency, i.e. more than 0.1% of the weight of the declared unit.

<http://echa.europa.eu/candidate-list-table>

**LCA INFORMATION****Declared unit:**

1 piece of product

**Conversion factor to mass:**

656 g per piece of product

**Reference service life:**

15 years

**Time representativeness:**

Primary data representing the manufacturing of the product were collected between March 2025 and April 2026. The assessed product is part of Belimo's existing product portfolio and has been commercially available for several years.

**Geographical scope:**

Purchased materials are sourced in Europe and globally, and manufacturing takes place in Switzerland. Baseline geographical scope for the use stage and end-of-life stages is defined as Global, to remain conservative. A European scenario is presented for the use-stage too.

**Physical material properties of product:**

Please refer to the table in chapter "Additional Environmental Information", as well as our website [www.belimo.com](http://www.belimo.com) and the belonging [technical data sheets](#).

**Variation:**

No variation is calculated since the EPD type is a worst-case representation.

**Database(s) and LCA software used:**

The LCA was performed in SimaPro Craft v.10.2.0.2 using the Ecoinvent v.3.11 background database and the EN 15804 A2 reference package based on the EF 3.1 characterization method, in accordance with ISO 14040/44 principles.

**Description of system boundaries:**

The type of EPD is Cradle to gate (A1-A3) with options (A5 and B6), modules C1-C4, and module D. The system boundaries and modules are described below.

B6\*\*, C1\*, C2\*, C3\*, C4\* and D\* are introduced as scenarios attributed to European practice and are presented further below.

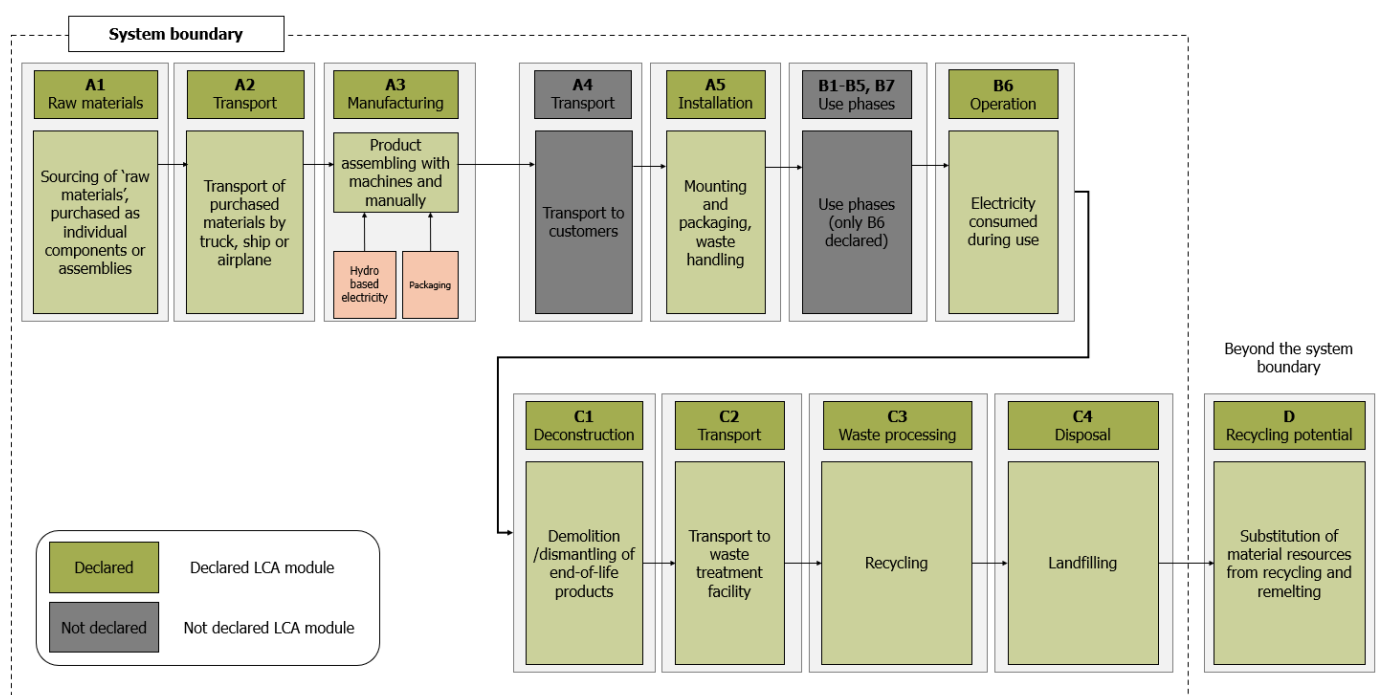
## LCA INFORMATION

Modules declared, geographical scope, share of primary data (in GWP-GHG results) and data variation (in GWP-GHG results):

|                       | Product stage       |           |               | Distribution/<br>installation<br>stage |                           | Use stage |             |        |             |               |                        |                       | End-of-life stage          |           |                  |          | Beyond<br>product life<br>cycle        |
|-----------------------|---------------------|-----------|---------------|----------------------------------------|---------------------------|-----------|-------------|--------|-------------|---------------|------------------------|-----------------------|----------------------------|-----------|------------------|----------|----------------------------------------|
|                       | Raw material supply | Transport | Manufacturing | Transport                              | Construction installation | Use       | Maintenance | Repair | Replacement | Refurbishment | Operational energy use | Operational water use | De-construction demolition | Transport | Waste processing | Disposal | Reuse-Recovery-Recycling-<br>potential |
| Module                | A1                  | A2        | A3            | A4                                     | A5                        | B1        | B2          | B3     | B4          | B5            | B6                     | B7                    | C1                         | C2        | C3               | C4       | D                                      |
| Modules declared      | x                   | x         | x             | ND                                     | x                         | ND        | ND          | ND     | ND          | ND            | x                      | ND                    | x                          | x         | x                | x        | x                                      |
| Geography             | GLO                 | GLO       | CH            | -                                      | GLO                       | -         | -           | -      | -           | -             | GLO                    | -                     | GLO                        | GLO       | GLO              | GLO      | GLO                                    |
| Share of primary data | 6.5%                |           |               | -                                      | -                         | -         | -           | -      | -           | -             | -                      | -                     | -                          | -         | -                | -        | -                                      |
| Variation – products  | N/A                 |           |               | -                                      | -                         | -         | -           | -      | -           | -             | -                      | -                     | -                          | -         | -                | -        | -                                      |
| Variation – sites     | 0%                  |           |               | -                                      | -                         | -         | -           | -      | -           | -             | -                      | -                     | -                          | -         | -                | -        | -                                      |

“X” = Declared Modules. “ND” = Not Declared modules/processes/life-cycle stages

Process flow diagram:



**LCA INFORMATION****Global scenario (default):****A1-A3 (Product stage):**

Modules A1-A3 cover the supply of purchased materials, their transport to Belimo, and final manufacturing. Components are sourced globally and transported by road, sea, and air. Final assembly takes place at Belimo's production facility, mainly using manual labor and electricity certified as European hydropower (0.0124 kg CO<sub>2</sub>e/kWh). Energy consumption (electricity and district heating) includes both production and office operations and is evenly allocated by unit (piece) over all products sold by Belimo. Products are packed, stacked on a one-way HDPE pallet, and prepared for shipment.

**A5 (Construction stage):**

Module A5 covers packaging waste generated during installation. Corrugated cardboard and kraft paper are assumed to be landfilled with construction waste, while the higher value plastic pallets are assumed to be recycled on the market. Related flows are reported in Module D. No environmental emissions from installation itself occur, as it is performed manually or with negligible-impact tools, such as a wrench.

**B6 (Use stage):**

Module B6 accounts for electricity consumption during product operation. Impacts depend on the electricity mix, operating hours, and idle time. Calculations assume a 15-year service life.

- **B6:** Global average electricity mix

**C1-C4 (End-of-life stage):**

No incineration scenario is introduced as it is not relevant for the end-of-life treatment of such construction products. The waste management practice of Europe and other global markets (Americas, Africa, Middle East, Asia Pacific) may differ. Therefore, two scenarios are presented; European scenario as additional results and Global scenario as main results:

- **C1:** Demolition with heavy machinery. Belimo products are negligible relative to building mass. Thus, impacts are declared as 0
- **C2:** 50 km transport by 7.5-16 t EURO 5 lorry (50% load factor)
- **C3:** 0 (no recycling)
- **C4:** 100% landfill with mixed demolition waste

Both scenarios are declared separately. Users may apply either one or combine them into an average, depending on the regional context.

**D (Benefits and loads beyond system boundary):**

Declares net flows of energy and secondary materials leaving the product system and that fulfils the end-of-waste criteria

- **D:** credits from pallet recycling in A5 (*benefits*)

**Credit calculation principle (for each material fraction):**

- Virgin equivalent mass = recovered mass × (1 – recycled content)
- Substituted mass = virgin equivalent mass × substitution rate
- Credit = substituted mass × impact of virgin production
- Burden = recovered mass × processing burden
- Net credit = credit – burden

## LCA INFORMATION

### More information:

Recycled material is not used directly in Belimo's manufacturing. Production generates no co-products or notable waste. The only recycled input is partially recycled metal from the global market, whose burden is already included in the LCA.

### European scenario:

#### B6\*\* (Use stage):

- **B6\*\*:** European average electricity mix

#### C1\*-C4\* (End-of-life stage):

- **C1\*:** Selective dismantling with source separation, manually or with tools. Impacts negligible, thus declared as 0
- **C2\*:** 50 km transport by 7.5-16 t EURO 5 lorry (50% load factor)
- **C3\*:** Modern recycling facility
  - Metals, plastics, cables, electronics and motors are fractioned and sorted
    - Metals (ferrous/non-ferrous): recovered 100% for recycling and remelting
    - Plastics: incinerated, Electronics: recovered for further recycling
- *Other minor complexes such as adhesive and lubricant are neglected*
- **C4\*:** 0 (no landfill)

#### D\* (Benefits and loads beyond system boundary):

- **D\*:** credits from pallet recycling in A5 + material fractions recycling in C3\* (*benefits*)
- **D\*:** burden from metal remelting at smelting facility in C3\* (*loads*)

### Cut-off criteria:

All major raw material and energy inputs are included. All unit processes for which data exist are accounted for, and no single neglected flow exceeds 1% of total mass or energy. Overall omissions remain below 5%, meaning more than 95% of flows are covered. The LCA includes all processes from raw material extraction through production and end-of-life. Capital goods (equipment, buildings), staff transport, and personnel-related activities are excluded. Omitted processes include:

- landfilling of ashes from incineration or remelting
- minor inputs such as adhesives and lubricants
- end-of-life management of production and R&D waste

### Allocation rules:

Allocation is avoided where possible. The only allocations applied in the LCA were:

- Electricity and heat consumption, allocated equally per product unit sold
- Pallet use, allocated among products on a mass basis according to load capacity

### Data quality:

Data quality of primary and secondary data had been judged by its precision (measured, calculated, or estimated), completeness (e.g., unreported emissions), consistency (degree of uniformity of the methodology applied), and representativeness (geographical, technological, and temporal). A data quality assessment compliant with EN 15941 and EN 15804 Annex E, Table E.2, was conducted and documented in the LCA report for each dataset. The selected datasets were generally rated as having good to very good geographical, temporal, and technological representativeness. Data were collected between March 2025 and April 2026. The table below indicates the difference of primary and secondary data used in the study, in accordance with PCR 2019:14.

| Process                                                   | Source type    | Source                      | Reference year | Data category  | Share of primary data, of GWP-GHG results for A1-A3 |
|-----------------------------------------------------------|----------------|-----------------------------|----------------|----------------|-----------------------------------------------------|
| A1: Purchase of materials                                 | Collected data | Belimo                      | 2025           | Secondary data | 0.0%                                                |
| A2: Transport of materials to manufacturing site          | Collected data | Belimo                      | 2025           | Primary data   | 4.4%                                                |
| A3: Packaging use                                         | Collected data | Belimo                      | 2025           | Primary data   | 1.7%                                                |
| A3: Energy used in manufacturing                          | Collected data | Belimo / Certified supplier | 2025           | Primary data   | 0.4%                                                |
| Total share of primary data, of GWP-GHG results for A1-A3 |                |                             |                |                | 6.5%                                                |

*The share of primary data is calculated based on GWP-GHG results. It is a simplified indicator for data quality that supports the use of more primary data, to increase the representativeness of and comparability between EPDs. Note that the indicator does not capture all relevant aspects of data quality and is not comparable across product categories.*

## ENVIRONMENTAL PERFORMANCE

### Main/default results (Global scenario)

#### LCA results of the product(s) - main environmental performance results

Results are per declared unit

#### Mandatory impact category indicators according to EN 15804

| Indicator              | Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A1-A3     | A5        | B6       | C1       | C2       | C3       | C4       | D         |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|----------|----------|----------|----------|----------|-----------|
| GWP-total              | kg CO <sub>2</sub> eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 3.98E+00  | 1.26E-01  | 5.67E+01 | 0.00E+00 | 1.33E-02 | 0.00E+00 | 4.11E-03 | -1.93E-02 |
| GWP-fossil             | kg CO <sub>2</sub> eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 4.03E+00  | 4.08E-03  | 5.62E+01 | 0.00E+00 | 1.33E-02 | 0.00E+00 | 4.10E-03 | -1.92E-02 |
| GWP-biogenic           | kg CO <sub>2</sub> eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | -5.57E-02 | 1.22E-01  | 3.35E-01 | 0.00E+00 | 4.08E-06 | 0.00E+00 | 1.97E-06 | -6.71E-05 |
| GWP-luluc              | kg CO <sub>2</sub> eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 9.24E-03  | 4.23E-06  | 1.20E-01 | 0.00E+00 | 5.94E-06 | 0.00E+00 | 2.35E-06 | -9.25E-06 |
| ODP                    | kg CFC 11 eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1.71E-07  | 4.70E-11  | 3.98E-07 | 0.00E+00 | 1.68E-10 | 0.00E+00 | 1.14E-10 | -9.64E-10 |
| AP                     | mol H <sup>+</sup> eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 7.07E-02  | 2.23E-05  | 2.98E-01 | 0.00E+00 | 4.52E-05 | 0.00E+00 | 2.87E-05 | -5.36E-05 |
| EP-freshwater          | kg P eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 5.99E-03  | 1.35E-06  | 2.85E-02 | 0.00E+00 | 1.45E-06 | 0.00E+00 | 3.59E-07 | -3.05E-06 |
| EP-marine              | kg N eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2.43E-02  | 4.81E-05  | 5.74E-02 | 0.00E+00 | 1.43E-05 | 0.00E+00 | 1.10E-05 | -1.17E-05 |
| EP-terrestrial         | mol N eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 7.09E-02  | 4.63E-05  | 5.77E-01 | 0.00E+00 | 1.56E-04 | 0.00E+00 | 1.20E-04 | -1.20E-04 |
| POCP                   | kg NMVOC eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 2.34E-02  | 4.70E-05  | 1.72E-01 | 0.00E+00 | 6.13E-05 | 0.00E+00 | 4.35E-05 | -1.04E-04 |
| ADP-minerals & metals* | kg Sb eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 8.71E-04  | 1.84E-08  | 3.43E-04 | 0.00E+00 | 4.34E-08 | 0.00E+00 | 5.97E-09 | -1.02E-07 |
| ADP-fossil*            | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 6.16E+01  | 4.84E-02  | 7.57E+02 | 0.00E+00 | 1.83E-01 | 0.00E+00 | 1.00E-01 | -6.42E-01 |
| WDP*                   | m <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 2.92E+00  | -1.02E-02 | 1.28E+01 | 0.00E+00 | 1.04E-03 | 0.00E+00 | 4.46E-03 | -4.07E-03 |
| Acronyms               | GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption |           |           |          |          |          |          |          |           |

\*Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

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

The results of the end-of-life stage (modules C1-C4) should be considered when using the results of the product stage (modules A1-A3).

#### Additional mandatory and voluntary impact category indicators

| Indicator | Unit                   | A1-A3    | A5       | B6       | C1       | C2       | C3       | C4       | D         |
|-----------|------------------------|----------|----------|----------|----------|----------|----------|----------|-----------|
| GWP-GHG** | kg CO <sub>2</sub> eq. | 4.04E+00 | 4.09E-03 | 5.63E+01 | 0.00E+00 | 1.33E-02 | 0.00E+00 | 4.10E-03 | -3.84E-05 |

\*\*This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such, the indicator is identical to GWP-total except that the CF for biogenic CO<sub>2</sub> is set to zero.

## ENVIRONMENTAL PERFORMANCE

## Resource Use indicators

| Indicator | Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A1-A3    | A5        | B6       | C1       | C2       | C3       | C4       | D         |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-----------|----------|----------|----------|----------|----------|-----------|
| PERE      | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.22E+01 | 7.26E-03  | 1.19E+02 | 0.00E+00 | 2.55E-03 | 0.00E+00 | 9.39E-04 | -1.31E-02 |
| 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  |
| PERT      | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.22E+01 | 7.26E-03  | 1.19E+02 | 0.00E+00 | 2.55E-03 | 0.00E+00 | 9.39E-04 | -1.31E-02 |
| PENRE     | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 6.16E+01 | 4.84E-02  | 7.57E+02 | 0.00E+00 | 1.83E-01 | 0.00E+00 | 1.00E-01 | -6.42E-01 |
| PENRM     | 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  |
| PENRT     | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 6.16E+01 | 4.84E-02  | 7.57E+02 | 0.00E+00 | 1.83E-01 | 0.00E+00 | 1.00E-01 | -6.42E-01 |
| SM        | kg                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.79E-01 | 1.29E-05  | 1.11E-01 | 0.00E+00 | 8.07E-05 | 0.00E+00 | 2.50E-05 | -9.29E-05 |
| RSF       | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 8.33E-03 | 2.32E-07  | 7.63E-04 | 0.00E+00 | 1.04E-06 | 0.00E+00 | 5.22E-07 | -4.94E-07 |
| 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  |
| FW        | m³                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 7.42E-02 | -2.34E-04 | 3.53E-01 | 0.00E+00 | 2.53E-05 | 0.00E+00 | 1.04E-04 | -9.98E-05 |
| Acronyms  | PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water |          |           |          |          |          |          |          |           |

## Waste indicators

| Indicator                    | Unit | A1-A3    | A5       | B6       | C1       | C2       | C3       | C4       | D         |
|------------------------------|------|----------|----------|----------|----------|----------|----------|----------|-----------|
| Hazardous waste disposed     | kg   | 7.33E-01 | 1.67E-04 | 5.36E+00 | 0.00E+00 | 4.19E-04 | 0.00E+00 | 1.14E-04 | -5.65E-04 |
| Non-hazardous waste disposed | kg   | 2.99E+01 | 1.91E-01 | 1.38E+02 | 0.00E+00 | 8.08E-03 | 0.00E+00 | 2.64E-03 | -1.65E-01 |
| Radioactive waste disposed   | kg   | 6.87E-04 | 1.86E-07 | 1.93E-03 | 0.00E+00 | 3.62E-08 | 0.00E+00 | 1.47E-08 | -3.39E-07 |

## Output flow indicators

| Indicator                     | Unit | A1-A3    | A5       | B6       | C1       | C2       | C3       | C4       | D        |
|-------------------------------|------|----------|----------|----------|----------|----------|----------|----------|----------|
| Components for re-use         | 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 |
| Material for recycling        | kg   | 0.00E+00 | 8.63E-03 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Materials for energy recovery | 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 |
| Exported energy, electricity  | 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 |
| Exported energy, thermal      | 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 |

## ENVIRONMENTAL PERFORMANCE

### Additional results (European scenario)

#### LCA results of the product(s) - main environmental performance results

Results are per declared unit

#### Mandatory impact category indicators according to EN 15804

| Indicator              | Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | B6**     | C1*      | C2*      | C3*      | C4*      | D*        |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|-----------|
| GWP-total              | kg CO <sub>2</sub> eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2.78E+01 | 0.00E+00 | 6.12E-03 | 9.19E-01 | 0.00E+00 | -1.08E+00 |
| GWP-fossil             | kg CO <sub>2</sub> eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2.69E+01 | 0.00E+00 | 6.11E-03 | 9.16E-01 | 0.00E+00 | -1.07E+00 |
| GWP-biogenic           | kg CO <sub>2</sub> eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 8.67E-01 | 0.00E+00 | 4.08E-06 | 3.33E-03 | 0.00E+00 | -3.81E-03 |
| GWP-luluc              | kg CO <sub>2</sub> eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 7.93E-02 | 0.00E+00 | 2.06E-06 | 1.56E-05 | 0.00E+00 | -1.92E-03 |
| ODP                    | kg CFC 11 eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 4.99E-07 | 0.00E+00 | 1.33E-10 | 3.46E-10 | 0.00E+00 | -1.12E-08 |
| AP                     | mol H <sup>+</sup> eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.55E-01 | 0.00E+00 | 1.31E-05 | 3.22E-04 | 0.00E+00 | -3.56E-02 |
| EP-freshwater          | kg P eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2.58E-02 | 0.00E+00 | 4.24E-07 | 1.26E-05 | 0.00E+00 | -1.80E-03 |
| EP-marine              | kg N eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2.47E-02 | 0.00E+00 | 3.16E-06 | 1.77E-04 | 0.00E+00 | -1.84E-03 |
| EP-terrestrial         | mol N eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2.18E-01 | 0.00E+00 | 3.41E-05 | 1.44E-03 | 0.00E+00 | -2.27E-02 |
| POCP                   | kg NMVOC eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 6.98E-02 | 0.00E+00 | 2.08E-05 | 3.68E-04 | 0.00E+00 | -7.41E-03 |
| ADP-minerals & metals* | kg Sb eq.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 3.63E-04 | 0.00E+00 | 2.10E-08 | 5.00E-07 | 0.00E+00 | -4.60E-04 |
| ADP-fossil*            | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 6.19E+02 | 0.00E+00 | 8.69E-02 | 2.73E-01 | 0.00E+00 | -1.46E+01 |
| WDP*                   | m <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1.50E+01 | 0.00E+00 | 4.44E-04 | 2.12E-02 | 0.00E+00 | -2.12E+00 |
| Acronyms               | GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption |          |          |          |          |          |           |

\*Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

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

The results of the end-of-life stage (modules C1-C4) should be considered when using the results of the product stage (modules A1-A3).

#### Additional mandatory and voluntary impact category indicators

| Indicator | Unit                   | B6**     | C1*      | C2*      | C3*      | C4*      | D*        |
|-----------|------------------------|----------|----------|----------|----------|----------|-----------|
| GWP-GHG** | kg CO <sub>2</sub> eq. | 2.69E+01 | 0.00E+00 | 6.12E-03 | 9.16E-01 | 0.00E+00 | -1.07E+00 |

\*\*This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such, the indicator is identical to GWP-total except that the CF for biogenic CO<sub>2</sub> is set to zero.

## ENVIRONMENTAL PERFORMANCE

## Resource Use indicators

| Indicator | Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | B6**     | C1*      | C2*      | C3*      | C4*      | D*        |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|-----------|
| PERE      | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.67E+02 | 0.00E+00 | 1.43E-03 | 1.98E-02 | 0.00E+00 | -7.32E+00 |
| PERM      | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00  |
| PERT      | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.67E+02 | 0.00E+00 | 1.43E-03 | 1.98E-02 | 0.00E+00 | -7.32E+00 |
| PENRE     | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 6.19E+02 | 0.00E+00 | 8.69E-02 | 2.73E-01 | 0.00E+00 | -1.46E+01 |
| PENRM     | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00  |
| PENRT     | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 6.19E+02 | 0.00E+00 | 8.69E-02 | 2.73E-01 | 0.00E+00 | -1.46E+01 |
| SM        | kg                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 9.96E-02 | 0.00E+00 | 3.94E-05 | 2.62E-04 | 0.00E+00 | 3.99E-01  |
| RSF       | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 8.58E-04 | 0.00E+00 | 5.17E-07 | 9.03E-06 | 0.00E+00 | -6.85E-05 |
| NRSF      | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00  |
| FW        | m³                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 4.04E-01 | 0.00E+00 | 1.10E-05 | 4.99E-04 | 0.00E+00 | -5.00E-02 |
| Acronyms  | PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water |          |          |          |          |          |           |

## Waste indicators

| Indicator                    | Unit | B6**     | C1*      | C2*      | C3*      | C4*      | D*        |
|------------------------------|------|----------|----------|----------|----------|----------|-----------|
| Hazardous waste disposed     | kg   | 1.50E+00 | 0.00E+00 | 1.26E-04 | 1.66E-02 | 0.00E+00 | -1.17E-01 |
| Non-hazardous waste disposed | kg   | 1.27E+02 | 0.00E+00 | 2.71E-03 | 3.60E-01 | 0.00E+00 | -1.60E+01 |
| Radioactive waste disposed   | kg   | 4.45E-03 | 0.00E+00 | 2.59E-08 | 1.41E-07 | 0.00E+00 | -4.77E-05 |

## Output flow indicators

| Indicator                     | Unit | B6**     | C1*      | C2*      | C3*      | C4*      | D*        |
|-------------------------------|------|----------|----------|----------|----------|----------|-----------|
| Components for re-use         | kg   | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00  |
| Material for recycling        | kg   | 0.00E+00 | 0.00E+00 | 0.00E+00 | 3.58E-01 | 0.00E+00 | 0.00E+00  |
| Materials for energy recovery | kg   | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 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 | -1.59E+00 |
| Exported energy, thermal      | MJ   | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | -6.08E+00 |

## ABBREVIATIONS

| General abbreviation | Definition                                                                   |
|----------------------|------------------------------------------------------------------------------|
| CAS No.              | Chemical Abstracts Service number                                            |
| CEN                  | European Committee for Standardization                                       |
| CQC                  | China Quality Certification Center in China                                  |
| EC No.               | European Community number                                                    |
| EF                   | Environmental Footprint                                                      |
| EMEA                 | Europe, Middle East, and Africa                                              |
| EN                   | European Norm (Standard)                                                     |
| HVAC                 | Heating, Ventilation and Air-Conditioning                                    |
| ISO                  | International Organization for Standardization                               |
| ND                   | Not Declared                                                                 |
| PCB                  | Printed Circuit Board                                                        |
| PCBA                 | Printed Circuit Board Assembly                                               |
| PCR                  | Product Category Rule                                                        |
| SCIP                 | Substances of Concern In Products, European Chemicals Agency (ECHA) database |
| SQS                  | Swiss Association for Quality and Management Systems                         |
| SVHC                 | Substances of Very High Concern                                              |

**REFERENCES**

- a) **Background database:** *Ecoinvent v. 3.11*
- b) **Characterization and reference package:** *EN 15804 reference package based on Environmental Footprint (EF) 3.1 methodology*
- c) **EN 15804:2012 + A2:2019/AC:2021** – *Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products*
- d) **EN 15942:2011** – *Sustainability of construction works – Environmental product declarations – Communication format: business-to-business*
- e) **General Program Instructions of the International EPD System**, Version 5.0.1
- f) **ISO 14025:2006** – *Environmental labels and declarations – Type III environmental declarations – Principles and procedures*
- g) **ISO 14040:2006** – *Environmental management – Life cycle assessment – Principles and framework*
- h) **ISO 14044:2006** – *Environmental management – Life cycle assessment – Requirements and guidelines*
- i) **LCA modelling software:** *SimaPro Craft v. 10.2.0.2*
- j) **Product Category Rules (PCR):** *2019:14 Construction Products, Version 2.0.1*