ENVIRONMENTAL PRODUCT DECLARATION

meta200

Program	The International EPD® System EPD International AB www.environdec.com
EPD registration number	S-P-05725
Published	2022-05-03
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An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com.

In accordance with
ISO 14025:2006 and
EN15804:2012+A2:2019

MOVE BEYOND

CONTENTS

EPD®

Program operator:
The International EPD® System:
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2027-05-02

Geographical scope of application:
Asia and the Pacific

Reference year for underlying data:
2021

Reference years of datasets:
2016-2021

Product category rules (PCR):
EN15804:2012 + A2:2019 as core PCR
PCR 2019:14 Construction Products, version 1.1
C-PCR-008 (TO PCR 2019:14) Lifts (Elevators) version 2020-10-30

Product classification:
UN CPC 4354 – Lifts, skip hoists, escalators and moving walkways

PCR review was conducted by:
The Technical Committee of the International EPD® System
Chair: Hüdai Kara
The Technical committee can be contacted via the Secretariat
https://www.environdec.com/contact-us

Verification:
CEN standard EN15804 serves as core PCR. Independent verification of the declaration and data, according to EN ISO 14025:2010
EPD® verification (external)

Third party verifier:
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“Approved by the International EPD® System”
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About this EPD®

Introduction

At TK Elevator, we have a strong sense of responsibility towards our customers, employees, society and the environment. Our aim is always to develop solutions that go far beyond the industry standards in all these areas.

Within the context of sustainability, we want to understand the environmental performance of our products. That is why we develop Life Cycle Assessments (LCAs) to identify relevant fields of action and enhance the design process.

Our goal is to minimize the environmental impact of our products. To communicate the results of LCAs to the public and ensure transparency regarding the environmental impact of our products, we publish EPDs.

The benefit for our customers is solutions that fulfil the highest demands in terms of efficiency and product responsibility. In addition, they can use EPDs in the context of their green building certifications and introduce elevators into the life cycle assessment of their buildings.

What is an EPD®?

An EPD® provides information about the environmental performance of a product. In the case of this publication, the results refer to TKE meta200 elevators.

Development of this EPD

Both the EPD® and the underlying LCA study have been developed and third-party-verified in accordance with the product category rules (PCRs) for elevators within the framework of the International EPD® system and its general program instructions for type III environmental declarations according to ISO 14025.

Furthermore, development and verification also follow ISO 14040/44 and the calculation of the energy demand is carried out in accordance with ISO 25745-2. The characterization methodologies used to calculate impact categories on midpoint level are those recommended by EC-JRC, as requested by the PCRs.

Data collection

The data used in the present study is a combination of measured, calculated and estimated data. The main data sources are the internal data of TK Elevator, generic databases such as GaBi and data from Tier 1 suppliers.

Description of functional unit (FU)

According to the PCRs for elevators, the functional unit is defined as “transportation of a load over a distance, expressed in ton [t] over a kilometer [km] travelled, i.e. ton-kilometer [tkm].”

Comparability of results

Comparability between EPDs based on this c-PCR-008 (to PCR 2019:14) and EPDs based on PCR 2015:05 is not conceivable and shall be avoided. Any comparability of this kind shall be considered as false and misleading the EPD user.

EPD®s within the same product category but from different program operators may not be comparable.

EPDs of construction products may not be comparable if they do not comply with EN 15804+A2:2019.

KEY TERMS

Environmental product declaration according to ISO 14025: Type III environmental declarations provide quantified environmental data using predetermined parameters.

Life-cycle assessment (LCA) according to ISO 14040: “Compilation and evaluation of the inputs, outputs and the potential environmental impact of a product system throughout its life cycle.”

Product category rules (PCR) according to ISO 14025: “A set of specific rules, requirements and guidelines for developing Type III environmental declarations.”

Functional unit (FU) according to ISO 14040: “The quantified performance of a product system for use as a reference unit.”

REFERENCE STANDARDS

ISO 14040 (2006). Environmental management. Life cycle assessment. Principles and framework.

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

ISO 14025 (2006). Environmental labels and declarations. Type III environmental declarations. Principles and procedures.

ISO 25745-2 (2015). Energy performance of lifts, escalators and moving walks. Part 2: Energy calculation and classification for lifts (elevators).

EN15804:2012+A2:2019 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

PCR 2019-14 Construction products

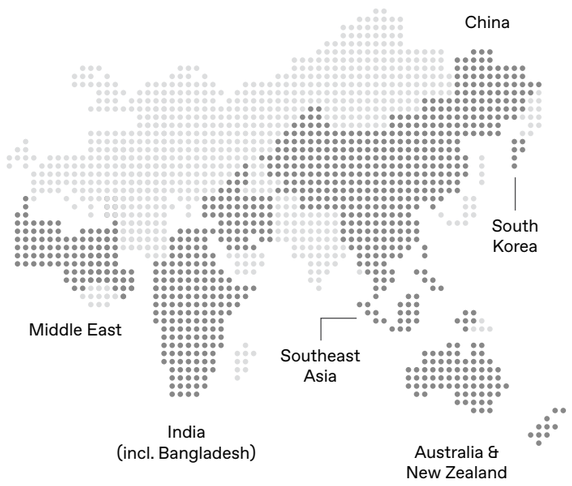
Elevator plant, Zhongshan, China

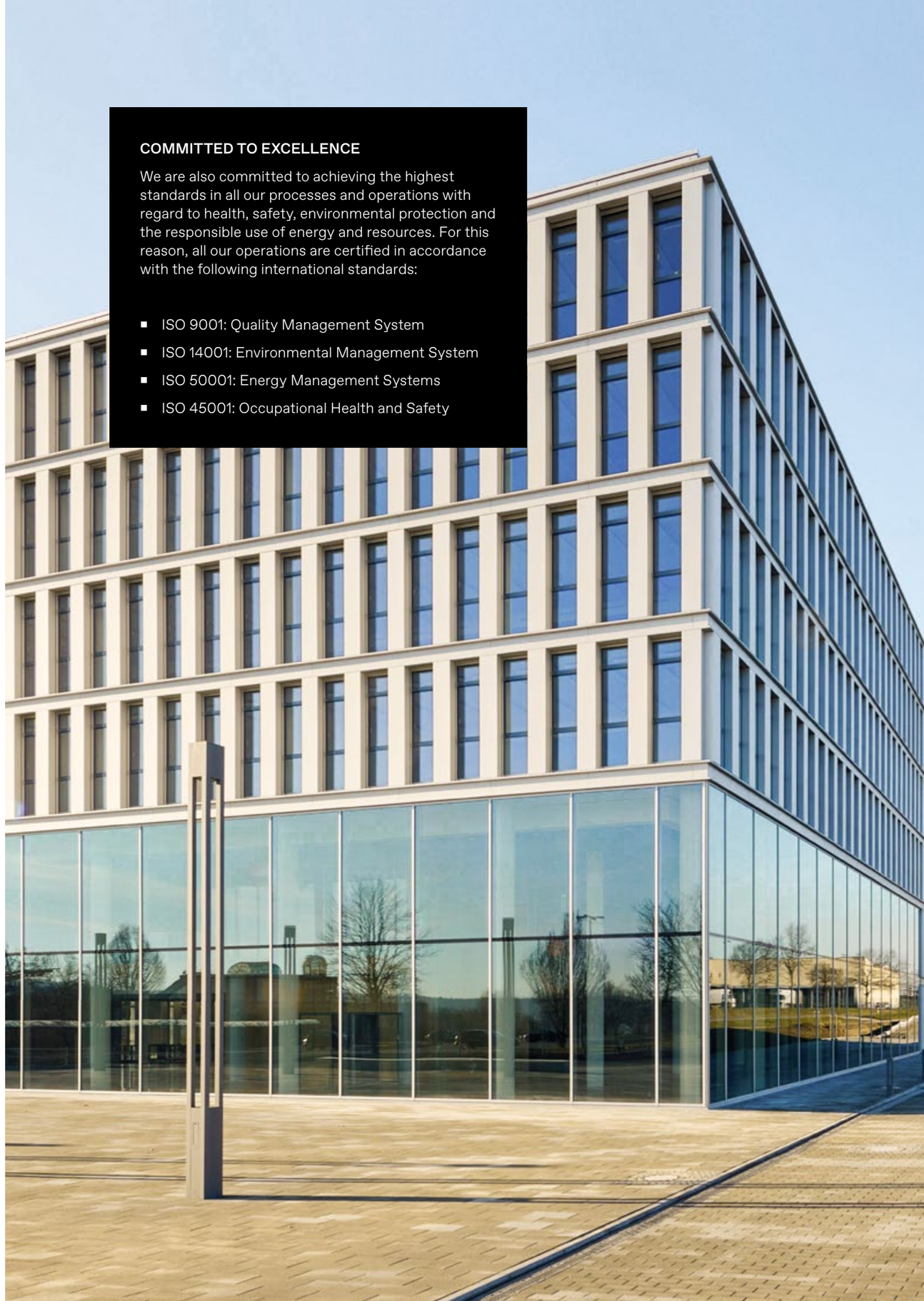
About us

TK Elevator serves customers in over 150 countries and employs more than 50,000 people across approximately 1,000 locations.

Our customers are around the world, and our manufacturing footprint reflects this reality, extending from North and South America to Europe and the Far East. At each of these locations, we concentrate our expertise and experience on engineering and manufacturing urban mobility solutions, developing innovations and continuously optimising existing products.

As a part of this network, our plant in Shanghai and Zhongshan, China produce meta200 elevators to the highest quality standards customers expect from TK Elevator.





COMMITTED TO EXCELLENCE

We are also committed to achieving the highest standards in all our processes and operations with regard to health, safety, environmental protection and the responsible use of energy and resources. For this reason, all our operations are certified in accordance with the following international standards:

- ISO 9001: Quality Management System
- ISO 14001: Environmental Management System
- ISO 50001: Energy Management Systems
- ISO 45001: Occupational Health and Safety

The meta200 elevator system

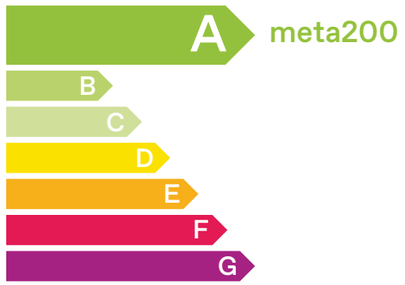
meta200 targets mid-rise buildings in the residential and commercial sectors, where design and performance matter. Offering inspiring designs and German quality engineering, meta200 brings an all round premium experience to your building.

Sense the difference

- **Increases your returns**
  High performance German engineering makes meta200 a great investment.
- **Underlines your building's premium**
  Trend-based interiors to match your building's style and extend the building's vibe into the elevator.
- **Provides a stylish experience**
  With a focus on usability and overall ride comfort, meta200 ensures you travel in comfort and style.

Energy efficiency

With this configuration, the meta200 elevator achieves class A energy efficiency according to ISO 25745-2 for usage categories 3 and 4. This classification is based on the internal calculation carried out for the underlying LCA reference unit, and it is also influenced by capacity, usage-related parameters and energy-saving features. Energy efficiency of the meta200 elevator (calculated for the reference unit specified in Table 1).



Energy efficiency of the meta200 elevator
(calculated for the reference unit specified in Table 1)

Committed to excellence

meta200 elevator complies with all relevant international standards and regulations:

- EN 81: Safety rules for the construction and installation of lifts
  Part 20: Passenger and goods/ passenger lifts
  Part 50: Design rules, calculations, examinations and tests of lift components
- GB7588-2003+XG1-2015: Safety rules for the construction and installation of electric lifts

The meta200 elevator system

meta200		
Index	**Representative values for the reference unit**	**Application range of the elevator model**
Type of installation	New installation	
Commercial name	meta200	
Main purpose	Transport of passengers	
Type of lift	Electric, with/without machineroom (MR/MRL)	
Type of drive system	Gearless traction drive	
Rated load [Q]	1600kg	630 kg – 2000 kg
Rated speed	1.75m/s	1 m/s – 4 m/s
Number of stops	13	Up to 40
Travel height	48m	Up to 150m
Number of operating days per year	365	-
Applied usage category (UC) acc. to ISO 25745-2	2, 3, 4	
Designed reference service life (RSL)	25 years	
Geographic region of installation	Asia and the Pacific	
Optional equipment	Regenerative drive	

Table 1: Specification of assessed elevator according to the PCRs

	UC2	UC3	UC4
FU (tkm)	1287.72	3090.53	8094.24

Table 2: Functional units for selected usage categories according to the PCRs

Representative installation

The reference for the underlying life-cycle assessment (LCA) study is an elevator to be installed in a mid-rise residential or commercial building in Asia and the Pacific region. Its configuration corresponds to the typical application range of the meta200 series. For energy consumption during operation, the Chinese and average Asian grid mixes were considered.

Value and relevance of functional unit (FU)

The FU is determined by the physical characteristics of the assessed elevator (e.g. rated load, rated speed, travelled height) and parameters that are chosen based on its assumed use (e.g. use category, trips per day, operating days per year). The usage categories included in the analysis reflect the use of this product in mid rise residential and commercial buildings.

Content declaration

A detailed composition of the reference elevator and packaging in quantitative terms according to the PCRs is set out in Figure 1. This content declaration considers all life-cycle phases and cut-off rules according to the PCRs.

Almost 80% of the material the elevator is made of belongs to the material category of ferrous metals, followed by inorganic materials with nearly 20%, electrics and electronics (4.31 %) and plastics and rubbers (3.18%). The rest of the material categories account each for less than 2%.

The subsystems in which these materials are Counterweight, Car, Guiderails, Doors, Traction machine, Doors, Controller and Inverter.

Substances in the SVHC list according to REACH directive are avoided as far as possible. Nevertheless, lead (CAS number 7439-92-1) may be present above 0.1 % in weight in some articles used in the product.

The main materials used for the packaging of the elevator is wood, that represents 100% of the overall packaging weight, and contains 169.4 kg C of biogenic carbon.

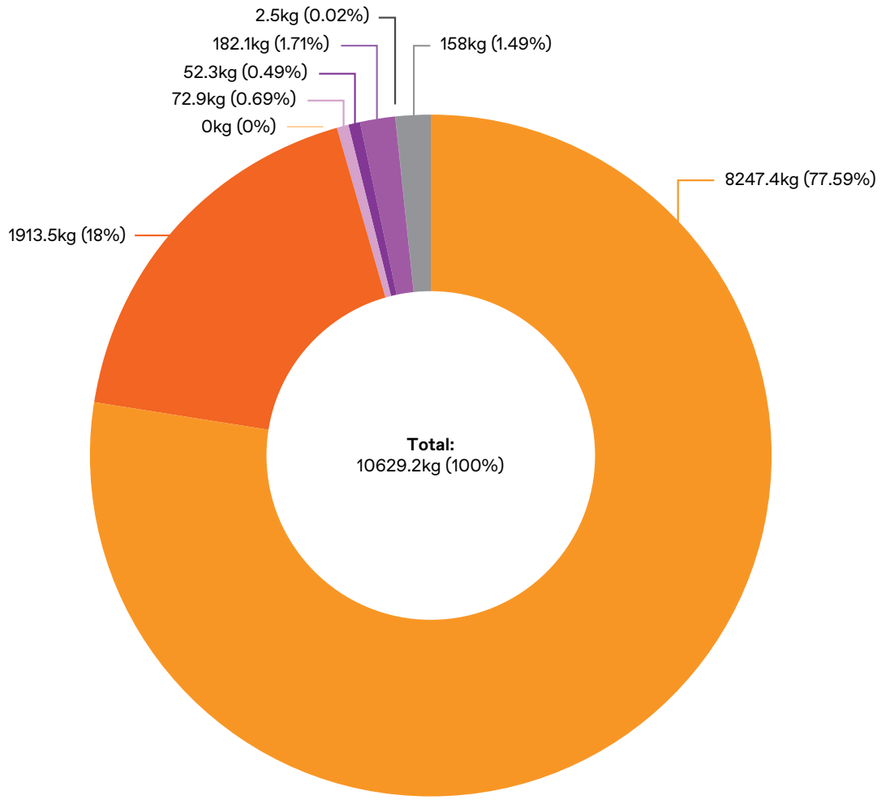


Figure 1: Material balance of assessed elevator (excl. spare parts)

- Ferrous metals (carbon steel, stainless steel, galvanized steel and cast iron)
- Inorganic materials (concrete, cardboard)
- Organic materials
- Plastics & rubbers
- Non-ferrous metals (aluminum)
- Electrics & electronics (electrical cables, printed boards and electronic elements)
- Lubricants & paintings
- Other materials

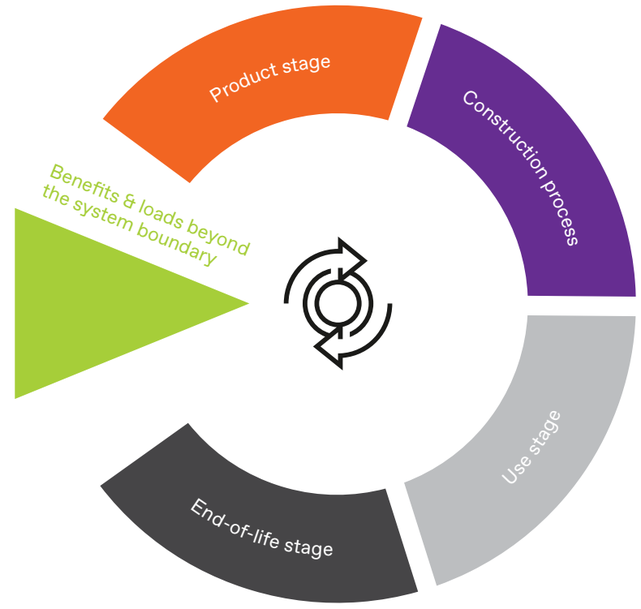
Life-cycle assessment

According to the applicable PCRs, this EPD has a cradle to grave scope plus module D. Therefore it covers four main stages. The product stage (A1-A3) aggregates all processes related to the extraction of raw materials and road transport to manufacturing facilities, as well as their further transformation and processing to produce assemble and pack all components for the assessed unit. Energy and auxiliary materials consumed at TKE´s manufacturing centers and tier-1 suppliers facilities, all of them located in China, are taken into account. TKE production plants in Zhongshan and Shanghai produce meta200 elevator with similar material composition and production processes, in such way that the variation in environmental impacts remains below 10% for all categories declared in table 4. . For product stage, the percentage of specific data used is higher than 90%. The construction process stage (A4-A5) considers the road and sea transport from TKE to the installation site (in Asia and the Pacific region) and the final assembly of the elevator, including fuel and electricity consumption, auxiliary materials required and waste treatment of packaging. The use stage (B1-B7) consists of all processes related to operation and preventive maintenance, mainly transport of workers to maintenance site, production of spare parts, energy and auxiliary materials used for maintenance and operational energy use. The end-of-life stage (C1-C4) considers all processes that take place at the end of the elevator service life, this is, the final disassembly, waste processing and disposal of the elevator components and materials. Energy and auxiliary materials required to dismantle the unit, carry out an initial waste classification are considered, as well as road transport to waste processing facilities and final disposal. Finally, module D includes the benefits derived from the recycling of metallic materials and energy recovery from the incineration of packaging materials. The geographical scope for all downstream processes is Asia and the Pacific.

The resulting system boundaries are presented in the figure 1 and table 3 below:

A1-A3 Product stage	
Information module	**Module declared**
A1 Raw material supply	x
A2 Transport	x
A3 Manufacturing	x

A4-A5 Construction process	
Information module	**Module declared**
A4 Transport	x
A5 Installation	x



D Benefits & loads beyond system boundary	
Information module	**Module declared**
D Reuse, recovery and recycling potential	x

C1-C4 End-of-life stage	
Information module	**Module declared**
C1 Deconstruction	x
C2 Transport	x
C3 Waste processing	x
C4 Waste disposal	x

B1-B7 User stage	
Information module	**Module declared**
B1 Use	n.d.
B2 Maintenance	x
B3 Repair	n.d.
B4 Replacement	n.d.
B5 Refurbishment	n.d.
B6 Operational energy use	x
B7 Operational water use	n.d.

Figure 2: Life-cycle stages and information modules according to the PCRs

Results of the study

The following section contains the results of the underlying LCA study according to the PCRs. The disclosure of results is structured in three subsections: Potential environmental impacts, use of resources, waste categories and output flows. The tables show results per FU for the three analyzed UCs.

Potential environmental impacts

In this section, results for core impact categories are presented. For the different product versions included in the scope of the EPD, variations in these results remain below 10% for all information modules.

Information module	Usage category	GWP-total	GWP-fossil	GWP-biogenic	ODP	AP	EP-freshwater	EP-freshwater	EP-marine	EP-terrestrial	POCP	ADP-minerals & metals	ADP-fossil	WDP	GWP-100*
		kg CO_2 eq.	kg CO_2 eq.	kg CO_2 eq.	kg CFC-11 eq.	Mol of H+ eq.	kg P eq.	kg PO4 eq.	kg N eq.	Mol N eq.	kg NMVOC eq.	kg Sb eq.	MJ, net cal. value	m^3 world equiv.	kg CO_2 -eq
A1	UC2	1.85E+01	1.85E+01	1.97E-02	3.14E-10	5.23E-02	1.48E-05	4.55E-05	1.02E-02	1.08E-01	3.55E-02	2.90E-04	1.96E+02	7.21E+01	1.82E+01
	UC3	7.70E+00	7.69E+00	8.19E-03	1.31E-10	2.18E-02	6.17E-06	1.90E-05	4.26E-03	4.48E-02	1.48E-02	1.21E-04	8.17E+01	3.00E+01	7.58E+00
	UC4	2.94E+00	2.94E+00	3.13E-03	4.99E-11	8.32E-03	2.36E-06	7.24E-06	1.63E-03	1.71E-02	5.64E-03	4.62E-05	3.12E+01	1.15E+01	2.90E+00
A2	UC2	4.00E-01	3.80E-01	1.68E-02	4.85E-17	1.14E-03	1.13E-06	3.46E-06	5.20E-04	5.82E-03	1.02E-03	2.89E-08	5.05E+00	3.29E-03	3.80E-01
	UC3	1.67E-01	1.58E-01	6.99E-03	2.02E-17	4.75E-04	4.69E-07	1.44E-06	2.17E-04	2.43E-03	4.26E-04	1.20E-08	2.10E+00	1.37E-03	1.58E-01
	UC4	6.36E-02	6.04E-02	2.67E-03	7.71E-18	1.81E-04	1.79E-07	5.50E-07	8.27E-05	9.27E-04	1.63E-04	4.59E-09	8.03E-01	5.24E-04	6.04E-02
A3	UC2	1.38E+00	2.26E+00	-8.77E-01	2.57E-13	8.45E-03	6.16E-06	1.89E-05	2.07E-03	2.19E-02	6.31E-03	8.94E-07	3.22E+01	1.29E+00	2.37E+00
	UC3	5.76E-01	9.41E-01	-3.65E-01	1.07E-13	3.52E-03	2.57E-06	7.88E-06	8.63E-04	9.12E-03	2.63E-03	3.72E-07	1.34E+01	5.36E-01	9.88E-01
	UC4	2.20E-01	3.59E-01	-1.40E-01	4.08E-14	1.34E-03	9.79E-07	3.01E-06	3.29E-04	3.48E-03	1.00E-03	1.42E-07	5.12E+00	2.05E-01	3.77E-01
Sum A1-A3	UC2	2.03E+01	2.11E+01	-8.41E-01	3.14E-10	6.19E-02	2.21E-05	6.78E-05	1.28E-02	1.35E-01	4.28E-02	2.91E-04	2.33E+02	7.34E+01	2.10E+01
	UC3	8.44E+00	8.79E+00	-3.50E-01	1.31E-10	2.58E-02	9.21E-06	2.83E-05	5.34E-03	5.64E-02	1.78E-02	1.21E-04	9.72E+01	3.06E+01	8.73E+00
	UC4	3.22E+00	3.36E+00	-1.34E-01	4.99E-11	9.85E-03	3.52E-06	1.08E-05	2.04E-03	2.15E-02	6.81E-03	4.64E-05	3.71E+01	1.17E+01	3.33E+00
A4	UC2	7.29E-01	7.18E-01	9.45E-03	7.90E-17	2.10E-02	7.07E-07	2.17E-06	5.62E-03	6.16E-02	1.53E-02	3.08E-08	8.96E+00	2.52E-03	7.18E-01
	UC3	3.04E-01	2.99E-01	3.94E-03	3.29E-17	8.77E-03	2.94E-07	9.04E-07	2.34E-03	2.57E-02	6.36E-03	1.28E-08	3.73E+00	1.05E-03	2.99E-01
	UC4	1.16E-01	1.14E-01	1.50E-03	1.26E-17	3.35E-03	1.12E-07	3.45E-07	8.94E-04	9.80E-03	2.43E-03	4.89E-09	1.43E+00	4.02E-04	1.14E-01
A5	UC2	1.42E+00	1.67E-01	1.25E+00	1.10E-15	5.39E-04	2.00E-06	6.13E-06	1.70E-04	1.67E-03	8.13E-04	1.42E-06	2.08E+00	6.11E-02	1.12E+00
	UC3	5.90E-01	6.95E-02	5.21E-01	4.60E-16	2.25E-04	8.32E-07	2.55E-06	7.10E-05	6.97E-04	3.39E-04	5.92E-07	8.69E-01	2.55E-02	4.68E-01
	UC4	2.25E-01	2.66E-02	1.99E-01	1.76E-16	8.58E-05	3.18E-07	9.75E-07	2.71E-05	2.66E-04	1.29E-04	2.26E-07	3.32E-01	9.72E-03	1.79E-01
B2	UC2	2.05E+00	2.02E+00	2.63E-02	1.10E-12	7.02E-03	3.23E-06	9.91E-06	1.56E-03	1.63E-02	5.06E-03	6.27E-05	3.39E+01	2.23E+00	2.10E+00
	UC3	8.54E-01	8.42E-01	1.09E-02	4.58E-13	2.93E-03	1.34E-06	4.13E-06	6.50E-04	6.81E-03	2.11E-03	2.61E-05	1.41E+01	9.30E-01	8.75E-01
	UC4	3.26E-01	3.22E-01	4.18E-03	1.75E-13	1.12E-03	5.13E-07	1.58E-06	2.48E-04	2.60E-03	8.05E-04	9.98E-06	5.40E+00	3.55E-01	3.34E-01
B6	UC2	2.47E+01	2.47E+01	-3.76E-04	1.42E-13	1.39E-01	1.03E-05	3.15E-05	2.14E-02	2.34E-01	6.44E-02	1.96E-06	2.87E+02	5.24E+00	2.46E+01
	UC3	1.53E+01	1.53E+01	-2.32E-04	8.78E-14	8.60E-02	6.34E-06	1.95E-05	1.32E-02	1.44E-01	3.98E-02	1.21E-06	1.77E+02	3.23E+00	1.52E+01
	UC4	9.64E+00	9.63E+00	-1.46E-04	5.54E-14	5.43E-02	4.00E-06	1.23E-05	8.34E-03	9.11E-02	2.51E-02	7.65E-07	1.12E+02	2.04E+00	9.61E+00
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	UC3	2.63E-02	2.61E-02	1.61E-04	3.73E-16	6.04E-05	5.57E-08	1.71E-07	1.30E-05	1.36E-04	4.03E-05	8.52E-09	4.08E-01	2.47E-02	2.60E-02
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C2	UC2	1.69E-02	1.65E-02	2.46E-04	3.25E-18	6.08E-05	4.90E-08	1.50E-07	2.83E-05	3.16E-04	5.49E-05	1.46E-09	2.19E-01	1.53E-04	1.65E-02
	UC3	7.05E-03	6.89E-03	1.03E-04	1.36E-18	2.53E-05	2.04E-08	6.26E-08	1.18E-05	1.32E-04	2.29E-05	6.09E-10	9.14E-02	6.37E-05	6.88E-03
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C3	UC2	1.03E-02	1.02E-02	2.62E-05	4.55E-17	9.52E-05	2.33E-08	7.14E-08	4.71E-05	5.17E-04	1.37E-04	1.13E-08	1.93E-01	1.72E-03	1.02E-02
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	UC4	1.64E-03	1.62E-03	4.17E-06	7.25E-18	1.51E-05	3.70E-09	1.14E-08	7.49E-06	8.23E-05	2.18E-05	1.79E-09	3.07E-02	2.73E-04	1.62E-03
C4	UC2	2.00E+00	2.00E+00	2.13E-04	5.66E-16	1.04E-03	1.88E-07	5.78E-07	4.05E-04	4.62E-03	1.06E-03	8.61E-09	9.61E-01	2.48E-01	2.00E+00
	UC3	8.32E-01	8.31E-01	8.89E-05	2.36E-16	4.34E-04	7.84E-08	2.41E-07	1.69E-04	1.93E-03	4.41E-04	3.59E-09	4.00E-01	1.03E-01	8.31E-01
	UC4	3.18E-01	3.17E-01	3.39E-05	9.00E-17	1.66E-04	2.99E-08	9.19E-08	6.45E-05	7.35E-04	1.69E-04	1.37E-09	1.53E-01	3.95E-02	3.17E-01
D	UC2	-7.03E+00	-7.03E+00	-4.57E-03	-1.80E-14	-1.29E-02	-1.73E-06	-5.32E-06	-2.50E-03	-2.54E-02	-1.08E-02	-1.64E-05	-7.10E+01	-1.79E+01	-6.88E+00
	UC3	-2.93E+00	-2.93E+00	-1.91E-03	-7.52E-15	-5.39E-03	-7.22E-07	-2.22E-06	-1.04E-03	-1.06E-02	-4.49E-03	-6.81E-06	-2.96E+01	-7.47E+00	-2.87E+00
	UC4	-1.12E+00	-1.12E+00	-7.28E-04	-2.87E-15	-2.06E-03	-2.76E-07	-8.46E-07	-3.97E-04	-4.04E-03	-1.72E-03	-2.60E-06	-1.13E+01	-2.85E+00	-1.09E+00

Table 3: Impact category results by information module

**GWP-100: IPCC AR5 GWP, excluded biogenic carbon.*

Impact category results by life-cycle stage per FU

The figure below shows the share of the different life-cycle stages for the most relevant impact categories in percentages, resulting in a sum of 100%. It is based in UC3.

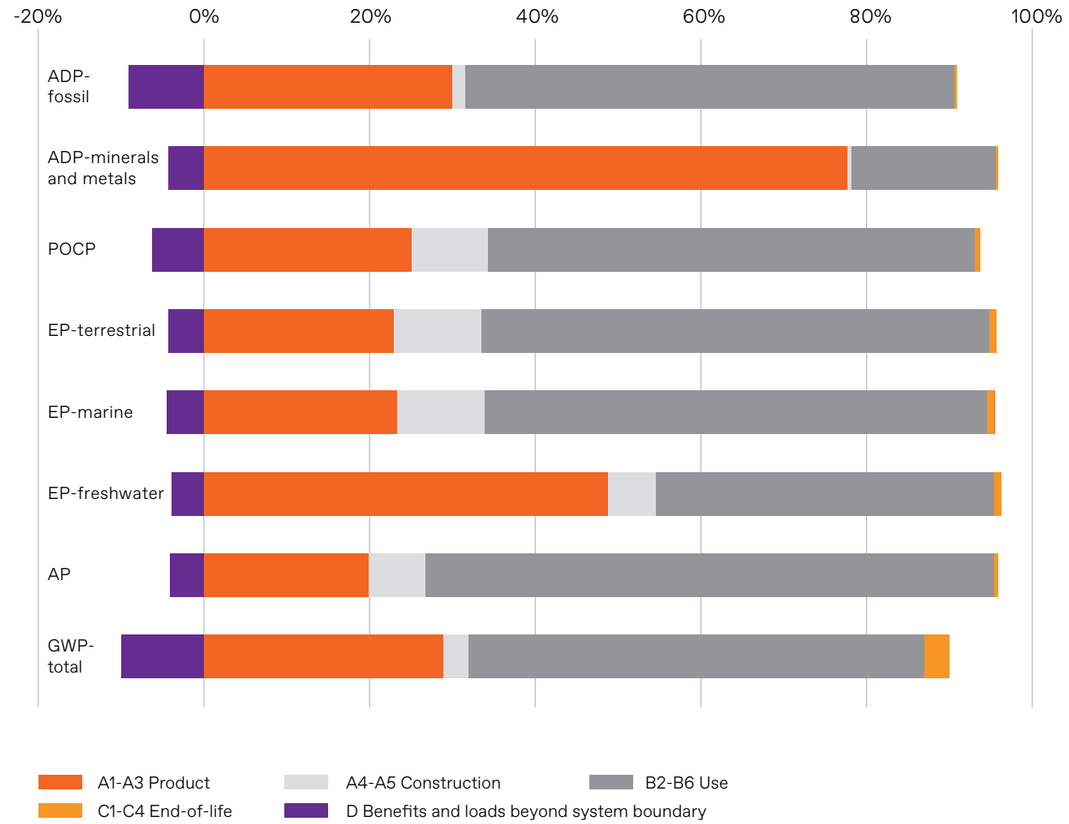

Figure 3: Impact category results by life-cycle stage (in %, UC3)

In the figure below, the impact results of the three largest contributors (A1, B2 and B6) to the overall UC3 results are compared with each other and the sum of the rest of the information modules.

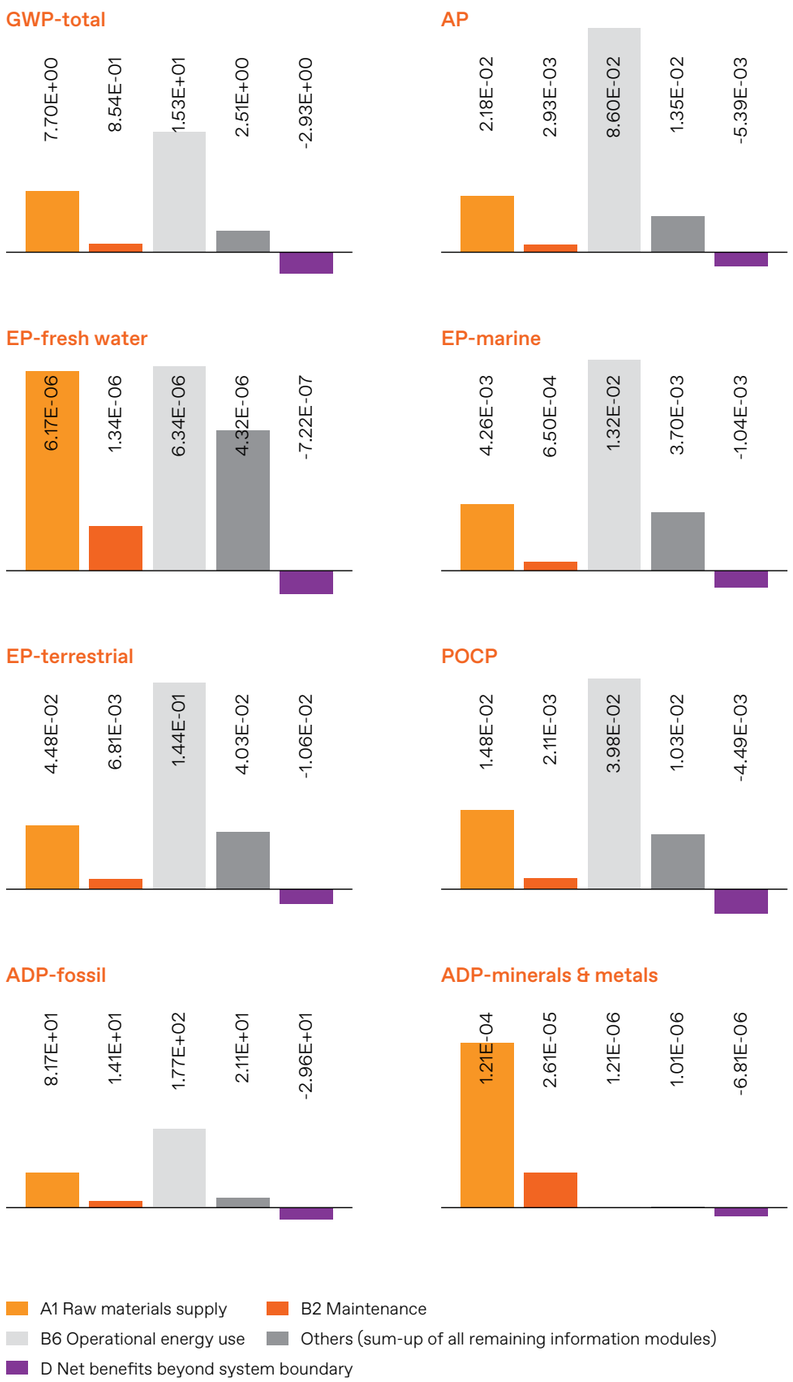

Figure 4: Comparison of impacts of main contributors

Use of resources

At this point the results for the use of resources are presented. These are divided into renewable and non-renewable energy resources, including primary energy and energy resources used as raw materials, secondary materials and fuels, and water.

Indicator		PERE	PERM	PERT	PENRE	PENRM	PENRT	FW	SM	NRSF	RSF
Unit		MJ	MJ	MJ	MJ	MJ	MJ	m3	kg	MJ	MJ
A1	UC2	1.27E+01	0.00E+00	1.27E+01	1.97E+02	0.00E+00	1.97E+02	1.69E+00	3.50E-01	0.00E+00	0.00E+00
	UC3	5.28E+00	0.00E+00	5.28E+00	8.19E+01	0.00E+00	8.19E+01	7.04E-01	1.46E-01	0.00E+00	0.00E+00
	UC4	2.01E+00	0.00E+00	2.01E+00	3.13E+01	0.00E+00	3.13E+01	2.69E-01	5.57E-02	0.00E+00	0.00E+00
A2	UC2	2.82E-01	0.00E+00	2.82E-01	5.06E+00	0.00E+00	5.06E+00	3.23E-04	0.00E+00	0.00E+00	0.00E+00
	UC3	1.17E-01	0.00E+00	1.17E-01	2.11E+00	0.00E+00	2.11E+00	1.34E-04	0.00E+00	0.00E+00	0.00E+00
	UC4	4.48E-02	0.00E+00	4.48E-02	8.04E-01	0.00E+00	8.04E-01	5.13E-05	0.00E+00	0.00E+00	0.00E+00
A3	UC2	2.08E+01	1.22E+01	3.30E+01	3.22E+01	0.00E+00	3.22E+01	3.16E-02	0.00E+00	0.00E+00	0.00E+00
	UC3	8.67E+00	5.08E+00	1.38E+01	1.34E+01	0.00E+00	1.34E+01	1.32E-02	0.00E+00	0.00E+00	0.00E+00
	UC4	3.31E+00	1.94E+00	5.25E+00	5.12E+00	0.00E+00	5.12E+00	5.03E-03	0.00E+00	0.00E+00	0.00E+00
Sum A1-A3	UC2	3.38E+01	1.22E+01	4.60E+01	2.34E+02	0.00E+00	2.34E+02	1.72E+00	3.50E-01	0.00E+00	0.00E+00
	UC3	1.41E+01	5.08E+00	1.91E+01	9.74E+01	0.00E+00	9.74E+01	7.17E-01	1.46E-01	0.00E+00	0.00E+00
	UC4	5.37E+00	1.94E+00	7.31E+00	3.72E+01	0.00E+00	3.72E+01	2.74E-01	5.57E-02	0.00E+00	0.00E+00
A4	UC2	1.69E-01	0.00E+00	1.69E-01	8.97E+00	0.00E+00	8.97E+00	2.04E-04	0.00E+00	0.00E+00	0.00E+00
	UC3	7.05E-02	0.00E+00	7.05E-02	3.74E+00	0.00E+00	3.74E+00	8.51E-05	0.00E+00	0.00E+00	0.00E+00
	UC4	2.69E-02	0.00E+00	2.69E-02	1.43E+00	0.00E+00	1.43E+00	3.25E-05	0.00E+00	0.00E+00	0.00E+00
A5	UC2	3.90E-01	-1.22E+01	-1.18E+01	2.09E+00	0.00E+00	2.09E+00	1.64E-03	4.06E-04	0.00E+00	0.00E+00
	UC3	1.62E-01	-5.08E+00	-4.92E+00	8.69E-01	0.00E+00	8.69E-01	6.82E-04	1.69E-04	0.00E+00	0.00E+00
	UC4	6.20E-02	-1.94E+00	-1.88E+00	3.32E-01	0.00E+00	3.32E-01	2.60E-04	6.46E-05	0.00E+00	0.00E+00
B2	UC2	3.56E+00	0.00E+00	3.56E+00	3.40E+01	0.00E+00	3.40E+01	5.29E-02	5.68E-02	0.00E+00	0.00E+00
	UC3	1.49E+00	0.00E+00	1.49E+00	1.42E+01	0.00E+00	1.42E+01	2.21E-02	2.37E-02	0.00E+00	0.00E+00
	UC4	5.67E-01	0.00E+00	5.67E-01	5.40E+00	0.00E+00	5.40E+00	8.42E-03	9.04E-03	0.00E+00	0.00E+00
B6	UC2	5.15E+01	0.00E+00	5.15E+01	2.87E+02	0.00E+00	2.87E+02	1.46E-01	0.00E+00	0.00E+00	0.00E+00
	UC3	3.18E+01	0.00E+00	3.18E+01	1.77E+02	0.00E+00	1.77E+02	9.04E-02	0.00E+00	0.00E+00	0.00E+00
	UC4	2.01E+01	0.00E+00	2.01E+01	1.12E+02	0.00E+00	1.12E+02	5.71E-02	0.00E+00	0.00E+00	0.00E+00
C1	UC2	3.03E-01	0.00E+00	3.03E-01	9.81E-01	0.00E+00	9.81E-01	1.57E-03	5.42E-04	0.00E+00	0.00E+00
	UC3	1.26E-01	0.00E+00	1.26E-01	4.09E-01	0.00E+00	4.09E-01	6.54E-04	2.26E-04	0.00E+00	0.00E+00
	UC4	4.82E-02	0.00E+00	4.82E-02	1.56E-01	0.00E+00	1.56E-01	2.50E-04	8.62E-05	0.00E+00	0.00E+00
C2	UC2	1.26E-02	0.00E+00	1.26E-02	2.20E-01	0.00E+00	2.20E-01	1.45E-05	0.00E+00	0.00E+00	0.00E+00
	UC3	5.26E-03	0.00E+00	5.26E-03	9.18E-02	0.00E+00	9.18E-02	6.03E-06	0.00E+00	0.00E+00	0.00E+00
	UC4	2.01E-03	0.00E+00	2.01E-03	3.50E-02	0.00E+00	3.50E-02	2.30E-06	0.00E+00	0.00E+00	0.00E+00
C3	UC2	1.70E-02	0.00E+00	1.70E-02	1.93E-01	0.00E+00	1.93E-01	5.00E-05	0.00E+00	0.00E+00	0.00E+00
	UC3	7.09E-03	0.00E+00	7.09E-03	8.03E-02	0.00E+00	8.03E-02	2.08E-05	0.00E+00	0.00E+00	0.00E+00
	UC4	2.71E-03	0.00E+00	2.71E-03	3.07E-02	0.00E+00	3.07E-02	7.95E-06	0.00E+00	0.00E+00	0.00E+00
C4	UC2	1.72E-01	0.00E+00	1.72E-01	9.61E-01	0.00E+00	9.61E-01	5.87E-03	0.00E+00	0.00E+00	0.00E+00
	UC3	7.15E-02	0.00E+00	7.15E-02	4.00E-01	0.00E+00	4.00E-01	2.45E-03	0.00E+00	0.00E+00	0.00E+00
	UC4	2.73E-02	0.00E+00	2.73E-02	1.53E-01	0.00E+00	1.53E-01	9.34E-04	0.00E+00	0.00E+00	0.00E+00
D	UC2	2.39E+00	0.00E+00	2.39E+00	-7.10E+01	0.00E+00	-7.10E+01	-4.21E-01	0.00E+00	0.00E+00	0.00E+00
	UC3	9.95E-01	0.00E+00	9.95E-01	-2.96E+01	0.00E+00	-2.96E+01	-1.75E-01	0.00E+00	0.00E+00	0.00E+00
	UC4	3.80E-01	0.00E+00	3.80E-01	-1.13E+01	0.00E+00	-1.13E+01	-6.69E-02	0.00E+00	0.00E+00	0.00E+00

Table 4: Indicators describing resource use by information module

PERE Use of renewable primary energy excluding renewable energy resources used as raw material **PERM** Use of renewable primary energy resources used as raw material **PERT** Total use of renewable primary energy resources (primary energy and primary energy resources used as raw material) **PENRE** Use of non-renewable primary energy excluding non-renewable energy resources used as raw material **PENRM** Use of non-renewable primary energy resources used as raw material **PENRT** Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw material) **SM** Use of secondary material **RSF** Use of renewable secondary fuels **NRSF** Use of non-renewable secondary fuels **FW** Net use of fresh water

Waste categories and output flows

The table below provides information about the amount of disposed waste by information module per tkm, according to the categories established in the reference PCRs.

Indicator		HWD	NHWD	RWD
Unit		kg	kg	kg
A1	UC2	2.85E-06	9.10E-01	1.08E-03
	UC3	1.19E-06	3.79E-01	4.50E-04
	UC4	4.54E-07	1.45E-01	1.72E-04
A2	UC2	2.55E-10	7.51E-04	6.12E-06
	UC3	1.06E-10	3.13E-04	2.55E-06
	UC4	4.05E-11	1.19E-04	9.73E-07
A3	UC2	2.50E-08	1.17E-01	6.38E-04
	UC3	1.04E-08	4.88E-02	2.66E-04
	UC4	3.98E-09	1.86E-02	1.02E-04
Sum A1-A3	UC2	2.88E-06	1.03E+00	1.72E-03
	UC3	1.20E-06	4.28E-01	7.19E-04
	UC4	4.58E-07	1.63E-01	2.74E-04
A4	UC2	1.82E-10	1.03E-03	1.02E-05
	UC3	7.60E-11	4.28E-04	4.27E-06
	UC4	2.90E-11	1.64E-04	1.63E-06
A5	UC2	6.08E-10	3.52E-01	1.06E-04
	UC3	2.53E-10	1.47E-01	4.40E-05
	UC4	9.67E-11	5.61E-02	1.68E-05
B2	UC2	3.85E-08	1.29E-01	6.10E-04
	UC3	1.60E-08	5.36E-02	2.54E-04
	UC4	6.12E-09	2.05E-02	9.71E-05
B6	UC2	3.52E-08	1.27E-01	7.57E-03
	UC3	2.17E-08	7.87E-02	4.67E-03
	UC4	1.37E-08	4.97E-02	2.95E-03
C1	UC2	3.01E-10	1.32E-03	9.31E-05
	UC3	1.26E-10	5.50E-04	3.88E-05
	UC4	4.79E-11	2.10E-04	1.48E-05
C2	UC2	1.16E-11	3.46E-05	4.00E-07
	UC3	4.84E-12	1.44E-05	1.66E-07
	UC4	1.85E-12	5.50E-06	6.36E-08
C3	UC2	1.12E-11	5.55E-05	1.42E-06
	UC3	4.66E-12	2.31E-05	5.91E-07
	UC4	1.78E-12	8.83E-06	2.26E-07
C4	UC3	7.36E-11	1.13E-01	1.68E-05
	UC2	1.77E-10	2.72E-01	4.02E-05
	UC4	2.81E-11	4.33E-02	6.40E-06
D	UC2	1.31E-08	7.63E-01	-4.30E-04
	UC3	5.46E-09	3.18E-01	-1.79E-04
	UC4	2.09E-09	1.21E-01	-6.85E-05

Table 5: Waste indicators by information module

HWD Hazardous waste disposed
NHWD Non hazardous waste disposed
RWD Radioactive waste disposed

The amounts of materials leaving the system boundary after reaching the end-of-waste state is reported in table below. Most part of the elevator materials are metals, with high recyclability. Organic materials used in packaging are considered to be directed to incineration. No components are reused after the end-of-waste state.

Indicator		CRE	MFR	MER	EEE	EET
Unit		kg	kg	kg	MJ	MJ
A1	UC2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	UC3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	UC4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A2	UC2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	UC3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	UC4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A3	UC2	0.00E+00	2.25E-02	0.00E+00	0.00E+00	0.00E+00
	UC3	0.00E+00	9.38E-03	0.00E+00	0.00E+00	0.00E+00
	UC4	0.00E+00	3.58E-03	0.00E+00	0.00E+00	0.00E+00
Sum A1-A3	UC2	0.00E+00	2.25E-02	0.00E+00	0.00E+00	0.00E+00
	UC3	0.00E+00	9.38E-03	0.00E+00	0.00E+00	0.00E+00
	UC4	0.00E+00	3.58E-03	0.00E+00	0.00E+00	0.00E+00
A4	UC2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	UC3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	UC4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A5	UC2	0.00E+00	0.00E+00	1.35E+00	1.37E+00	3.96E+00
	UC3	0.00E+00	0.00E+00	5.62E-01	5.69E-01	1.65E+00
	UC4	0.00E+00	0.00E+00	2.14E-01	2.17E-01	6.30E-01
B2	UC2	0.00E+00	3.02E-01	4.93E-02	4.99E-02	1.45E-01
	UC3	0.00E+00	1.26E-01	2.05E-02	2.08E-02	6.03E-02
	UC4	0.00E+00	4.80E-02	7.84E-03	7.94E-03	2.30E-02
B6	UC2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	UC3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	UC4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	UC2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	UC3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	UC4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	UC2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	UC3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	UC4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C3	UC2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	UC3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	UC4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C4	UC2	0.00E+00	6.63E+00	0.00E+00	0.00E+00	0.00E+00
	UC3	0.00E+00	2.76E+00	0.00E+00	0.00E+00	0.00E+00
	UC4	0.00E+00	1.06E+00	0.00E+00	0.00E+00	0.00E+00

Table 6: Output flows

CRE Components for reuse
MFR Materials for recycling
MER Materials for energy recovery
EEE Exported energy Electrical
EET Exported energy Thermal

Analysis of results / Conclusion

General observations

The use stage is the most important contributor to the overall burden of the assessed elevator over its entire life cycle. With the exception of GWP-biogenic, the values for the main impact categories exceed 30%, while the value for AP even exceeds 70%. The product stage represents the second highest impact area. Module D results in significant benefits beyond the system boundary for most impact categories. In contrast, the construction and end-of-life stages have very little or no relevance in terms of the environmental burden.

[B6] Operational energy use

This information module is the information module with the highest contribution to the downstream stage and overall environmental burden of the assessed elevator for ADP- Fossil, GWP –total, AP, EP-freshwater, EP-marine, EP terrestrial and POCP. As a result, operation during the use phase thus significantly influences overall environmental impact due to the consumed energy. Analysis of alternative use scenarios, in which the assessed elevator is operated in different locations, showed substantial differences in the overall results for most impact categories (GWP-total, ADP-fossil, AP, EP-freshwater, EP- terrestrial, EP- marine, POCP). These differences can be attributed to the variations between energy sources for different grid mixes. As a consequence, the choice of grid mix needs to be carefully considered.

Product stage [A-1] – Raw material supply

This information module affects the product stage the most, causing almost all of its impact in all categories. It is the main contributor to ADP-minerals and metals, representing close to 80% of the overall burden in this category. For the rest of categories, it generates contributions from 18.4% (AP) to 34.5% (EP-freshwater). These impacts are mainly caused by energy intensive extraction and production processes of raw materials used for the different components of the elevator. The high level of the results is primarily produced by components made from carbon steel and other “Ferrous metals”, which represent close to 80% of the total weight of the assessed elevator. Nevertheless, in relative terms, components with a high share of Electrics & electronics (based on their specific impact per kg) have the highest impact on results and are therefore also of major relevance in the assessed life cycle.

[B2] Maintenance

This information module dominates the use phase for ADP –minerals and metals, causing more than 98% of its burden. In this case, the production of spare components for the elevator for the whole service life is the most significant aspect of module [B2]. The same as for A1, ferrous metals and electric and electronic equipment (see table 9) are the main contributors to this burden.

Potential for improvements

The use of ferrous metals, especially carbon steel, has a major effect on the A1 and B2 impacts. In context of Car, Rails, Fishplate & Mounting Material, Doors and Machine, components with optimized geometries could be developed in order to provide a weight reduction and therefore lower impacts. With reference to the ferrous metals, components made of organics, plastics and rubbers show lower impacts than of ferrous metals due to a major weight reduction. As a result, using these materials as an alternative – if feasible for their application – may achieve improved results. In addition, in terms of moving parts, the lower weight results in less energy demand and thus optimises B6 values.

Explanation of negative values GWP-biogenic for [A-3]

The negative GWP-biogenic for A3 is a result of the cradle-to-gate process of wood production, where wood absorbs CO_2 during its growth period (negative CO_2 balance). Release of this CO_2 is considered in A5 when the packaging materials are disposed of (positive CO_2 balance).

Scenarios and additional technical information

Allocations in [A3]

At TKE production sites, the share of resources (energy and materials) and waste that is used for the production of a meta200 elevator as specified in table 1 need to be defined by allocation. The consumptions, inflows and outflows assigned to the reference unit are based on the annual figures for the overall facility and the number of elevator units produced in the year. Using the same approach, inputs and outputs at suppliers are allocated based on the weight of primary products delivered to TKE for the assembly of the assessed elevator.

Electricity grid mix in manufacturing [A3] and operation [B6]

The meta200 elevator is produced at TKE sites in Shanghai and Zhongshan (China), which are operated using 100% renewable energy (wind). Their tier-1 suppliers are located in different areas in China. For the operational energy use, a combination of grid mixes representative for China and the rest of Asia and the Pacific is considered. Therefore electricity datasets for China (average and wind power) and Asia have been used in the study. Table 7 reflects their environmental impact expressed in kg CO2-eq/ kWh.

Country	CO2-eq/ kWh
Electricity from wind power (China)	0.013
China	0.826
Asia without China	0.717

Table 7: Information on electricity grid mixes

Transport to installation site [A4]

Road and sea transport is used to deliver meta200 elevators to their destinations. Average distances are estimated based on the most frequent meta200 elevators installation locations in China and the Asia Pacific region. The table 8 below summarizes A4 data.

Type of vehicle	Truck-trailer, Euro 4, 34 - 40t gross weight / 27t payload capacity
Distance	556.6 km
Capacity utilisation	61 %

Table 8: Transport to installation

Type of vehicle	Container ship, 5,000 to 200,000 dwt payload capacity, ocean going
Distance	3570 km
Capacity utilisation	70 %

Table 9: Data in context of transport to installation site

Maintenance

Preventive maintenance activities are scheduled activities, which ensure the proper operation of the elevator during its reference service life. The main inputs in this module are the transport of workers to the installation site, the electricity consumption during maintenance activities and the raw material extraction for spare parts. Tables 10 and 11 summarize these inputs.

Data	Value	Unit
Maintenance cycle and process	As in maintenance manual	
Annual electricity consumption by maintenance tools	12	kWh
Annual oil consumption	3.5	l
Annual wax consumption	2	l
Transportation distance to disposal site (packaging materials)	40	km
Annual travelled distance by maintenance staff (trolleybus)	240	l

Table 10: Data in context of preventive maintenance

Material type	Weight of materials [kg]	Share of total [%]
Ferrous metals	175.12	45.09%
Electrics & Electronics	56.53	14.55%
Plastics & Rubbers	145	37.37%
Non-ferrous metals	11.6	2.99%
Overall	**388.52**	**100**

Table 11: Material content. Spare parts.

Energy consumption in operation [B6]

The meta200 elevator annual energy consumption during operation has been calculated acc. to ISO 25745-2. For this study Usage categories 2, 3 and 4 of ISO 25745-2 have been considered (between 125 and 750 trips per day) as they represent the most typical applications for this reference unit in mid-rise residential or commercial buildings. The annual energy consumptions are those indicated in table 12.

Usage category (acc to ISO 25745-2)	Calculated annual energy consumption [kWh]
2	1649.03
3	2443.85
4	4040.65

Table 12: Calculated annual energy consumption

End-of-life C2-C4

The elevator is mainly composed by metallic materials, with high recyclability and growing recycling ratios in all regions. Plastics are considered to be disposed at waste incineration facilities, and the rest of materials are considered as landfilled.

Net benefits in module D are calculated based on the metals directed to recovery using a net flow calculation acc. to EN15804, taking into account the input and outflows of recycled materials.

Processes	Unit	Amount kg/kg
Collection process	kg collected seperately	1
	kg collected with mixed construction waste	0
Recovery system	kg for reuse	0
	kg for recycling	0.8
	kg for energy recovery	0.09
Disposal	kg for final deposition	0.11

Table 13

Glossary

Impact category	Abbreviation	Unit	Characterization method	Description
Global Warming Potential (100 years)	GWP-total	kg CO2 eq	Baseline model of 100 years of the IPCC based on IPCC2013	The global warming potential (GWP) is a relative measure of how much heat a greenhouse gets trapped in the atmosphere. It is indicated in kg of CO_2-equivalents for a specified time horizon.
Global Warming Potential biogenic, fossil, land use and land use change	GWP-fossil GWP-biogenic GWP-luluc			These are subsets of the total GWP covering the biogenic, fossil, and land use related part of the GWP. These three add up to the main climate change impact.
Ozone depletion potential	ODP	kg CFC-11 eq.	Steady-state ODPs, WMO 2014	Ozone Depletion Potential characterizes the destructive effects on the stratospheric ozone layer of anthropogenic emissions of ozone depleting substances (ODS), mainly chlorofluorocarbons (CFCs) and nitrogen oxides (NO_x). It is calculated over a time horizon of 100 years
Acidification potential	AP	Mol of H+ eq	Accumulated Exceedance, Seppäla et al., 2008	The acidification potential describes the acid deposition in plants, soils and surface waters caused by the conversion of air pollutants in acid. It is calculated as Mol of H+ eq
Eutrophication aquatic freshwater	EP-freshwater	kg P eq.	EUTREND model, Struijs et al., 2009b as implemented in ReCiPe	Aquatic eutrophication is the undesired enrichment of waters with nutrients. It induces the growth of plants and algae, which may result in oxygen depletion. At an excessive level it affects the biological balance of affected waters Aquatic eutrophication potential is measured in kg of PO4-eq (freshwater) and kg of N eq (marine water).
Eutrophication aquatic marine	EP-marine	kg N eq.		
Eutrophication, terrestrial	EP terrestrial	Mol N eq.	Accumulated Exceedance, Seppäla et al., 2008	Terrestrial eutrophication is the undesired enrichment of soils with nutrients. It may increase the susceptibility of plants to diseases and pests, as cause degradation of plant stability. If the nitrification level exceeds the amounts of nitrogen necessary for a maximum harvest, it can lead to an enrichment of nitrate which can cause increased nitrate content in groundwater. Terrestrial eutrophication is expressed as Accumulated Exceedance in MOL N.
Photochemical ozone formation	POCP	kg NMVOC eq.	LOTOS-EUROS, Van Zelm et al., 2008, as applied in ReCiPe	Photochemical ozone creation potential (also referred to as photochemical smog) quantifies the creation of ozone on ground-level where it is considered as a pollutant, while in the high levels of the atmosphere it protects against ultraviolet (UV) light. Ozone on lower levels is a harm to human health and can for example cause inflamed airways or damage lungs. It is expressed in kg of NMVOC-equivalents.
Abiotic depletion potential for non fossil resources	ADP-minerals and metals	kg Sb eq	CML 2002, Guinée et al., 2002 and vvan Oers et al 2002	Abiotic resources are natural resources which are regarded as non-living. Their current rate of depletion by humans is not considered sustainable and is cause for concern due to their scarcity. The depletion of abiotic resources is reflected in two separate impact categories: Elements, such as iron ore, indicated in kg of Sb-equivalents; and Fossil fuels, for example, crude oil indicated in MJNCV.
Abiotic depletion for fossil resources potential	ADP-fossil	MJ, net calorific value		

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