EPD®

TKE

ENVIRONMENTAL PRODUCT DECLARATION

EOX

EPD Owner	TK Elevator Brazil
Program	The International EPD® System EPD International AB www.environdec.com
EPD registration number	S-P-09507
Published	2023-09-27
Valid until	2028-09-27

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

ECO PLATFORM EPD VERIFIED

In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019

MOVE BEYOND

Measuring the environmental performance of our products is the foundation for continuous improvement.

CONTENTS

Program-related information & mandatory statement

Program operator
The International EPD® System

more information is available on www.environdec.com, email: info@environdec.com

EPD® International AB
Box 210 60
SE-100 31 Stockholm, Sweden

EPD® owner
TK Elevator GmbH
E-Plus-Strasse 1
40472 Düsseldorf
Germany
www.tkelevator.com
info@tkelevator.com

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Geographical scope of application
Latin America

Reference year for underlying data 2022

Reference years of datasets
2017-2022

Product category rules (PCR)
EN15804:2012 + A2:2019 as core PCR
PCR 2019:14 Construction Products, version 1.2.5 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

Verification:

Independent verification of the declaration and data, according to EN ISO 14025:2010

Covering: ☐ EPD process certification
☒ EPD verification by individual verifier

Procedure for follow-up during EPD validity involves third party verifier: ☐ Yes ☒ No

Third party verifier: Rubén Carnerero Acosta (individual verifier)
Approved by the International EPD® System
Contact: r.carnerero@ik-ingenieria.com

PCR review was conducted by The Technical Committee of the International EPD® System
See www.environdec.com/TC for a list of members. Review chair: Claudia A. Peña, University of Concepción, Chile. The review panel may be contacted via the Secretariat. www.environdec.com/contact

The Technical Committee can be contacted via the Secretariat
www.environdec.com/contact-us

ISO standard ISO 21930 and CEN standard EN 15804 serves as the core Product Category Rules (PCR)

The EPD owner has the sole ownership, liability, and responsibility for the EPD . EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same 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 equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

About this EPD

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.

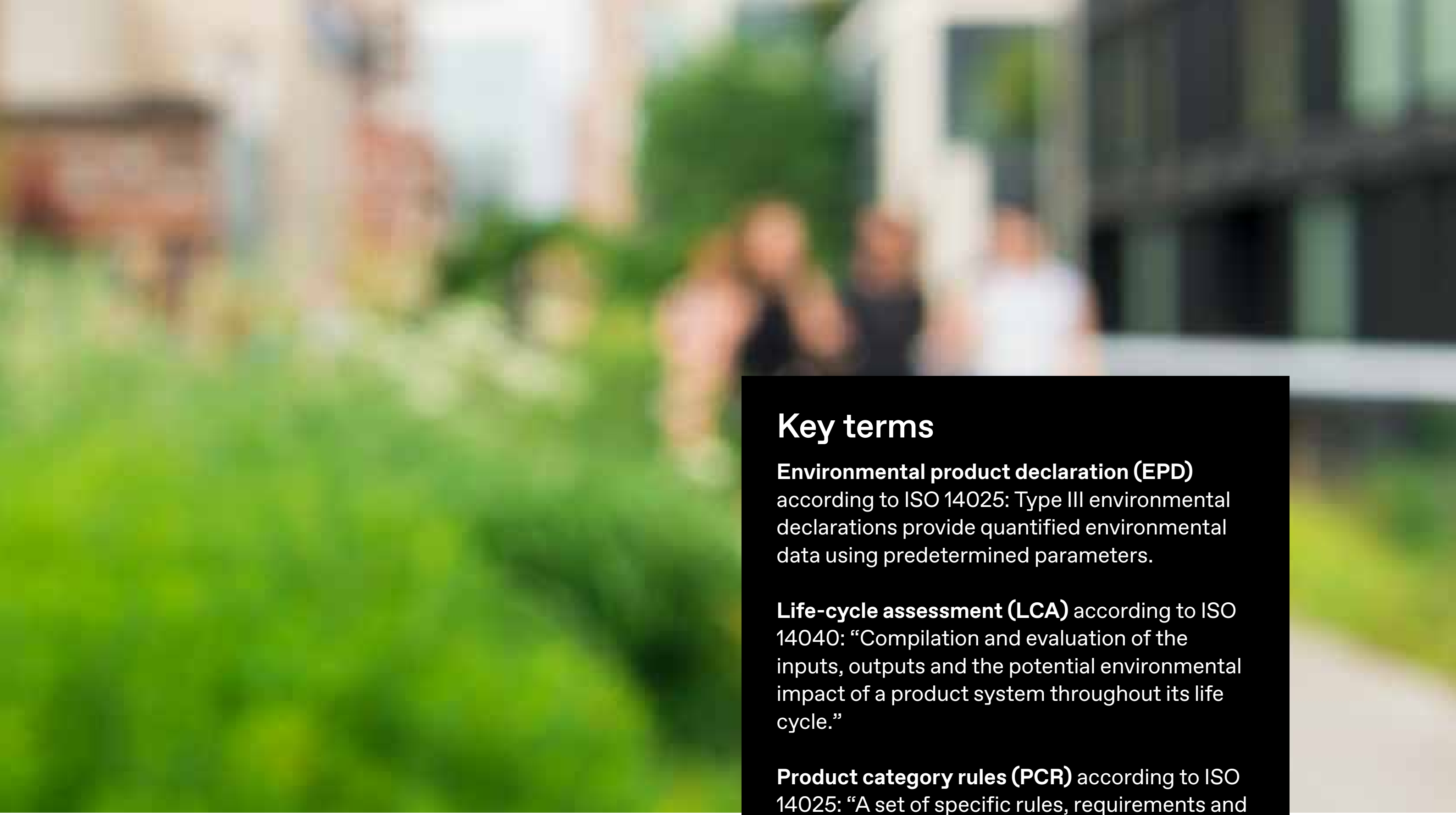
What is an EPD®?
An EPD provides information about the environmental performance of a product. In the case of this publication, the results refer to TKE EOX elevators.

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 (c-PCR) 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.

Cut-off criteria
Cut-off criteria were applied in accordance with the PCR and EN 15804. The evaluation was comprehensive, covering all mandatory inflows and outflows while also considering the quality and



Key terms

Environmental product declaration (EPD) 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.”

completeness of data. For information module [A1-Raw material supply] the amount of input materials corresponds to 100% of the reference unit weight. Production, maintenance and disposal of manufacturing infrastructure, indirect activities, business travel and all other non-mandatory processes were not included in the analysis.

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.

Comparability between EPDs based on this c-PCR-008 (to PCR 2019:14) is only achievable, if the following performance characteristics are equivalent: Functional unit, Reference Service Lifetime, Usage Category, travel height, number of stops, rated load, rated speed and geographic region.

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.
ISO 14020 (2022) - Environmental labels and declarations.
GPI 3.01 - General Programme Instructions.
c-PCR 008 Lifts (elevators) - Product Category Rules.

About us

With customers in over 100 countries served by more than 50,000 employees, TK Elevator achieved sales of around €8 billion in the fiscal year 2018/2019. Over 1,000 locations around the world provide an extensive network that guarantees closeness to customers.

At our manufacturing site in Guaíba, state of Rio Grande do Sul, south of Brazil, we employ around 800 people. With a production area of 27,000 m^2, this site attends the Latin America market.

The manufacturing site was purchased in 1999 by TK Elevator from the company Sûr S/A and recently we became responsible to be cluster lead for belt elevators in all over the world. Here is where we concentrate our expertise and experience in engineering and manufacturing elevator systems and parts, developing innovations and continuously optimizing existing components.

Using state-of-the-art methods and flexible production techniques, we proudly supply for customers in all Latin America and also for other countries.

All our processes are certified in accordance with the following international standards:

- DIN EN ISO 9001: Quality Management System.
- DIN EN ISO 14001: Environmental Management System.
- DIN EN ISO 45001: Occupational Health and Safety Management System.

Recently we have been also approved to be certified to ISO 50001 (Energy Management Systems).

With our annual production capacity of around 3,800 elevators, we achieve an export rate of around 25%, proudly serving customers around the globe.

THE EOX ELEVATOR SYSTEM

The EOX elevator system

EOX is TK Elevator's new efficient and natively digital elevator platform. EOX is a future-proof fusion of both the latest energy-saving and digital technologies in vertical mobility.

It spells out TK Elevator's commitment to add value to your buildings: By contributing to energy efficiency [E] and the improvement of the environmental performance. By putting our customers at the centre and going full circle [O] on today's and tomorrow's needs of everyone who designs, constructs, manages or uses a building. And by digitally transforming [X] the everyday elevator.

Naturally green

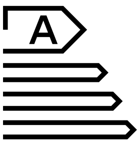
EOX proves that efficiency and technology can go hand in hand. With its standard included LED lighting for shaft, cabin and landing devices, regenerative drive, stand-by and sleep mode, as well as its innovative mode it actively saves energy in your buildings.

A dashboard in the customer portal provides customers with complete transparency about the elevator's energy consumption and savings on a daily, monthly and yearly basis. And thanks to clever engineering, our 100% renewable electricity factories and digitally augmented services, fewer CO_2 emissions are produced because of it.

Natively digital

Powered by cloud infrastructure from Microsoft as well as high-performance accelerated computing from NVIDIA, EOX has the built-in capability to evolve with customer needs. All the components needed for digital expansion are already included from day one, minimizing on-site visits required for future enhancements. Meanwhile, passengers can already connect to EOX with their mobile device to call on the next available cabin, enjoy dynamic content on an in-built multimedia screen in the cabin, and benefit from improved uptime as a result of smart maintenance features.

Improvements



The low-energy design of EOX elevators means that they consume up to 28% less energy than previous products and qualifies them for the highest energy efficiency rating, namely Class A as defined by ISO 25745-2.

At the same time, based on the reference configuration specified in table 1, the material resources needed to produce the elevator have been reduced by more than 10% in comparison with previous products, achieving over 15% reduction in the carbon footprint associated to the use of materials.

The EOX elevator series complies with all relevant international standards and regulations:

- Lifts Directive 2014/33/EU: Directive of the European Parliament
- EN 81: Safety rules for the construction and installation of lifts
  - P art 20: Passenger and goods/ passenger lifts
  - P art 50: Design rules, calculations, examinations and tests of lift components
- Type-tested system: certification by notified body
- ISO 25745-1/2

The EOX elevator system

Table 01: Specification of assessed elevator according to the PCRs

EOX		
Index	**Representative values for the reference unit**	**Application range of the elevator model**
Type of installation	New installation	
Commercial name (type)	EOX	
Main purpose	Transport of passengers	
Type of elevator	Electric, without machine room (MRL)	
Type of drive system	Gearless traction drive	
Rated load [Q]	630kg	450 up to 1600kg
Rated speed	1 m/s	1 m/s up to 1.75 m/s
Number of stops	5	Up to 20
Travelled height	12,25 m	Up to 75 m
Number of operating days per year	365	
Applied usage category (UC) according to ISO 25745-2	2	1 & 3
Designed reference service life (RSL)	25 years	
Geographic region of installation	Latin America	
Optional equipment	None	
FU (tkm)	323.50	129.40 & 776.40

Representative installation
The reference for the underlying life-cycle assessment (LCA) study is an elevator to be installed in a low rise residential building in Latin America. Its configuration corresponds to the typical application range of the EOX series. For energy consumption during operation, the Latin America average grid mix was 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 category included in the analysis reflect the use of this product in low rise residential 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.

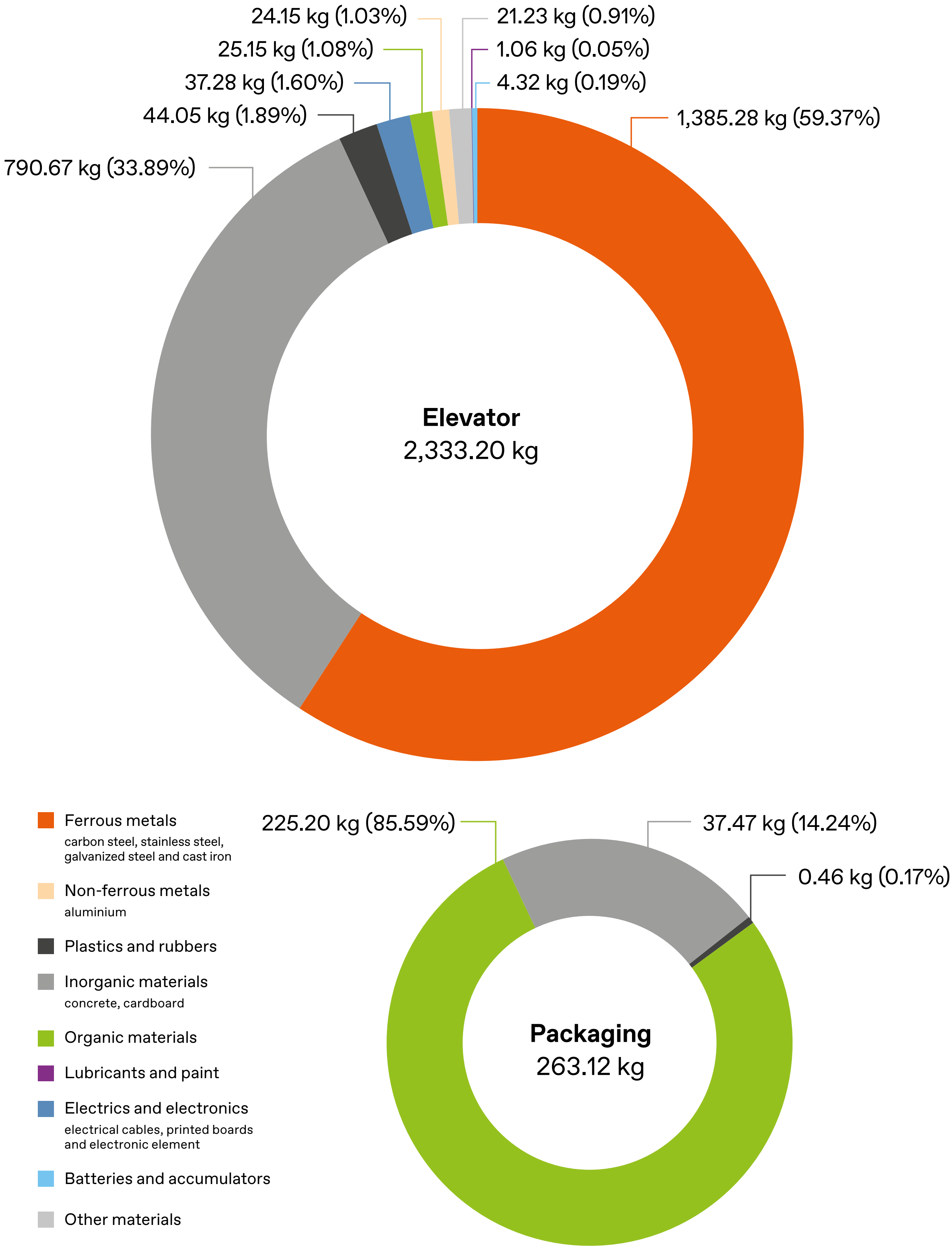
Almost 60% of the material the elevator is made of belongs to the material category of ferrous metals, followed by inorganic materials with more than 33%, plastics and rubbers (1,89%), organic materials (1,08%) and non-ferrous metals (1,03%). The rest of the material categories account each for less than 1%.

The product-specific content of recycled materials is undetermined. Generic percentages taken from Gabi databases are used for calculations

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

The main materials used for the packaging of the elevator are wood and cardboard, that represent 99% of the overall packaging weight, and contain 165.8 kg C of biogenic carbon.

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



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 obtention of raw materials and their further transformation and processing to produce, assemble and pack all components for the assessed unit. Manufacturing activities take place at TKE site in Brazil and suppliers' facilities located in Brazil, Switzerland, Argentina and China. The construction process stage (A4-A5) considers the road and sea transport from TKE to the installation site (in Latin America), the final assembly of the elevator, and the disposal of packaging. For product and construction stages (A1 to A5), the percentage of specific data used is higher than 90%. 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. 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 modules A1, A2 and A3 is China, Germany and Latin America, while all the other modules are related to Latin America. The resulting system boundaries are presented in the figure below:

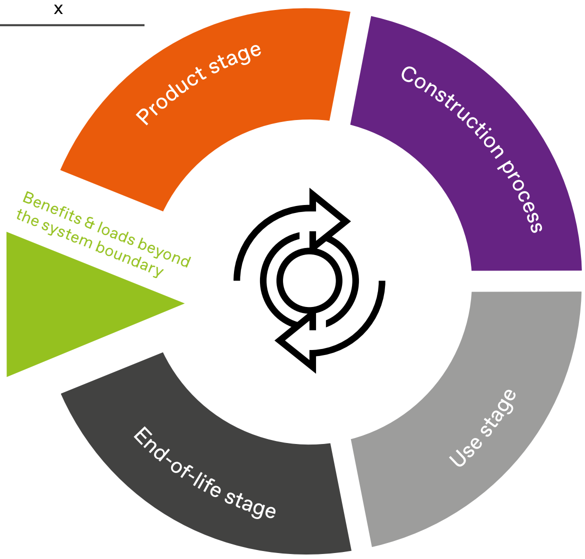
Figure 2: Elevator life cycle stages and respective information modules according to the PCRs

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 Use 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.

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 usage category 2.

Potential environmental impact

Table 02: Impact category results by information module

Information Module	GWP - total	GWP - fossil	GWP - biogenic	ODP	AP	EP - freshwater	EP - marine	EP - terrestrial	POCP	ADP - minerals and metals	ADP Fossil	WDP	GWP-100
	kg CO2 eq.	kg CO2 eq.	kg CO2 eq.	kg CFC-11 eq.	Mole of H+ eq.	kg P eq.	kg N eq.	Mole of N eq.	kg NMVOC eq.	kg Sb eq.	MJ	m^3 world equiv.	kg CO2 -eq
A1-A3	1,45E+01	1,53E+01	-7,96E-01	7,25E-11	7,28E-02	2,54E-05	1,49E-02	1,56E-01	4,60E-02	6,71E-04	1,97E+02	3,78E+00	1,57E+01
A4	1,57E+00	1,57E+00	-2,03E-02	1,27E-13	8,61E-03	6,18E-06	3,04E-03	3,41E-02	6,85E-03	9,33E-08	2,10E+01	1,67E-02	1,57E+00
A5	1,82E+00	2,54E-01	1,57E+00	1,12E-12	6,86E-04	2,55E-06	2,19E-04	2,18E-03	1,01E-03	7,23E-07	2,79E+00	4,02E-02	1,42E+00
B2	2,59E+00	2,60E+00	-2,95E-02	7,74E-11	1,04E-02	6,18E-06	1,88E-03	1,78E-02	6,09E-03	6,18E-05	4,36E+01	8,41E-01	2,69E+00
B6	1,59E+01	1,58E+01	1,17E-02	6,12E-11	1,27E-01	5,56E-05	1,63E-02	1,60E-01	4,47E-02	1,22E-06	1,86E+02	9,64E+00	1,58E+01
C1	1,35E-01	1,35E-01	1,64E-04	4,72E-13	9,52E-04	4,18E-07	1,27E-04	1,24E-03	3,55E-04	1,50E-08	1,61E+00	6,90E-02	1,34E-01
C2	4,00E-02	4,02E-02	-5,53E-04	5,12E-15	1,51E-04	1,44E-07	7,11E-05	7,88E-04	1,39E-04	2,59E-09	5,36E-01	4,76E-04	4,01E-02
C3	1,51E-02	1,51E-02	2,30E-06	4,53E-14	7,42E-05	3,92E-08	3,40E-05	3,89E-04	9,58E-05	1,61E-08	2,89E-01	2,62E-03	1,51E-02
C4	2,32E+00	1,07E+00	1,25E+00	7,08E-13	1,46E-03	1,04E-06	5,29E-04	6,55E-03	1,39E-03	3,17E-09	1,76E+00	3,84E-01	1,07E+00
D	-2,52E+00	-2,52E+00	2,05E-03	1,81E-12	-9,34E-03	-7,70E-07	-1,62E-03	-1,72E-02	-5,04E-03	-6,18E-05	-2,45E+01	-2,13E-01	-2,50E+00

* GWP-100: IPCC AR5 GWP, excluded biogenic carbon. See glossary for acronyms.
**ADP impact categories (see template) disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.

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 UC2.

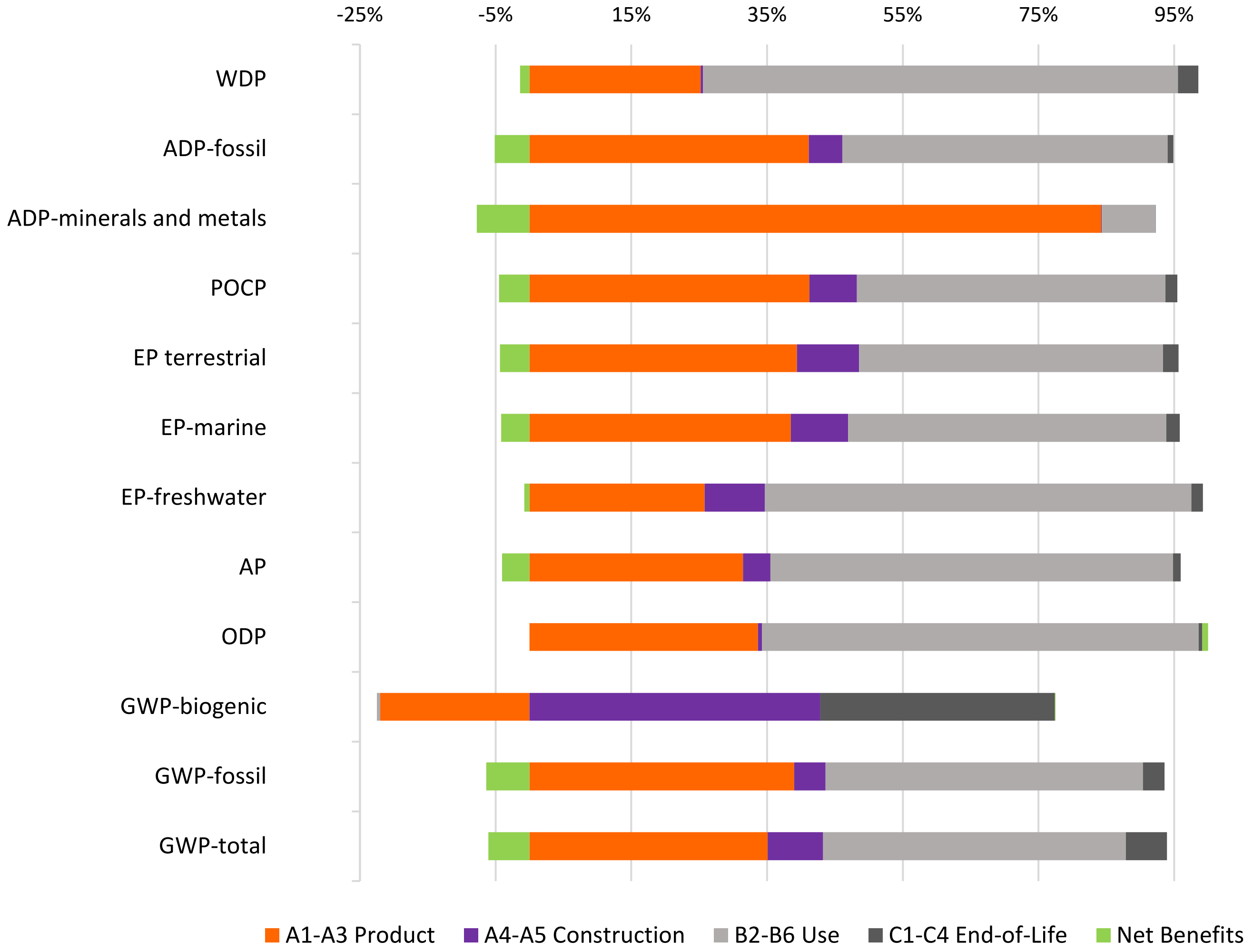
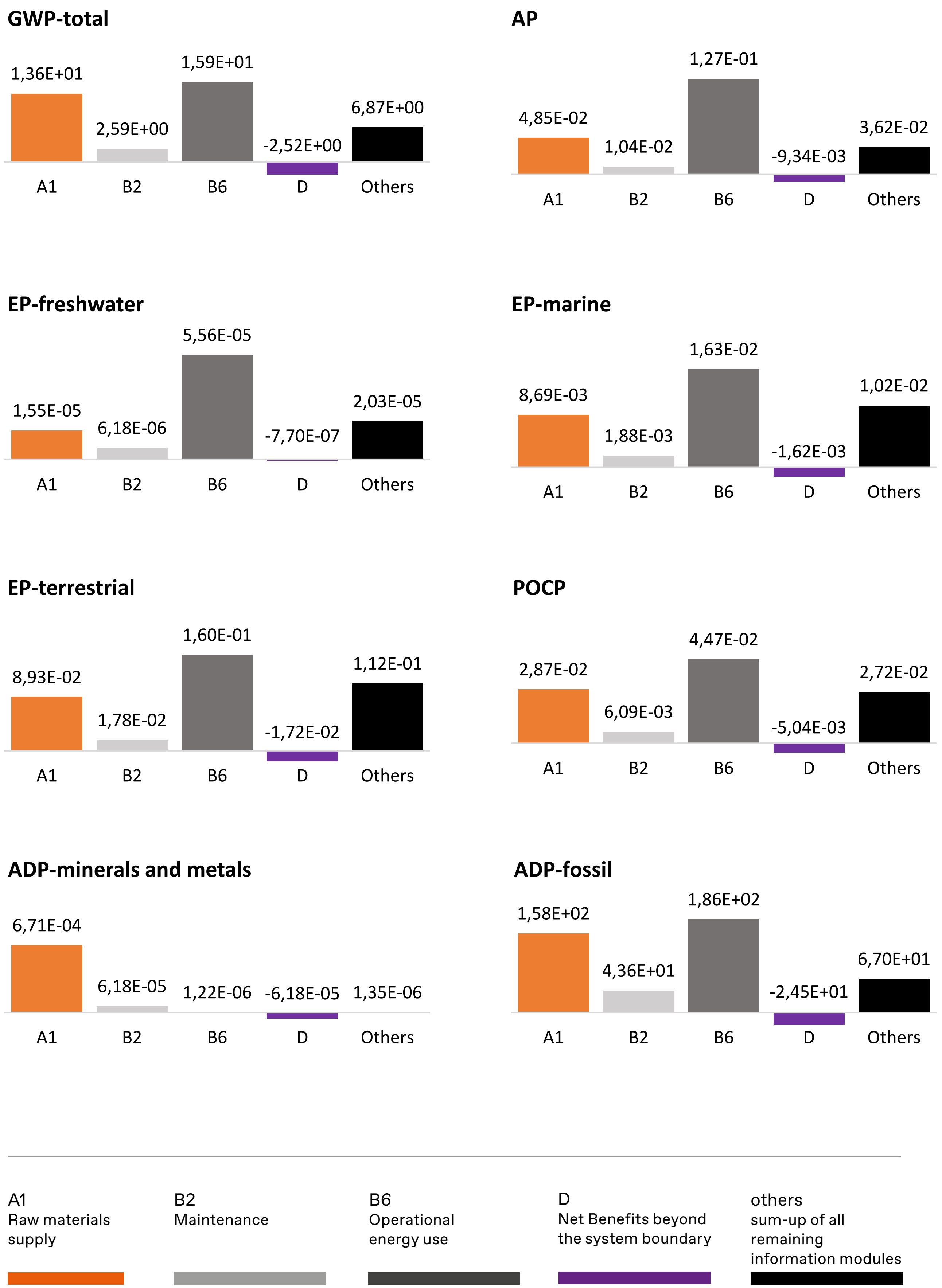


Figure 1: Impact category results by life-cycle stage (in %, UC2)

In the figure above, the impact results of the three largest contributors (B6, A1, and B2) to the overall UC2 results are compared with each other and the sum of the rest of the information modules.

Figure 2: 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-A3	6,13E+01	9,51E+00	7,08E+01	1,97E+02	1,78E-01	1,97E+02	1,10E-01	1,39E+00	0,00E+00	0,00E+00
A4	1,39E+00	0,00E+00	1,39E+00	2,10E+01	0,00E+00	2,10E+01	1,54E-03	0,00E+00	0,00E+00	0,00E+00
A5	7,69E-01	0,00E+00	7,69E-01	2,79E+00	0,00E+00	2,79E+00	1,30E-03	2,75E-03	0,00E+00	0,00E+00
B2	1,04E+01	0,00E+00	1,04E+01	4,37E+01	0,00E+00	4,37E+01	2,91E-02	2,60E-01	1,59E-24	1,35E-25
B6	1,57E+02	0,00E+00	1,57E+02	1,86E+02	0,00E+00	1,86E+02	5,95E-01	0,00E+00	0,00E+00	0,00E+00
C1	1,12E+00	0,00E+00	1,12E+00	1,61E+00	0,00E+00	1,61E+00	4,24E-03	2,44E-03	0,00E+00	0,00E+00
C2	3,90E-02	0,00E+00	3,90E-02	5,38E-01	0,00E+00	5,38E-01	4,33E-05	0,00E+00	0,00E+00	0,00E+00
C3	3,18E-02	0,00E+00	3,18E-02	2,90E-01	0,00E+00	2,90E-01	7,73E-05	0,00E+00	0,00E+00	0,00E+00
C4	3,32E-01	0,00E+00	3,32E-01	1,76E+00	0,00E+00	1,76E+00	9,00E-03	0,00E+00	0,00E+00	0,00E+00
D	-1,95E+00	0,00E+00	-1,95E+00	-2,46E+01	0,00E+00	-2,46E+01	-9,78E-03	0,00E+00	0,00E+00	0,00E+00

Table 03: 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.

The amounts of materials leaving the system boundary after reaching the end-of-waste state are 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 recycling.

Indicator	HWD	NHWD	RWD
Unit	kg	kg	kg
A1-A3	5,26E-05	1,62E+00	1,77E-03
A4	7,23E-11	2,83E-03	2,47E-05
A5	8,98E-09	4,34E-01	1,79E-04
B2	9,27E-06	9,04E-01	6,58E-04
B6	-4,94E-09	9,42E-02	4,72E-03
C1	-2,45E-11	1,48E-03	3,40E-05
C2	1,67E-12	8,35E-05	1,01E-06
C3	-3,10E-12	8,04E-05	2,37E-06
C4	1,20E-08	2,71E+00	6,49E-05
D	-5,73E-10	-8,60E-02	-6,00E-04

Indicator	CRE	MFR	MER	EEE	EET
Unit	kg	kg	kg	MJ	MJ
A1-A3	0,00E+00	2,16E+00	0,00E+00	0,00E+00	0,00E+00
A4	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
A5	0,00E+00	2,16E+00	0,00E+00	0,00E+00	0,00E+00
B2	0,00E+00	7,44E-01	0,00E+00	0,00E+00	0,00E+00
B6	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
C1	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
C2	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
C3	0,00E+00	4,79E+00	0,00E+00	0,00E+00	0,00E+00
C4	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

Table 04: Waste indicators by information module

HWD Hazardous waste disposed

NHWD Non hazardous waste disposed

RWD Radioactive waste disposed

Table 05: 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 usage stage is the most important contributor to the overall burden of the assessed elevator over its entire life cycle in ten out of twelve analyzed categories (GWP-biogenic excluded). The product stage represents the second highest impact area, being the largest contributor to the remaining five categories. Module [D] results in benefits for almost all impact categories. In contrast, the construction and end-of-life stage have little relevance in terms of the environmental burden.

[B6] Operational energy use
This information module is the one with the highest contribution to the overall environmental burden of the assessed elevator for EP-freshwater, ADP- Fossil, GWP-fossil, WDP, GWP –total, EP-marine, AP, POCP and EP-terrestrial. It is the second most important contributor to ODP and ADP-minerals and metals. As a result, operation during the use phase also 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 (AP, EP- freshwater, EP- terrestrial, EP- marine, POCP and WDP). 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 [A1] – Raw material supply
This information module is the information module with the highest contribution to the overall environmental burden of the assessed elevator in category ADP - minerals and metals and the second most important one in GWP (-total and –fossil), EP (-marine, -fresh water and -terrestrial), WDP, ADP-Fossil, POCP, AP and ODP. Its high impact is mainly caused by the 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 60 % of the total weight of the assessed elevator.

Nevertheless, in relative terms components with a high share of Electric and Electronics (based on their specific impact per kg) have the highest impact on the results and are therefore of major relevance in the product life cycle.

[B2] Maintenance
This information module is the most important contributor in terms of relative contribution for category ODP and the second most important for category ADP - minerals and metals, causing up to 35.9% of its burden. Moreover, it is the third one for categories GWP-total, GWP-fossil, AP, EP-freshwater, ADP-fossil and WDP. For these categories, 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 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 Rails, Fishplate & Mounting Material, Car, 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.

Scenarios and additional technical information

Allocations in [A3]

Resource usage and waste corresponding to EOX elevator production cannot be accurately determined. Overall annual facility figures and elevator units produced are used to allocate inputs and outputs for the assessed elevator. Suppliers' data is allocated based on the weight of primary products delivered to TKE BR for elevator assembly.

The in-house manufacturing process involves cutting, bending and press-joining metal sheets to produce final components for the elevator, including the frame counterweight, platform, ceiling cabin, tension pulley and cabin structural components. Other components, such as the car and safeties, are manufactured and assembled at TKE BR factory using primary products from suppliers, such as handrails, flooring, lighting, and cabin apron.

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

The EOX elevator is produced at TKE BR site in Brazil, which is operated using 100% renewable electricity, with elevator components and materials coming from suppliers located in Latin America (mainly Brazil and Argentina), Switzerland and China. Therefore, representative electricity grid mixes of the mentioned countries and respective energy origins have been taken for [A3]. In paralell, for the operational energy use, the average Latin America grid mix is considered. The table 6 reflects their environmental impact expressed in kg CO_2-eq/* kWh.

Table 06: Information on electricity grid mixes

Country	CO_2-eq/kWh
Switzerland (Germany)	0.440
China	0.798
Region South America (average)	0.374
Region South America (average) Electricity from wind power	0.010

Transport to installation site [A4]

Road and sea transport are used to deliver low rise elevators to Latin America destinations. Average distances have been calculated taking into account the countries where this elevator is most frequently installed. The table 7 below summarizes A4 data.

Table 07: Data in context of transport to installation site summarizes A4 data

Type of vehicle	Distance	Capacity utilisation	Bulk density
Truck-trailer, Euro 4, 34 - 40t gross weight / 27t payload capacity	1139.38 km	85%	156kg/m^3
Container ship, 5,000 to 200,000 dwt payload capacity, ocean going	859.31 km	70%	156kg/m^3

Installation in the building [A5]

This module includes all inputs and outputs related to the installation of the elevator at the building site, as well as the treatment of the waste generated by the packaging used for the transportation.

Table 08: Installation of the product in the building

Data	Value	Unit
Electricity Consumption by Installation Tools	47.20	kWh
Carbon steel (welding electrodes, anchorage)	2.58	kg
Transport distance for auxiliary materials	42	km
Transportation Distance to Disposal Site (packaging materials)	25.7	km
Waste materials (spare parts)	211.35	Kg
Waste materials (packaging)	263.13	Kg

Maintenance [B2]

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. The tables 9 and 10 summarize these inputs.

Table 09: Data in context of preventive maintenance

Data	Value	Unit
Maintenance cycle and process	As in maintenance manual	
Maintenance cycle	12 as LA average	Visit per year
Annual electricity consumption by maintenance tools	17	MJ
Annual oil consumption	0.769	l
Annual wax consumption	2	l
Transportation Distance to Disposal Site (packaging materials)	42	km
Annual gasoline consumption for transport of workers	1.64	l

Table 10: Material content. Spare parts

Material type	Weight in kg	Share of total in %
Ferrous metals	122.26	57.9%
Plastics & Rubbers	57.09	27.1%
Inorganic materials	15.53	7.4%
Non-ferrous metals	13.74	6.5%
Other materials	2.00	0.9%
Organic materials	0.36	0.2%
Overall	**211.42**	**100**

Energy consumption in operation [B6]

The EOX elevator annual energy consumption during operation has been calculated acc. to ISO 25745-2. For this study Usage category 2 of ISO 25745-2 have been considered (between 75 and 200 trips per day) as they represent the most typical applications for this reference unit in low rise residential buildings. The annual energy consumptions are those indicated in table 11 where the range of usage categories is kept for greater transparency.

Table 11: Calculated annual energy consumption

Usage category (acc. to ISO 25745-2)	Calculated annual energy consumption [kWh]
1	410.91
2	537.34
3	737.42

End-of-life [C2-C4]

The elevator is mainly composed by metallic materials, with high recyclability and high recycling ratios in Latin America countries. Plastics, among other materials, are considered to be disposed at recycling 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.

Table 12: Information about end-of-life processes

Processes	Unit	Amount kg/kg
Collection process	Kg collected separatedly	1
	Kg collected with mixed construction waste	0
Recovery system	kg for reuse	0
	kg for recycling	0.66
	Kg for energy recovery	0
Disposal	Kg for final deposition	0.34

Glossary

Glossary

Impact category	Abbreviation	Unit	Characterisation method	Description
Global Warming Potential (100 years)	GWP-total	kg CO_2-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 gas 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 (NOX). 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.		

Glossary

Impact category	Abbreviation	Unit	Characterisation method	Description
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 van 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 potentia	ADP-fossil	MJ, net calorific value		

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