Elevator Technology

Environmental Product Declaration

evolution elevator

In accordance with ISO 14025

thyssenkrupp

EPD®

Program-related information and verification

See PCR for detailed requirements.

Program:	The International EPD® System EPD International AB Box 210 60 SE-100 31 Stockholm Sweden www.environdec.com
EPD registration number:	S-P-02148
Publication date:	2020-9-30
Validity date:	2023-9-30
Product category rules:	Environdec PCR for Lifts (Elevators) Version 1.0
Product group classification:	UN CPC 4354 Lifts, skip hoists, escalators and moving walks
Reference year for data:	2016
Geographical scope:	North America
Product category rules (PCR):	Lifts (Elevators), Version 1.0, 2015:05, October 14th, 2015
Review panel for this PCR:	The Technical Committee of the International EPD® System. Full list of TC members available on www.environdec.com/TC
Independent verification of the declaration and data, according to ISO 14025: 2006:	☐ EPD Process Certification (internal) ■ EPD Verification (external)
Third-party verifier:	Thomas P. Gloria, Ph. D. — Industrial Ecology Consultants
Accredited by:	Approved by the International EPD System

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We are proud to publish this lift Environmental Product Declaration (EPD) that follows the Product Category Rules of the International EPD® System.

About us

With customers in over 100 countries served by more than 50,000 employees, thyssenkrupp 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.

After building its position as one of the world's leading elevator companies in a mere 40 years' time, thyssenkrupp Elevator became an independent company in August 2020. The company's most important business line is its service business, with approximately 1.4 million units under maintenance and over 24,000 service technicians globally.

The product portfolio covers commodity elevators for residential and commercial buildings to cutting-edge, highly customized solutions for state-of-the-art skyscrapers – such as One World Trade Center in New York. In addition, it also consists of escalators and moving walks, passenger boarding bridges, stair and platform lifts, as well as tailored service solutions such as MAX, the industry's first cloud-based digitally enhanced maintenance solution – thus covering a broad spectrum of urban mobility.

Products

As the world becomes increasingly connected and urbanized, efficient and reliable, mobility is key. We apply this mindset to our elevator designs and take a holistic approach to engineering in order to address challenges at a systemic level. As seen in our application of regenerative energy, as well as our MAX partnership with Microsoft, our goal is to continually improve our standards, finding energy saving and net zero opportunities at every turn. With MAX, our predictive maintenance and service solution, we equipped 180,000 elevators around the world with this revolutionary technology beginning in 2017. MAX Digital Services supports customers with enhanced features using collected MAX data. Service calls can be placed on hand-held devices. Automatic text or email notifications on elevator maintenance status are sent directly to the customer.

As demand for intelligent design production grows, so does our involvement with third-party entities and non-governmental organizations that push for transparency and accountability. We're currently developing Life Cycle Assessments (LCAs) for 100 percent of our products. We are proud to publish our fourth Lift Environmental Product Declaration (EPD) that follows the Product Category Rules (PCR) published by environdec on October 14, 2015. This document displays the environmental declaration of our evolution elevator.

Today's low- to mid-rise buildings are more innovative than ever, from how much energy they consume to how much space they occupy. The building's transportation system should be just as innovative. thyssenkrupp Elevator's evolution elevator combines reliable performance, energy-efficient features and a hassle-free installation. evolution also features our advanced regenerative drive technology, which captures generated power and feeds it back into the building's electrical grid, reducing energy costs. The evolution rail-supported elevator is designed to rely solely on the rail system for support. Plus the permanent magnet machine is more compact, meaning there is no need for a crane. The auto-rescue feature prevents passengers from being trapped in a power outage by automatically transporting them to the next available floor and opening the doors. As with all of our products, safety is our first priority, while ride quality, efficiency and performance have been engineered with excellence.

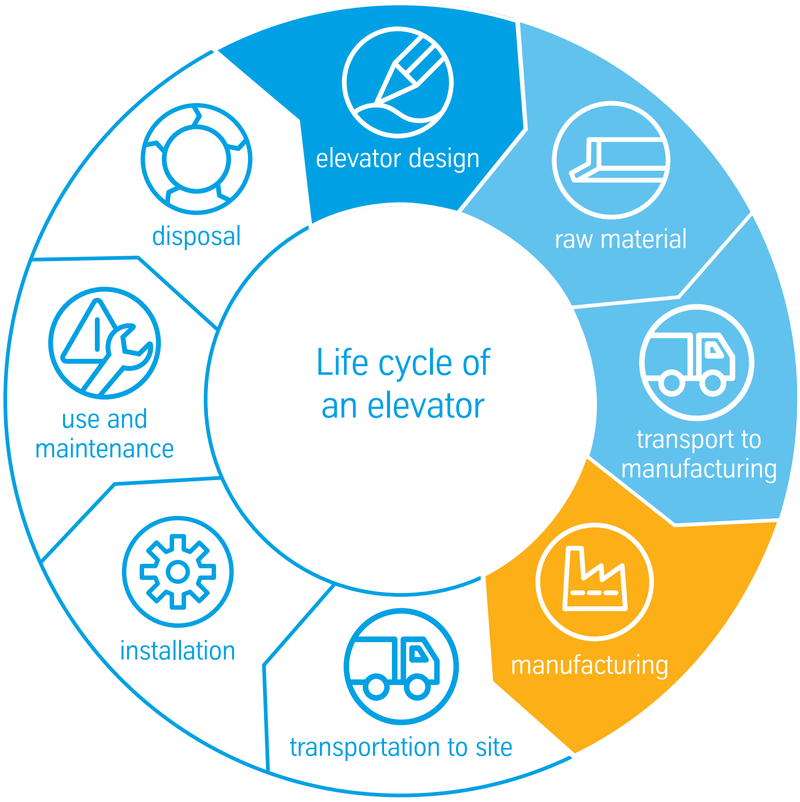
The general product system (shown below) is organized by three general life cycle stages, accounting for the cradle-to-grave life of the product: 1. Upstream, which includes the raw material supply, inbound transport and outsourced manufacturing; 2. Core, including own materials and in-house manufacturing; and 3. Downstream, which comprises transport and installation, use during the service life, and end-of-life during elevator modernization or building demolition. Note that the process of modernization is not included in the system, only the disposal of the components after 20 years of useful life.

We believe that sustainability requirements should be integrated into product designs, and we design with a life cycle approach. We are making continual improvements based on the results of our LCAs to ensure our products potential environmental impacts are reduced. Our life cycle figure reflects this philosophy by including the elevator design stage. The design stage is not included in the system boundaries and not included in the calculations of the LCA study, as per the system boundary set by the PCR.

System boundaries for a lift system

Upstream			Core	Downstream		
Raw material supply	Transport	Outsourced manufacturing	In-house manufacturing	Transport and installation	Use (Operation)	End-of-life treatment
U-1 Materials manufacturing	U-2 Transport to manufacturing site	U-3 Outsourced manufacturing	C-1 Own materials manufacturing	D-1 Transport from manufacturing to building site	D-3 Maintenance	D-5 Waste processing
			C-2 In-house manufacturing	D-2 Installation	D-4 Energy Consumption	D-6 Disposal

Life cycle



This declaration covers the evolution elevator produced in Middleton, TN, specified as follows:

evolution elevator specifications	
Commercial name	**evolution**
Type of installation	New installation
Main purpose	Transport of passengers
Type of lift	Traction
Type of drive system	Regen drive
Capacity rated load (fixed or range)	3500 lbs (1,588 kg)
Rated speed (fixed or range)	200 fpm (60.96 m/min)
Number of stops (fixed or range)	5
Traveled height (fixed or range)	64' (19.44 m)
Number of operating days per year (fixed or range)	365
Applied Usage Category (UC) according to ISO 25745-2	Category 3, Medium, n_d = 300
Designed Reference Service Life (RSL)	20 years
Geographic region of intended installation region	North America
Recommended application (main market)	Low- and mid-rise
Building rise (typical)	5-15 landings (40 to 150 ft)
Building type	All
Optional equipment	Photovoltaic cells*
Additional requirements	Rail supported, non-seismic

* Photovoltaic cells are an engineered option.

evolution

Today's low to mid-rise buildings are more innovative than ever, from improvements in energy efficiency to more intelligent use of space. The building's transportation system should be just as innovative. thyssenkrupp Elevator's evolution elevator offers increased speed, capacity and energy efficiency, while its machine room-less design allows you to maximize building space.

evolution also features our advanced regenerative drive technology, which captures generated power and feeds it back into the building's electrical grid, reducing energy costs. Since the cab is from thyssenkrupp Elevator, you'll benefit from the industry's only UL-validated 01350 CA compliant low-emitting interiors. So VOC (volatile organic compound) emissions are one less thing to worry about.

In addition to function, we know embedded chemicals have an impact on the environment and human health. As a result, we are part of the transparency movement to push for better and cleaner materials. We published Health Product Declarations (HPDs) disclosing the ingredients in our product down to 1000 ppm.

To ensure our customers aren't exposed to toxic chemicals, our cabs abide by the CA 01350 low VOC emission standard. Our cabs are also third-party validated by UL (Underwriters Laboratories), and thyssenkrupp Elevator is the only elevator company to achieve this validation.

The Cradle to Cradle Product Standard, a certification that evaluates a product using five quality categories, is one of the strictest in the industry. Every two years, manufacturers must demonstrate good-faith efforts to improve their products in order to gain recertification. We're proud to report that thyssenkrupp Elevator entered Cradle to Cradle's pilot project having only the second product in the building industry to achieve a Material Health Certification.

Functional unit

The functional unit evaluated for this study is:

The transportation of a load over a distance, expressed in tonne [t] over a kilometer [km] traveled (i.e. tonne-kilometer [tkm])

According to the PCR, the Functional Unit (FU) should be calculated as the average car load %Q [tonnes] times the distance traveled by the lift during the service life S_{RSL} [km].

$$FU = \%Q \times S_{RSL}$$

The average car load was calculated for the evolution by dividing the rated lift load [kg] by 1000 [kg/tonne], then multiplying by the percentage of rated load from Table 3 in ISO 25745-2.

$$\%Q = 1588 / 1000 \times 3\% = 0.0476 \text{ [tonnes]}$$

The lifetime distance traveled for the evolution was calculated by dividing the one-way average travel distance (S_{av}) [m] by 1000 [m/km], then multiplying by number of trips per day (n_d), the number of operating days per year (n_{op}), and the Reference Service Life (RSL) of the elevator [years].

$$S_{RSL} = 9.526 \text{ [m]} / 1000 \text{ [m/km]} \times 300 \text{ [trips/d]} \times 365 \text{ [d/yr]} \times 20 \text{ [yr]} = 20861 \text{ [km]}$$

Therefore, the functional unit provided by the evolution is calculated as:

$$FU = 0.0476 \text{ tonnes} \times 20861 \text{ km} = 994 \text{ tonne-km}$$

Comparability of EPDs is only achievable if the functional unit and the following performance characteristics of the different lift (elevator) systems are equivalent: usage category, traveling height, number of stops, rated load, rated speed, and geographic region.

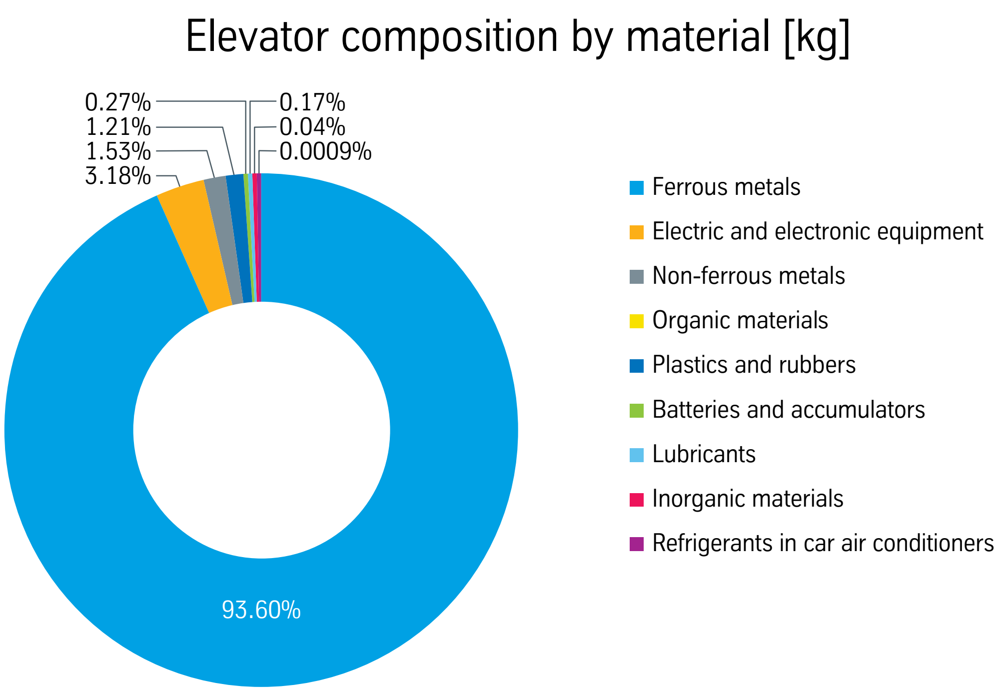
Content declaration

The elevator composition is declared in quantitative terms of the total, considering all life cycle stages and according to the cut-off rules described in Section 6 of the PCR.

Material classification	Units	evolution	DQI*
Ferrous metals	kg (%)	7774.7 (93.6%)	Calculated
Electric and electronic equipment	kg (%)	262.7 (3.18%)	Calculated
Non-ferrous metals	kg (%)	126.7 (1.53%)	Calculated
Organic materials	kg (%)	100.3 (1.21%)	Calculated
Plastics and rubbers	kg (%)	44.8 (0.27%)	Calculated
Batteries and accumulators	kg (%)	13.7 (0.17%)	Calculated
Lubricants	kg (%)	3.2 (0.04%)	Calculated
Inorganic materials	kg (%)	0.1 (0.0009%)	Calculated
Refrigerants in car air conditioners	kg (%)	-(-%)	Calculated
Total mass	**kg**	**8,326**	**Calculated**
Total mass per tkm	**kg**	**8.38**	**Calculated**

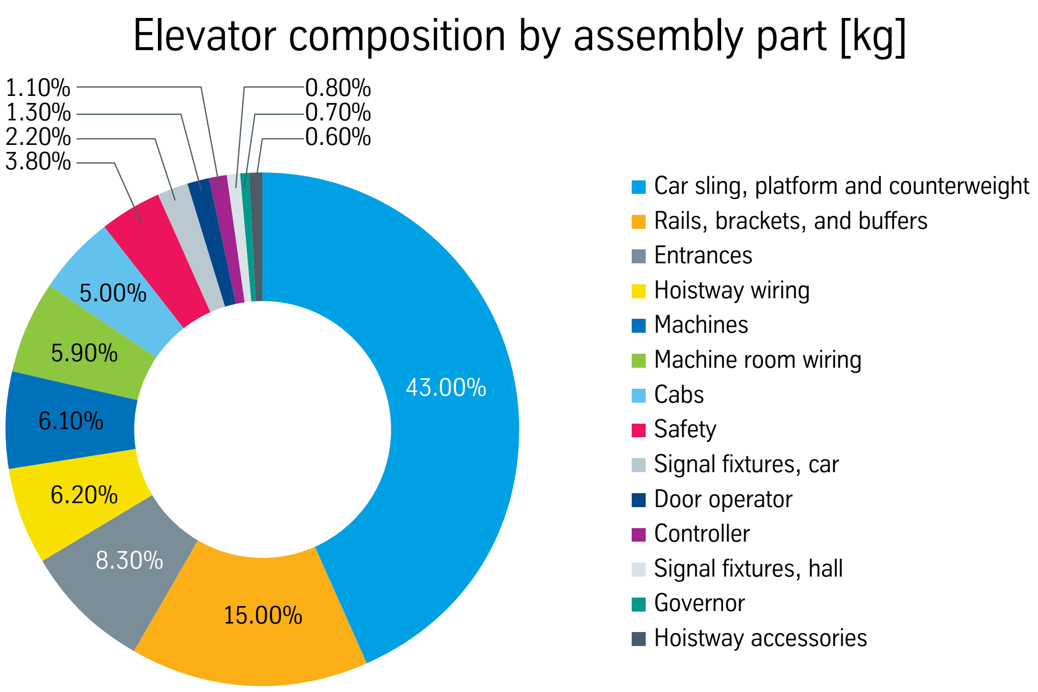
Table 1: Material composition by material classification for evolution

* measured / calculated / estimated / literature



Assembly name	Units	evolution	DQI*
Car sling, platform, and counterweight	kg (%)	3579.4 (43.0%)	Calculated
Rails, brackets, and buffers	kg (%)	1249.3 (15.0%)	Calculated
Entrances	kg (%)	690.1 (8.3%)	Calculated
Hoistway wiring	kg (%)	512.6 (6.2%)	Calculated
Machines	kg (%)	510.1 (6.1%)	Calculated
Machine room wiring	kg (%)	492.0 (5.9%)	Calculated
Cabs	kg (%)	418.7 (5.0%)	Calculated
Safety	kg (%)	320.5 (3.8%)	Calculated
Signal fixtures, car	kg (%)	180.2 (2.2%)	Calculated
Door operator	kg (%)	104.3 (1.3%)	Calculated
Controller	kg (%)	91.8 (1.1%)	Calculated
Signal fixtures, hall	kg (%)	69.3 (0.8%)	Calculated
Governor	kg (%)	56.9 (0.7%)	Calculated
Hoistway accessories	kg (%)	51.0 (0.6%)	Calculated
Total mass	**kg**	**8,326**	**Calculated**

Table 2: Material composition by assembly part for evolution



Environmental performance

Use of resources and energy

Primary energy and other resource use results are presented in this section for the evolution elevator. Table 3 below contains renewable and non-renewable primary energy, renewable and non-renewable resources, renewable and non-renewable secondary fuels and recovered energy flows in terms of life cycle information modules per tonne-km, and Table 5 provides the same information in a disaggregated form, as required by the PCR. Table 4 and Table 6 provided the resource and energy categories in terms of the full service life as absolute figures in aggregated and disaggregated forms, respectively.

Stage	Primary energy (non-renewable)	Primary energy (renewable)	Non-renewable resources	Renewable resources	Use of secondary fuels	Use of secondary materials	Recovered energy flows
Units	MJ/tkm	MJ/tkm	kg/tkm	kg/tkm	MJ/tkm	kg/tkm	MJ/tkm
U1	3.78E+02	3.01E+01	1.64E+02	2.80E+04	6.94E-06	1.07E+00	0.00E+00
U2	4.02E+01	5.48E-01	3.13E-01	1.16E+02	2.22E-28	0.00E+00	0.00E+00
U3	1.53E+00	1.92E-01	1.83E-01	6.83E+01	6.29E-24	0.00E+00	0.00E+00
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	3.43E+01	1.34E+00	3.43E+00	9.27E+02	2.22E-23	0.00E+00	0.00E+00
D1	2.10E+01	2.34E+01	1.53E+00	4.19E+02	2.75E-10	1.32E-02	0.00E+00
D2	1.89E+00	1.11E-01	4.89E-01	4.97E+01	4.19E-22	0.00E+00	0.00E+00
D3	3.17E+00	2.53E-02	2.25E-02	7.87E+00	3.76E-30	0.00E+00	0.00E+00
D4	4.15E+02	5.22E+01	4.97E+01	1.86E+04	0.00E+00	0.00E+00	0.00E+00
D5	3.85E-01	9.51E-03	3.05E-03	1.36E+00	4.50E-30	0.00E+00	0.00E+00
D6	1.59E+00	1.12E-01	5.62E-01	4.94E+01	5.53E-22	0.00E+00	0.00E+00
Total	**8.97E+02**	**1.08E+02**	**2.20E+02**	**4.82E+04**	**6.94E-06**	**1.09E+00**	**0.00E+00**

Table 3:Resource and energy use category results for evolution (per tkm)

Stage	Primary energy (non-renewable)	Primary energy (renewable)	Non-renewable resources	Renewable resources	Use of secondary fuels	Use of secondary materials	Recovered energy flows
Units	MJ	MJ	kg	kg	MJ	kg	MJ
U1	3.76E+05	2.99E+04	1.63E+05	2.78E+07	6.89E-03	1.07E+03	0.00E+00
U2	3.99E+04	5.45E+02	3.11E+02	1.16E+05	2.21E-25	0.00E+00	0.00E+00
U3	1.52E+03	1.90E+02	1.81E+02	6.79E+04	6.25E-21	0.00E+00	0.00E+00
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	3.40E+04	1.33E+03	3.41E+03	9.21E+05	2.21E-20	0.00E+00	0.00E+00
D1	2.09E+04	2.32E+04	1.52E+03	4.17E+05	2.73E-07	1.31E+01	0.00E+00
D2	1.87E+03	1.11E+02	4.86E+02	4.94E+04	4.17E-19	0.00E+00	0.00E+00
D3	3.15E+03	2.51E+01	2.23E+01	7.82E+03	3.73E-27	0.00E+00	0.00E+00
D4	4.12E+05	5.18E+04	4.94E+04	1.85E+07	0.00E+00	0.00E+00	0.00E+00
D5	3.82E+02	9.45E+00	3.03E+00	1.35E+03	4.47E-27	0.00E+00	0.00E+00
D6	1.58E+03	1.12E+02	5.58E+02	4.91E+04	5.50E-19	0.00E+00	0.00E+00
Total	**8.91E+05**	**1.07E+05**	**2.19E+05**	**4.79E+07**	**6.89E-03**	**1.08E+03**	**0.00E+00**

Table 4: Resource and energy categories for evolution (in absolute figures per RSL)

Solar power; a source of renewable energy.

	Resource type	Resource	Units	Upstream	Core	Downstream	Total
Non-renewable	Material	Inert rock	kg/tkm	1.63E+02	3.25E+00	4.97E+01	**2.15E+02**
		Other	kg/tkm	1.71E+00	1.87E-01	2.59E+00	**4.48E+00**
	Energy	Crude oil	kg/tkm	7.81E+01	6.27E-01	2.53E+01	**1.04E+02**
		Hard coal	kg/tkm	2.42E+02	1.19E+01	1.83E+02	**4.37E+02**
		Lignite	kg/tkm	9.12E+00	3.13E-01	1.17E+01	**2.11E+01**
		Natural gas	kg/tkm	7.23E+01	1.63E+01	1.31E+02	**2.20E+02**
		Other	kg/tkm	1.85E+01	5.13E+00	9.10E+01	**1.15E+02**
Renewable	Material	Water	kg/tkm	2.80E+04	9.15E+02	1.90E+04	**4.79E+04**
		Other	kg/tkm	1.09E+02	1.18E+01	1.64E+02	**2.84E+02**
	Energy	Hydropower	MJ/tkm	1.35E+01	7.18E-01	1.51E+01	**2.93E+01**
		Solar energy	MJ/tkm	1.22E+01	4.33E-01	2.49E+01	**3.76E+01**
		Wind power	MJ/tkm	4.18E+00	1.89E-01	1.82E+01	**2.26E+01**
		Other	MJ/tkm	1.00E+00	0.00E+00	1.31E-02	**1.02E+00**
Secondary resources	Materials	Steel scrap	kg/tkm	2.65E-02	0.00E+00	0.00E+00	**2.65E-02**
		Stainless steel scrap	kg/tkm	1.80E-03	0.00E+00	0.00E+00	**1.80E-03**
		Aluminum scrap	kg/tkm	4.05E-02	0.00E+00	5.01E-05	**4.05E-02**
		Iron scrap	kg/tkm	1.00E+00	0.00E+00	1.31E-02	**1.02E+00**
	Energy	Non-renewable	MJ/tkm	6.43E-06	2.05E-23	2.53E-10	**6.43E-06**
		Renewable	MJ/tkm	5.07E-07	1.74E-24	2.16E-11	**5.07E-07**
	Recovered energy flows		MJ/tkm	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**

Table 5: Disaggregated resource and energy categories for evolution (per tkm)

Potential environmental impacts

The life cycle impact assessment results for CML (Version: January 2016) in terms of the life cycle stages per tonne-km and in absolute figures are shown in Table 7 and Table 8, respectively. The same results in terms of the information modules and in terms of absolute figures by life cycle stage are shown in Table 9 and Table 10, respectively. Table 11 depicts the TRACI 2.1 life cycle impact results in terms of information modules divided by the functional unit.

Note that ODP impacts were negative, due to the negative ODP value in U1. This is likely due to credits given for steel-making co-products in the worldsteel background datasets that were used to model the majority of steel in the elevator.

	Abiotic depletion (elements)	Abiotic depletion (fossil)	Acidification	Eutrophication	Ozone layer depletion	Photochemical ozone creation	Global warming
Units	kg Sb-eq./tkm	MJ/tkm	kg SO_2-eq/ tkm	kg PO_4^{3-}-eq/ tkm	kg CFC-11-eq/ tkm	kg C_2H_4-eq/ tkm	kg CO_2-eq/ tkm
Upstream	1.87E-03	4.01E+02	1.85E-01	1.51E-02	-6.16E-08	1.58E-02	3.50E+01
Core	5.64E-07	2.91E+01	3.67E-03	3.32E-04	2.15E-12	2.68E-04	2.20E+00
Downstream	1.66E-05	3.52E+02	9.92E-02	9.73E-03	-4.30E-10	7.26E-03	3.03E+01
Total	**1.88E-03**	**7.82E+02**	**2.88E-01**	**2.52E-02**	**-6.20E-08**	**2.33E-02**	**6.75E+01**

Table 7: CML (Version: January 2016) impact category results by life cycle stage for evolutionv (per tkm)

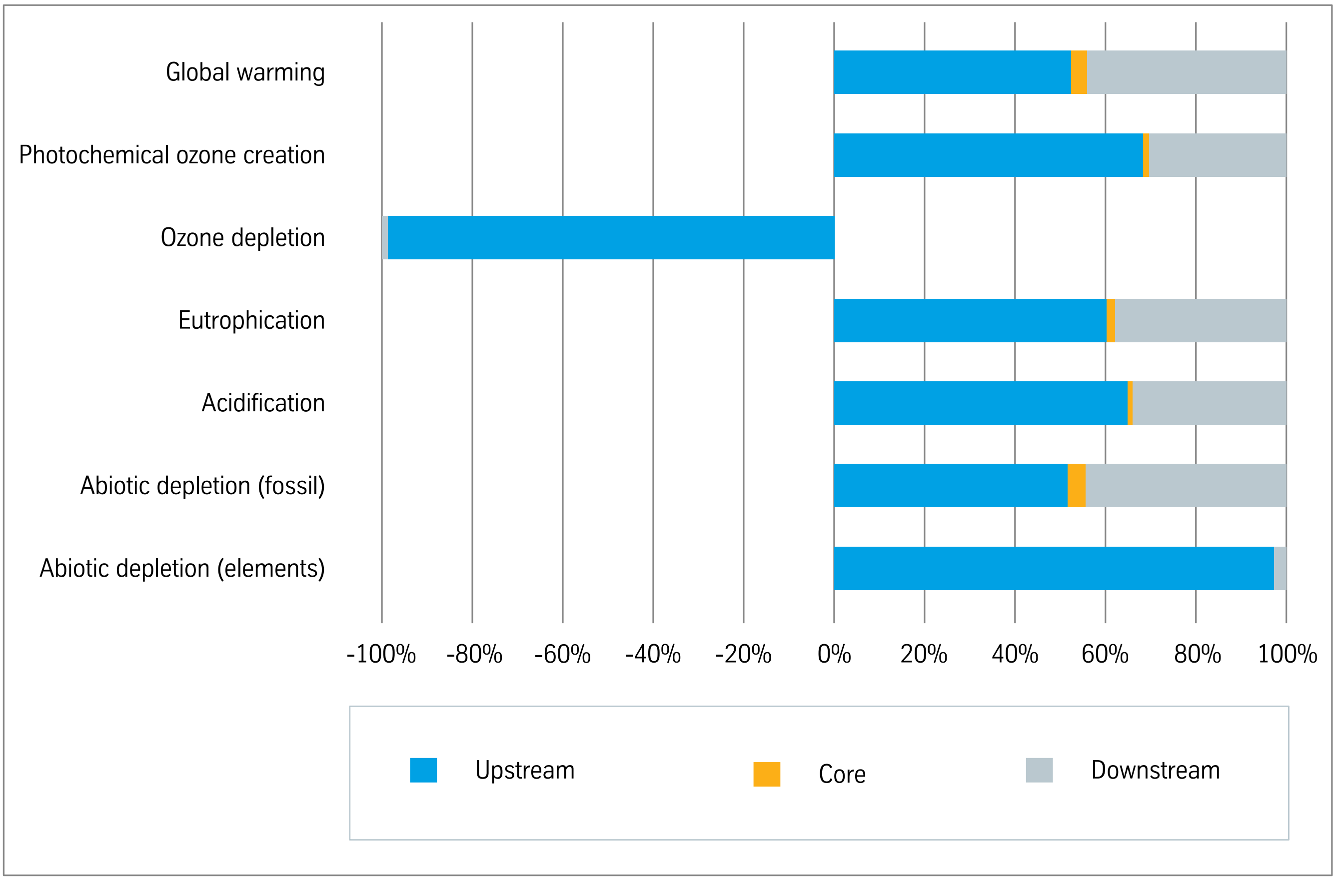


Figure: CML impact category results by main module for evolution

	Abiotic depletion (elements)	Abiotic depletion (fossil)	Acidification	Eutrophication	Ozone layer depletion	Photochemical ozone creation	Global warming
Units	kg Sb-eq.	MJ	kg SO_2-eq	kg PO_4^{3-}-eq	kg CFC-11-eq	kg C_2H_4-eq	kg CO_2-eq
Upstream	1.85E+00	3.99E+05	1.84E+02	1.50E+01	-6.12E-05	1.57E+01	3.49E+04
Core	5.60E-04	2.89E+04	3.64E+00	3.30E-01	2.14E-09	2.66E-01	2.19E+03
Downstream	1.65E-02	3.50E+05	9.86E+01	9.67E+00	-4.27E-07	7.22E+00	3.00E+04
Total	**1.87E+00**	**7.77E+05**	**2.86E+02**	**2.50E+01**	**-6.16E-05**	**2.32E+01**	**6.71E+04**

Table 8: CML (Version: January 2016)) impact category results by life cycle stage for evolution (in absolute figures per RSL)

Stage	Abiotic depletion (elements)	Abiotic depletion (fossil)	Acidification	Eutrophication	Ozone layer depletion	Photochemical ozone creation	Global warming
Units	kg Sb-eq./tkm	MJ/tkm	kg SO_2-eq/ tkm	kg PO_4^{3-}-eq/ tkm	kg CFC-11-eq/ tkm	kg C_2H_4-eq/ tkm	kg CO_2-eq/ tkm
U1	1.86E-03	3.60E+02	1.31E-01	8.74E-03	-6.16E-08	1.27E-02	3.19E+01
U2	5.02E-07	3.99E+01	5.41E-02	6.35E-03	9.10E-14	3.14E-03	3.00E+00
U3	2.27E-08	1.20E+00	3.19E-04	1.67E-05	1.39E-13	1.88E-05	9.91E-02
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	5.64E-07	2.91E+01	3.67E-03	3.32E-04	2.15E-12	2.68E-04	2.20E+00
D1	1.04E-05	2.01E+01	7.45E-03	1.37E-03	-3.99E-10	8.87E-04	1.52E+00
D2	5.28E-08	1.83E+00	4.14E-03	3.60E-03	-6.85E-11	1.14E-03	1.51E+00
D3	3.86E-08	3.15E+00	3.32E-04	9.04E-05	6.01E-15	4.26E-05	2.04E-01
D4	6.09E-06	3.25E+02	8.67E-02	4.52E-03	3.78E-11	5.11E-03	2.69E+01
D5	4.95E-09	3.82E-01	8.80E-05	2.37E-05	9.30E-16	8.92E-06	2.70E-02
D6	4.30E-08	1.55E+00	4.90E-04	1.25E-04	1.83E-14	7.75E-05	1.02E-01
Total	**1.88E-03**	**7.82E+02**	**2.88E-01**	**2.52E-02**	**-6.20E-08**	**2.33E-02**	**6.75E+01**

Table 9: CML (Version: January 2016) impact category results for evolution by life cycle information module (per tkm)

Stage	Abiotic depletion (elements)	Abiotic depletion (fossil)	Acidification	Eutrophication	Ozone layer depletion	Photochemical ozone creation	Global warming
Units	kg Sb-eq	MJ	kg SO_2-eq	kg PO_4^{3-}-eq	kg CFC-11-eq	kg ethene- eq	kg CO_2-eq
U1	1.85E+00	3.58E+05	1.30E+02	8.69E+00	-6.12E-05	1.26E+01	3.18E+04
U2	4.99E-04	3.97E+04	5.38E+01	6.31E+00	9.05E-11	3.12E+00	2.98E+03
U3	2.26E-05	1.20E+03	3.17E-01	1.66E-02	1.38E-10	1.87E-02	9.84E+01
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	5.60E-04	2.89E+04	3.64E+00	3.30E-01	2.14E-09	2.66E-01	2.19E+03
D1	1.03E-02	1.99E+04	7.41E+00	1.36E+00	-3.97E-07	8.82E-01	1.51E+03
D2	5.24E-05	1.82E+03	4.11E+00	3.58E+00	-6.81E-08	1.13E+00	1.50E+03
D3	3.84E-05	3.14E+03	3.30E-01	8.99E-02	5.97E-12	4.23E-02	2.03E+02
D4	6.05E-03	3.23E+05	8.62E+01	4.49E+00	3.76E-08	5.08E+00	2.67E+04
D5	4.92E-06	3.80E+02	8.75E-02	2.35E-02	9.24E-13	8.87E-03	2.68E+01
D6	4.28E-05	1.54E+03	4.87E-01	1.24E-01	1.82E-11	7.71E-02	1.01E+02
Total	**1.87E+00**	**7.77E+05**	**2.86E+02**	**2.50E+01**	**-6.16E-05**	**2.32E+01**	**6.71E+04**

Table 10: CML (Version: January 2016) impact category results for evolution by life cycle information module (in absolute figures per RSL)

Stage	Acidification	Eutrophication	Ozone depletion air	Smog air	Global warming
Units	kg SO_2-eq/tkm	kg N-eq/tkm	kg CFC-11-eq/tkm	kg O_3-eq/tkm	kg CO_2-eq/tkm
U1	3.04E-02	1.29E-03	9.63E+00	6.11E-08	3.11E-01
U2	2.00E-02	7.85E-04	1.03E+00	7.05E-12	3.94E-01
U3	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	1.73E-03	8.59E-05	7.27E-01	1.84E-10	1.86E-02
D1	2.82E-03	2.50E-04	6.59E-01	6.18E-10	6.75E-02
D2	6.90E-04	7.15E-05	1.70E-01	2.14E-13	3.19E-03
D3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D4	3.67E-02	1.53E-03	1.23E+01	4.82E-09	3.19E-01
D5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D6	4.42E-06	3.71E-07	6.72E-04	7.98E-15	8.57E-05
Total	**9.24E-02**	**4.01E-03**	**2.45E+01**	**6.68E-08**	**1.11E+00**

Table 11: TRACI 2.1 impact category results by life cycle information module for evolution (per tkm)

Waste production

Recent highlights in waste production during manufacturing include our painting process; we eliminated the painting line and added a powder coating process, reducing 83 percent of our hazardous waste since 2013. Table 12 and Table 13 depict the waste category results in terms of the life cycle stages divided by the functional unit and in absolute figures, respectively. Table 14 and Table 15 depict the waste category results for each life cycle module and in absolute figures for the service life, respectively.

Powder coating line at Middleton, TN plant

Stage	Hazardous waste (deposited)	Waste (deposited)
Units	kg/tkm	kg/tkm
Upstream	5.28E-05	1.86E+00
Core	1.52E-08	9.89E-02
Downstream	4.38E-07	3.57E+00
Total	**5.33E-05**	**5.53E+00**

Table 12: Hazardous and non-hazardous waste disposal by life cycle stage (per tkm)

Stage	Hazardous waste (deposited)	Waste (deposited)
Units	kg	kg
Upstream	5.25E-02	1.85E+03
Core	1.51E-05	9.83E+01
Downstream	4.35E-04	3.54E+03
Total	**5.29E-02**	**5.49E+03**

Table 13: Hazardous and non-hazardous waste disposal by life cycle stage (in absolute figures per RSL)

Stage	Hazardous waste (deposited)	Waste (deposited)
Units	kg/tkm	kg/tkm
U1	5.27E-05	1.86E+00
U2	1.49E-07	1.01E-03
U3	7.11E-10	4.99E-04
C1	0.00E+00	0.00E+00
C2	1.52E-08	9.89E-02
D1	1.71E-07	6.78E-02
D2	2.75E-08	1.10E+00
D3	3.82E-08	5.97E-05
D4	1.92E-07	1.35E-01
D5	2.99E-09	1.44E-05
D6	5.48E-09	2.26E+00
Total	**5.33E-05**	**5.53E+00**

Table 14: Hazardous and non-hazardous waste disposal for each life cycle information module (per tkm)

Stage	Hazardous waste (deposited)	Waste (deposited)
Units	kg	kg
U1	5.23E-02	1.85E+03
U2	1.48E-04	1.00E+00
U3	7.07E-07	4.95E-01
C1	0.00E+00	0.00E+00
C2	1.51E-05	9.83E+01
D1	1.70E-04	6.74E+01
D2	2.73E-05	1.09E+03
D3	3.80E-05	5.94E-02
D4	1.91E-04	1.34E+02
D5	2.97E-06	1.44E-02
D6	5.44E-06	2.25E+03
Total	**5.29E-02**	**5.49E+03**

Table 15: Hazardous and non-hazardous waste disposal by life cycle information module (in absolute figures per RSL)

Additional information

At thyssenkrupp Elevator, we're making continued efforts to reduce energy use and even reach net zero energy in our products. Our TAC32T controller offers increased reliability, safety and efficiency, using an absolute positioning system (APS) that increases energy efficiency. We believe making simple changes like installing LED lighting should be standard throughout our product line — and we have done just that. LEDs contain no mercury, have a 10-year lifespan, and reduce energy consumption without compromising look or visibility.

The energy mix used for the calculations of this EPD was U.S. average grid. If the elevator's operational use were provided by PV instead of the U.S. average grid, the impacts have been demonstrated to be significantly lower due to the large impacts contributed by the use phase.

In addition to function, we know that the embedded chemicals we're exposed to every day have an impact on the environment and our health. As a result, we are part of the transparency movement to push for better and cleaner materials. We published Health Product Declarations (HPDs) disclosing the ingredients in our product down to 1000 ppm. To ensure our customers aren't exposed to toxic chemicals, our cabs abide by the CA 01350 low VOC emission standard. Our cabs are third-party validated by UL (Underwriters Laboratories), and thyssenkrupp Elevator is the only elevator company to achieve this validation. The Cradle to Cradle Product Standard, a certification that evaluates a product using five quality categories, is one of the strictest in the industry. Every two years, manufacturers must demonstrate good-faith efforts to improve their products in order to gain recertification.

thyssenkrupp Elevator's Standard Elevator Cab received a Bronze Cradle to Cradle Material Health Certificate, which qualifies for LEED v4 Material Ingredient Disclosure Credit Eligible and CA 01350 Low-Emitting Materials. Our doors and entrances also have a Cradle to Cradle Material Health Certificate at the Bronze level. We continue our journey to full material transparency through vetting more and more products and incorporating material health into our engineering process for new products.

thyssenkrupp Elevator supports the U.S. Green Building Council and the LEED rating system through our corporate Gold sponsorship. In addition, we are a Visionary Sponsor of "The Living Building Challenge" program from the International Living Institute; we are committed to meet the program's strict list of imperatives, producing two Declare labels as part of our efforts.

Elevator life cycle results

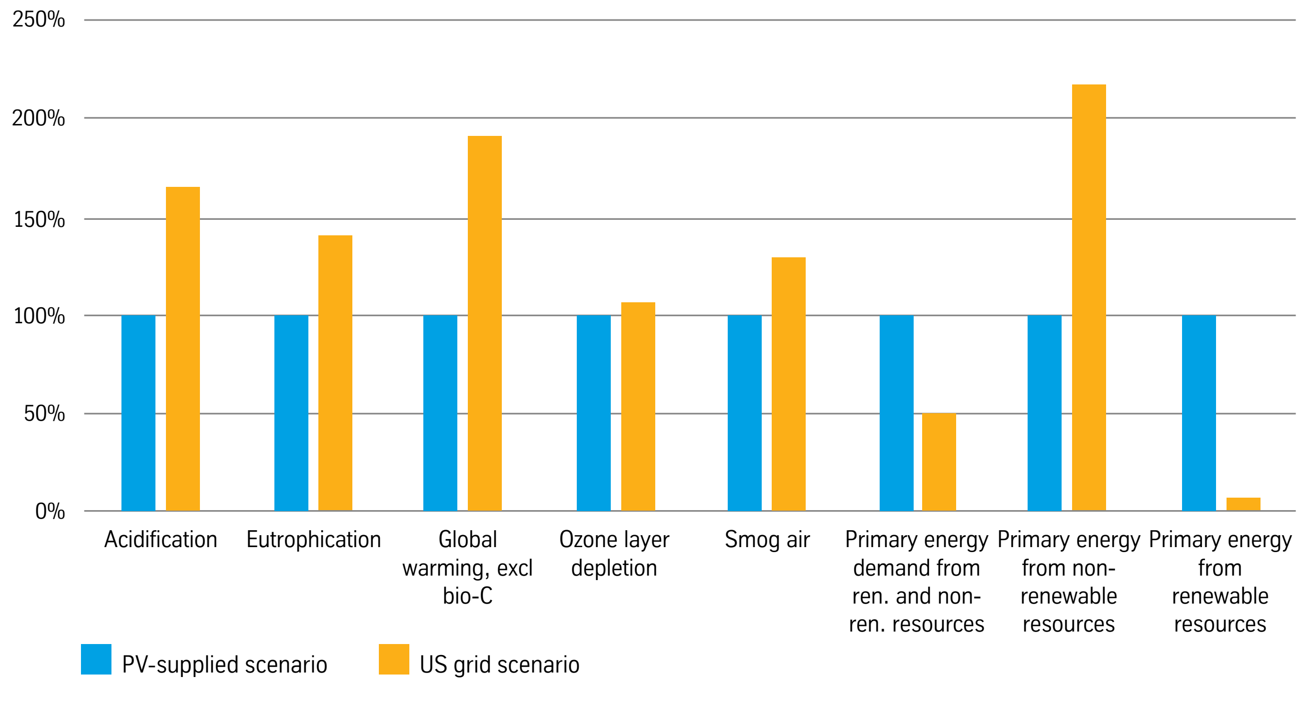


Figure: Elevator life cycle results (CML Jan 2016) with both PV and US grid-supplied electricity during use (PV scenario shown as 100%)

We're proud that we remain the leader in material transparency with Cradle to Cradle Material Health Certificates, Health Product Declarations and Declare labels.

LEED v4 & v4.1

Credit Matrix

thyssenkrupp

Credit	Intent	How thyssenkrupp Elevator can help
EA Optimize Energy Performance	Use whole building energy simulation to achieve increasing levels of energy performance. Use whole building energy simulation to achieve increasing levels of energy performance.	thyssenkrupp Elevator's team can help you determine energy savings, including savings from regenerative drives, using an energy calculator based on ISO 25745 over a baseline that can be added to your project's energy model.
MR Building Product Disclosure and Optimization: Environmental Product Declarations (EPDs)	Encourage the use of products and materials with publicly available, critically reviewed life-cycle assessments conforming to ISO 14044 that have at least cradle-to-gate scope.	thyssenkrupp Elevator North America has published four EPDs that follow the Product Category Rules of the International EPD® System.
MR Building Product Disclosure and Optimization: Material Ingredients	Encourage the use of products and materials for which life-cycle information is available and reward teams for selecting products from companies that have inventoried chemical ingredients.	thyssenkrupp Elevator has two Health Product Declarations, two Declare labels, and two Bronze Cradle to Cradle Material Health Certificates.
Pilot Credit: Integrative Analysis of Building Materials	Encourage the use of products and materials for which life-cycle information is available and that have environmentally, economically, and socially preferable life-cycle impacts.	thyssenkrupp Elevator has four elevator options that can count toward the required three products for this credit.
Innovation	Encourage projects to achieve exceptional or innovation performance.	thyssenkrupp Elevator has multiple comprehensive strategies with proven quantitative benefits outside of LEED's current credits.

engineering. tomorrow. together.

Results evaluation

The results are evaluated using the CML January 2016 impact methodology (Leiden, 2016), as required by the PCR, and the TRACI 2.1 (EPA, 2012) impact methodology, as this report supports a North American declaration. Since the smog model in TRACI 2.1 differs from the one used by CML, smog formation potential (SFP) is calculated in place of photochemical ozone creation potential (POCP). It shall be noted that these impact categories represent impact potentials; that is, they are approximations of environmental impacts that could occur if the emitted molecules would (a) actually follow the underlying impact pathway, and (b) meet certain conditions in the receiving environment while doing so. In addition, the inventory only captures that fraction of the total environmental load that corresponds to the chosen declared unit (relative approach). LCIA results are therefore relative expressions only and do not predict actual impacts, the exceeding of thresholds, safety margins, or risks.

For the majority of impact categories—including Global Warming Potential (GWP), Photochemical Ozone Creation Potential (POCP), Ozone Depletion Potential (ODP), Eutrophication Potential (EP), Acidification Potential (AP), and both Abiotic Depletion Potentials—the upstream (U1-U3) and downstream impacts (D1-D6) comprised the majority of potential impacts. The core stage (C1-C2) was, overall, a minor contributor for all impact categories, at under 1% to 4% of total potential impacts.

Within the upstream and downstream stages, the production of steel and the generation of use phase electricity were the dominant contributors to the potential environmental burdens. The majority of electric power in the average US grid is generated from fossil fuels. In addition, the elevator itself is primarily made of steel; as such, the relevance of steel to the environmental impact profile was expected.

For GWP, the greatest drivers of potential environmental impacts were CO_2 emissions associated with the generation of use phase electricity and the production of steel. Fossil fuels are burned to power mining vehicles and steel-making furnaces upstream of thyssenkrupp Elevator's manufacturing.

Non-ferrous metals, organic materials, inorganic materials, plastics and rubbers, elevator manufacturing (C2), outbound transport to the installation site (D1), installation (D2), maintenance (D3), transport to end-of-life (D5), and the landfilling of elevator parts were consistently minor contributors in all impacts.

Note that results presented in this document do not constitute comparative assertions that one scenario or system has better environmental performance than another. However, these results will be disclosed to the public in an EPD, which architects and builders will be able to use to compare thyssenkrupp Elevator's products with similar products presented in other EPDs that follow the same PCR and are evaluated with regard to the same functional unit.

Report verification was conducted by Dr. Thomas P. Gloria of Industrial Ecology Consultants. This verification was performed in accordance to ISO 14040/44, the selected PCR, Lifts (Elevators) Product Category Rules according to ISO 14025, and the General Program Instructions of the International EPD System. EPDs within the same product category, but from different program operators may not be comparable.

References

PCR 2015:05 (2015), "Product Category Rules for Lifts (Elevators) – UN CPC 4354", environdec

EPD International (2015),"General Programme Instructions of the international EPD® System – Version 2.5"

ISO 14025 (2006), "Environmental labels and declarations – Type III environmental declarations – Principles and procedures"

ISO 14040 (2006), "Environmental management – Life cycle assessment – Principles and framework"

ISO 14044 (2006), "Environmental management – Life cycle assessment – Requirements and guidelines"

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

Elevator Technology

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